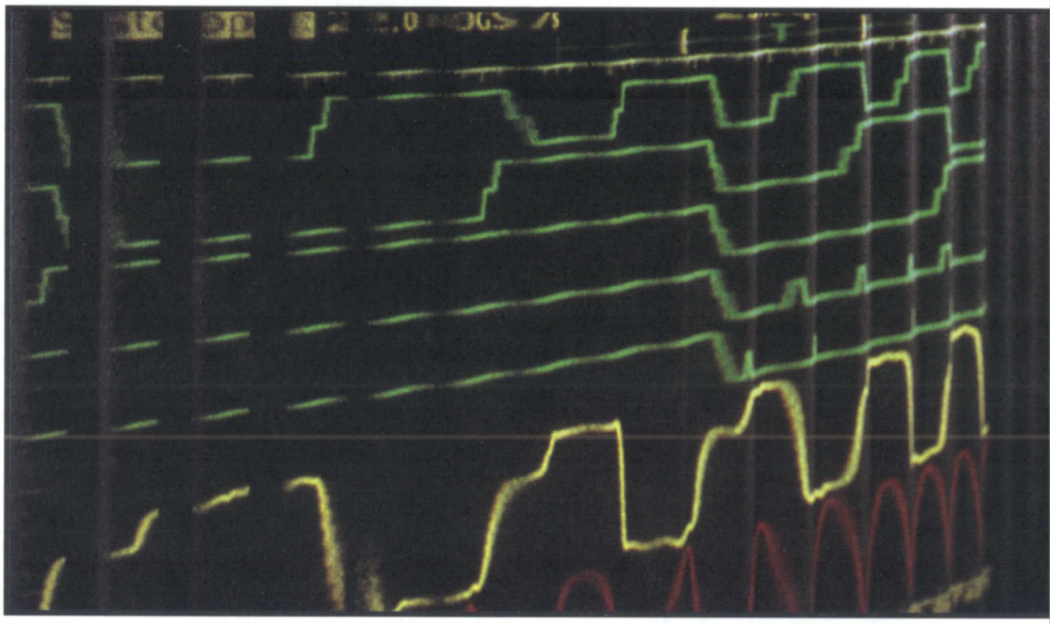
# Product Catalog
# 1994



# Tektronix: A Lifetime of Value

*The 1994 Tektronix Test and Measurement Catalog features a wide range of new products and enhancements to many of our proven instruments.*

## 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 pages 549 - 569.

## Technical Information Library

Now you have two ways to obtain technical information from Tektronix:



**Literature Available Through Our Traditional Request Service.**
This service provides detailed technical information. See pages 563 - 565 for the index of Application/Technical Notes available. The location of your nearest Tektronix representative can be found on pages 566 - 569.




**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 INFOfax. See page 562 for complete information.

## Tektronix/Advantest

In 1993 Tektronix became the exclusive distributor of Advantest test and measurement products in North America. Featured in this catalog, for the first time, are a wide-range of Advantest products in the RF/Microwave and Telecommunications areas. These exciting new products are highly complementary to the Tektronix T&M 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**

## Tektronix/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. While Rohde&Schwarz products are not featured in this catalog, a listing of the most popular instruments can be found on the separate sheet in the front of this catalog.

For more information about these exciting products from Rohde&Schwarz, please contact your local Tektronix sales office (listed on the inside back cover of this catalog) or call the National Marketing Center at 1-800-426-2200, Ext. 99. **ROHDE&SCHWARZ**

## Tektronix Contacts

Tektronix has a number of ways for you to get the information you need quickly and conveniently.

### Tektronix Sales/Service Offices

We have a worldwide network of sales and service offices. To find the office nearest you, see pages 566 - 569 and the inside back cover.

### Federal Administration Office

Federal Agencies should obtain price and delivery from, and place orders directly with, Tektronix Federal Order Administration. See page 550 for information.

### Tektronix National Marketing Center (NMC)

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.

### (TD) Distributor & Manufacturers Representatives

We have Authorized Tektronix Distributors and Manufacturers Representatives for selective products and geographic areas. As you use this catalog, watch for the (TD) icon. It identifies products that are available through our distributors and representatives. For a listing of their names, see pages 570 - 571.

### (TD) TekDIRECT

TekDIRECT provides all the same great benefits as above, plus VISA or MasterCard accepted and 24 hour shipping with rush delivery. Call 1-800-426-2200. Watch for products identifies with the (TD) icon.

## 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 558 for information.

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*Tektronix continues its commitment of providing the best, most cost-effective solutions for your acquisition, analysis, and measurement needs.*

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# Oscilloscopes

*Oscilloscopes remain the universal electronic measurement tool in a changing world. Today's Tektronix scopes are easier than ever to use, even as they grow in capability to meet the new demands of telecommunications, digital design, and industrial applications.*

Electronic instrumentation users and technical professionals of all kinds have come to expect technological leadership, innovation, and value from Tektronix. This New Products section introduces a host of new instruments, accessories, and enhancements that lives up to that expectation.

Whatever your requirement—a logic analyzer for debugging a PC motherboard design, an oscilloscope for viewing automotive ignition impulses, a breakfinder for fiber optic cables, or a VXI-based production test system—Tektronix offers solutions and support to meet your needs. Tektronix measurement instruments are ready to go to work in the real world, a world that wants more information, more quickly and more cost-effectively.

As you read through this New Products section, you'll see "Applications Spotlights" that profile unique applications or features of some of the products. These profiles are not intended to be detailed overviews of the respective instruments; in each case the Spotlight illustrates just one of product's the many capabilities. It is hoped, though, that the Applications Spotlights will provide some insight into what makes the instrument valuable in critical measurement situations.

In this section and throughout the catalog you'll find one of the broadest selections of electronic instrumentation available from any source. Let Tektronix work with you to find a solution to your test and measurement needs.

The TDS oscilloscope family ranges from low-cost models like the new TDS 320 to full-featured lab instruments like the TDS 644A. Individual models in the series are equipped with features aimed at digital design, semiconductor characterization, and general-purpose electronic service applications.

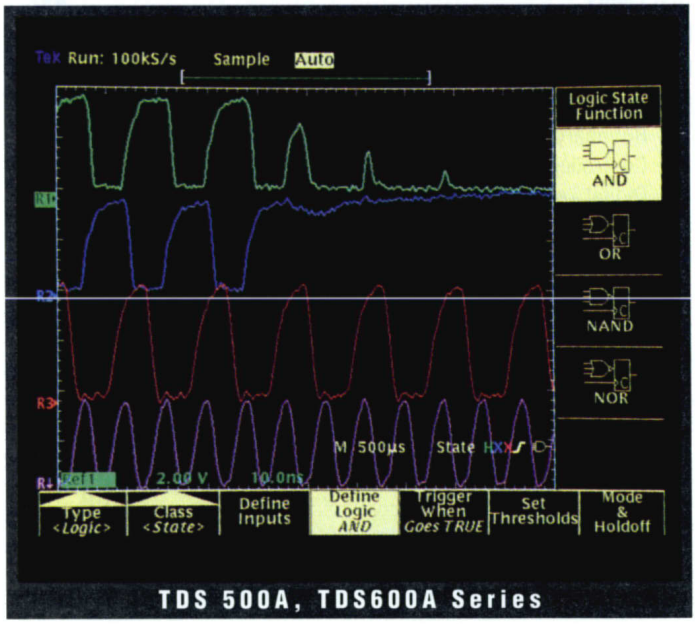
See page 44.



TDS Series Oscilloscopes

The TDS 500A and TDS 600A Series digital oscilloscopes extend the capabilities of their renowned predecessors. These affordable color scopes simplify the interpretation of viewed data and help you organize waveforms, cursors, and measurement readouts on a busy display.

See page 52.



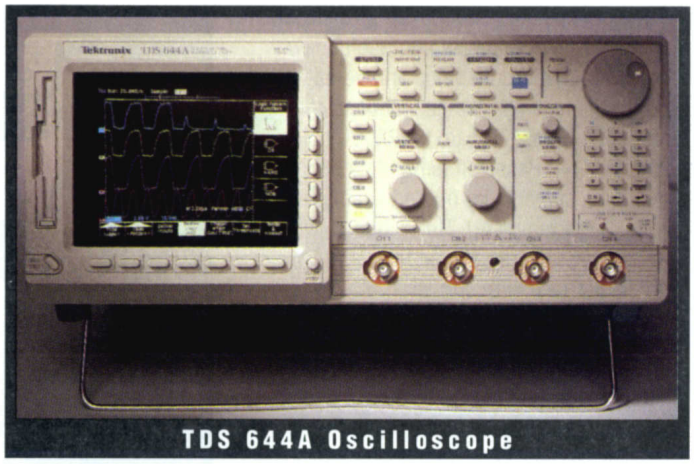

TDS 500A, TDS600A Series

# Oscilloscopes



The TDS 544A/644A digital oscilloscopes add the dimension of color to the pace-setting performance, ease of use, and accuracy that the TDS family is famous for. These powerful instruments are ideally suited to a multitude of applications: switching power supply design, digital system design and debug, telecommunications signal acquisition, limit testing, video measurements, and many others. The TDS 544A/644A models now include a 3.5 in. floppy disk drive (for more efficient waveform storage and documentation) and built-in FFT processing.

See page 52.



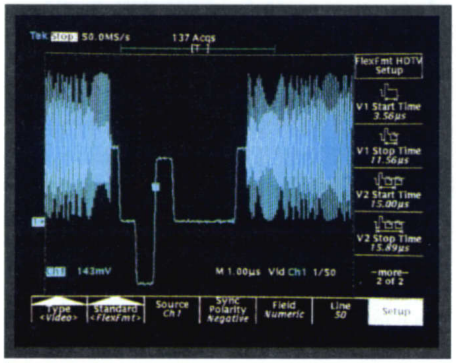

TDS 644A Oscilloscope

*Color provides a new axis of information on your scope display. Tektronix' reliable NuColor™ display, seen here on the TDS 644A, provides ultra-high resolution and contrast.*

## • APPLICATIONS SPOTLIGHT •

### *TDS 644A Conquers HDTV Triggering Challenges*

The TDS 644A's versatile Video Trigger Option streamlines even the most difficult video measurements, including HDTV signals. Since much of the world has yet to agree on a single HDTV format, a plethora of incompatible standards exists. Among these, 787.5/60, 1050/60, 1125/60, and 1250/50 are the most common, and the TDS 644A with Video Trigger Option offers these formats as basic menu selections. But HDTV is still an experimental medium, and new formats are still being developed. For example, military and medical imaging standards differ from each other and from all the commercial HDTV broadcast standards as well.




*HDTV waveform viewed on the TDS 644A.*

Fortunately, the TDS 644A has a solution: the FlexFormat™ mode. Unique to the TDS family Video Trigger Option, FlexFormat allows you to specify the timing of customized of tri-level sync pulses, input any field rate between 20 and 200 Hz, and define the number of lines and fields in the format. The screen photo above shows an HDTV waveform and some of the FlexFormat menu selections used to acquire it, as viewed on a TDS 644A.

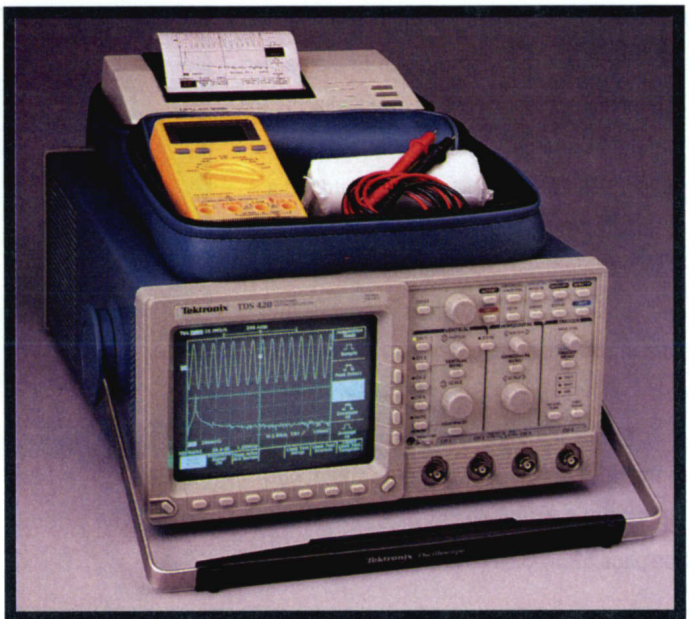
# Oscilloscopes

*Low cost needn't mean low performance. The TDS 400 Series puts unmatched value in the hands of the user, and doesn't scrimp on useful features.*

The pacesetting TDS 400 Series instruments have been enhanced with useful new features that add both value and versatility. Among the newly available standard and optional features: FFT, up to 60,000 point record length, Pass/Fail template testing (wherein a signal is compared against a pre-defined limit template), Roll Mode for viewing of slow-speed events, and an RS-232/Centronics printer interface with spooler.

The TDS 400 Series includes models with 150 MHz and 350 MHz bandwidth and four channels.

See page 58.




TDS 420 Oscilloscope

The Phaser 200 Color Printers are a valuable option to Tektronix' color instruments. These printers faithfully reproduce the color information viewed on the instrument screen. Each of the Series' two models—the low-cost Phaser 200e and the versatile 200i—offers true Adobe Postscript Level 2 for uncompromised font- and graphics-handling capability. And their two-page-per-minute print capacity is twice as fast as any other desktop color printer.

See page 534.



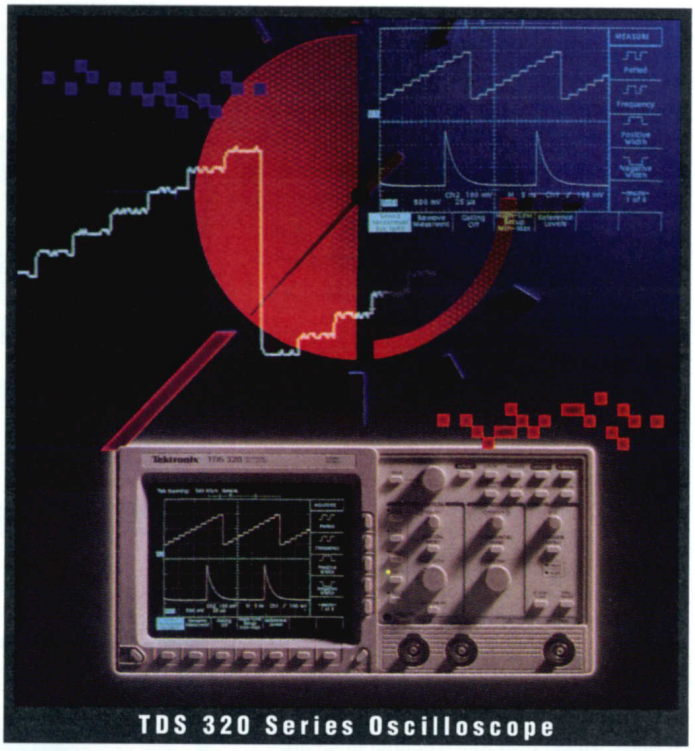
Phaser 200i Color Printer

# Oscilloscopes



The TDS 320 Digital Real-Time oscilloscope is the first low-cost instrument of its kind to employ oversampling to ensure non-aliased waveform displays in real time, even for single-shot events at the scope's full 100 MHz bandwidth. The TDS 320 is an ideal solution for the price-sensitive service, education, and design applications that demand a digital scope.

See page 61.



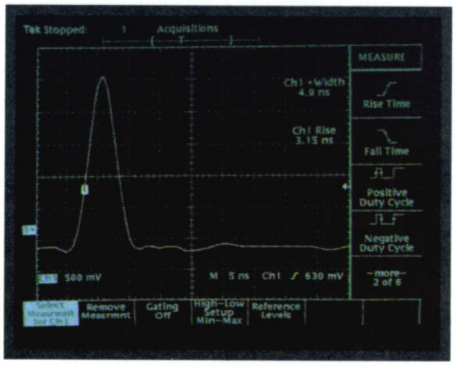
TDS 320 Series Oscilloscope

*The TDS 320 is the perfect tool to help you make the transition from analog to digital scopes.*

## • APPLICATIONS SPOTLIGHT •

### *Low-cost Digital Scope Views One-Shot Events that Elude Conventional DSOs*

The DSO's ability to acquire and store complex waveforms has made it the preferred tool for many general-purpose signal measurement tasks. Digitally stored signals are easy to analyze and document, and wideband lab-quality DSOs can display both repetitive and single-shot waveforms accurately. Even low-cost DSOs, whose lesser bandwidth is related to their lower sample rate, have traditionally done a good job with repetitive events.




*A single brief (4.9 ns) event seen on the TDS 320.*

The lower-cost digital scopes commonly used in service, debug, and repair applications have been unable to perform full-bandwidth acquisition of single-shot events. In fact, most such instruments offer only a fraction– usually less than half–of their repetitive signal bandwidth for these waveforms. Attempting to view one-time events beyond this specified frequency produces distorted, misleading measurements.

The TDS 320 Digital Real-Time Oscilloscope introduces oversampling to the world of low-cost DSOs. Whereas most other seemingly comparable DSOs sample at exactly twice their specified bandwidth (for example, 200 MS/s in a 100 MHz instrument), the TDS 320 samples at a full 500 megasamples per second! Even with conservative ratings, the TDS 320 has plenty of sampling headroom for single shot signals containing frequency components up to 100 MHz. To further enhance viewing of elusive single-shot events, the TDS 320 offers the vector display mode, which connects the sampled waveform "dots" to produce a more analog-like image. The instrument also has a peak detect mode that acts as an overrange indicator for frequency. Signals that are too fast for the current sweep speed appear as enveloped areas with every pixel lit.

# Oscilloscopes

*Tektronix scopes are found in advanced research labs, engineering departments, and on service benches around the world.*

The 11801B Digital Sampling Oscilloscope offers the widest measurement and waveform processing capabilities of any multi-gigahertz scope. This and its DC-to-50 GHz bandwidth, along with its high channel count (up to 136 channels!) puts it in a performance class all its own. It is suited for both benchtop and system applications ranging from multi-channel TDR measurements to automated statistical analysis of circuit jitter and noise.

See page 87.



11801B Oscilloscope

The new 100 MHz TAS 475 and 200 MHz TAS 485 oscilloscopes are the latest additions to the TAS 400 family of analog scopes. These true four-channel units are ideally suited for tough service applications where multiple channels are needed to view circuit conditions—applications like three-phase power or logic circuit troubleshooting. All TAS 400 Series scopes are backed with a free scope replacement for failures that occur during the three-year warranty period.

See page 120.



TAS 475, TAS 485 Oscilloscopes

# Interconnect Parameter Analyzer

The IPA 310 Interconnect Parameter Analyzer offers a new, easier way to create accurate SPICE models of IC package and circuit board interconnects. The IPA 310 is an integrated system that employs a high-performance TDR, a high-fidelity test fixture, and an external computer running Tek's unique Z-Profile™ algorithm to create SPICE models of lead frames, IC packages, connectors, and circuit board traces.

See page 92.

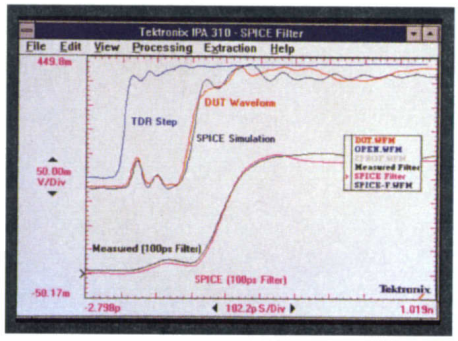



*Tektronix scope-based automated systems deliver precision and productivity.*

## • APPLICATIONS SPOTLIGHT •

### *Verified Models Mean More "First-Turn" Successes*

A comprehensive SPICE model of high-speed IC or circuit board behavior should predict package and interconnect effects as well as silicon circuit performance. To create such models, designers must use a time domain reflectometer (TDR) or network analyzer to measure circuit impedance characteristics, then compile a model, then build a test fixture to verify the model, run verification tests, modify the model, re-compile... Clearly such a process is at odds with today's demand for ever-shorter time to market and higher product quality.




*IPA 310 graphical display.*

The IPA 310 brings automation and user-friendliness to this tedious regimen. Its graphical approach to SPICE modeling and verification helps sort out the discrete effects of each element in a circuit's physical structure. The system's TDR sends out a stimulus pulse to the device under test then displays the resulting reflected waveform on the controller's monitor. Multiple reflections are stripped away by the built-in Z-Profile™ processing algorithm. The waveform is rich in data: each aberration reveals a circuit characteristic like bond wire inductance, lead capacitance to ground, etc. As shown in the screen photo, measured, simulated, and incident (TDR stimulus) waveforms can be viewed simultaneously and compared on the IPA 310. The object is to make the simulated response waveform conform as closely as possible to the measured response of the device under test. Because the IPA 310 produces measurements in readily-understood terms—impedance in ohms, capacitance in pF, and inductance in nH—it's easy to adjust the simulation input values for fine tuning of the model. The adjusted values are used to automatically re-calculate the model. The fine tuning/re-calculation step is repeated until the designer is satisfied with the congruency of the measured and simulated waveforms.

The result of all this? IC package and interconnect SPICE models as accurate as the best silicon models. One less "unknown" when forecasting total circuit behavior in high-speed IC environments. And time savings: the IPA 310 can cut modeling time from hours—even days—to minutes.

# Logic Analyzers

*Networking puts powerful DAS test resources where they're needed most—in the hands of users throughout your organization, not just in the test lab.*

The DAS/NT is the world's first fully networked real time system analysis tool. With over 1500 channels, an acquisition memory of up to 512K per channel, and support for the latest RISC and CISC μPs, the hardware is a match for the most complex analysis tasks. Equally valuable is its ability to speak "network"—the DAS/NT can be controlled from any workstation on your network, and returns immmediate readback of analyzer data to the workstation via a high-speed Ethernet connection. Thus a whole design team can share a single DAS/NT efficiently.

See page 153.



DAS/NT Networked System Analysis Tool

The DAS/XP is a standalone version of the DAS/NT. For those who do not need the full networking capability of the DAS/NT, the DAS/XP provides the same mouse based, high speed user interface via an X-Terminal.

See page 153.



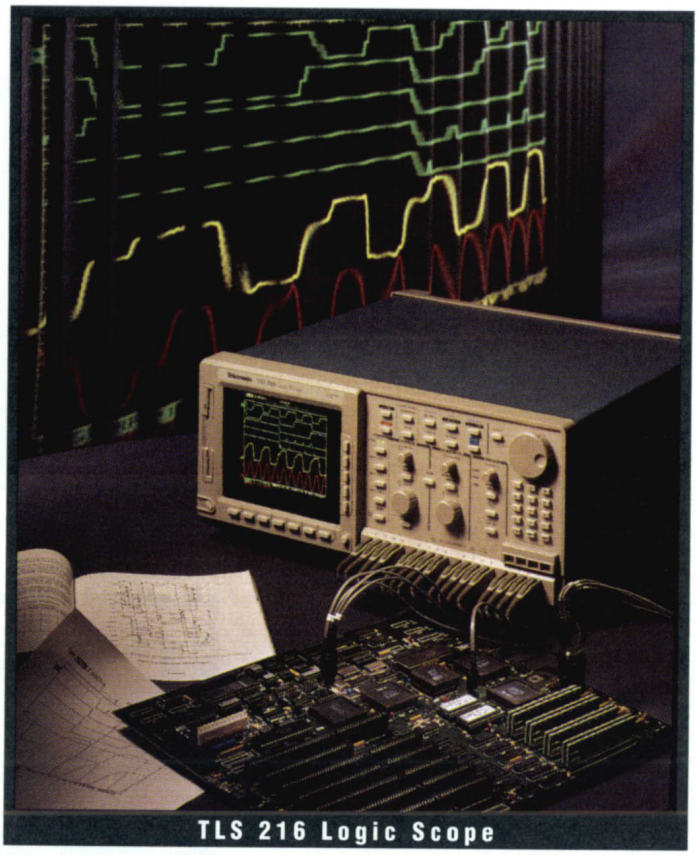
DAS/XP Standalone System Analysis Tool

# Logic Scope

The TLS 216 Logic Scope from Tektronix represents a new breed of instrument tailored to simplify the task of debugging and verifying today's digital hardware. It is specifically designed to increase the productivity of engineers who are expected to develop new products with higher performance, lower emissions, reduced size and power consumption... in less time and with smaller development teams.

The Logic Scope seamlessly combines the triggering and visualization characteristics of a logic analyzer with the analog acquisition system of high-speed digitizing oscilloscope.

See page 148.



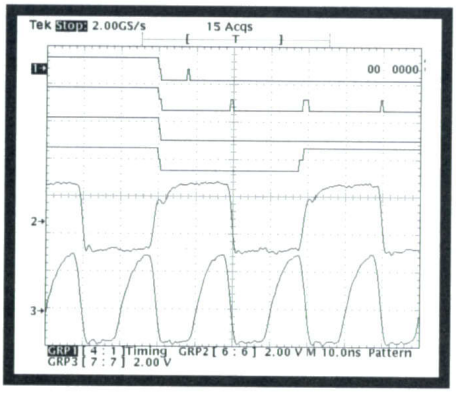
TLS 216 Logic Scope

*The Logic Scope is a digital design breakthrough–a faster, easier way to find and analyze complex logic circuit problems.*

## • APPLICATIONS SPOTLIGHT •

### *Logic Scope Spots Analog Glitches in a Digital World*

Digital system designers are finding ever more frequently that they must examine the analog characteristics of the high-speed digital signals in their designs. Many a digital timing violation is actually traceable to an analog fault like ground noise, reflections, or risetime-related race conditions.




*Ground spikes are revealed by the TLS 216 (upper two traces).*

But to correct such faults, first you have to see them. For example, ground noise spikes can be a cause of intermittent, unpredictable state changes in digital logic circuits. Unfortunately, these spikes may not show up on a conventional logic analyzer–it may lack the timing resolution to acquire them, or the spikes might be too small in amplitude to trigger the instrument. The TLS 216 Logic Scope offers a new way to examine these signals and reveal the analog causes behind the digital problems. In addition to its uncompromised logic analyzer and DSO facilities, it includes a third mode that bridges the two domains. The TLS 216's Dual Threshold timing display format allows the user to define two switching points–say, the 800mV and 2V levels used in TTL-compatible logic families–for the digital signal being observed. In most respects, this mode acts like a logic analyzer but as the photo screen print above shows, the second bit of vertical resolution reveals the errant ground spikes that can cause spurious 0-to-1 transitions "downstream" in the circuit.

The TLS 216's Dual Threshold timing mode is just one of the powerful tools that help the digital circuit designer see and understand the gradations between 1 and 0. As a digital design and debug solution, this integrated instrument is a whole that is greater than the sum of its parts.

# Telecommunications

*Specialized Tektronix telecom tools have found wide acceptance for design, installation, and maintenance of communications equipment.*

If your job is to find faults on telephone twisted pair cable, the new Tektronix TS 100 TelScout is built for you. Designed specifically for telephone local loop applications, TelScout applies the newest technology to provide both ease of use and telephony performance that cannot be found in any other TDR.

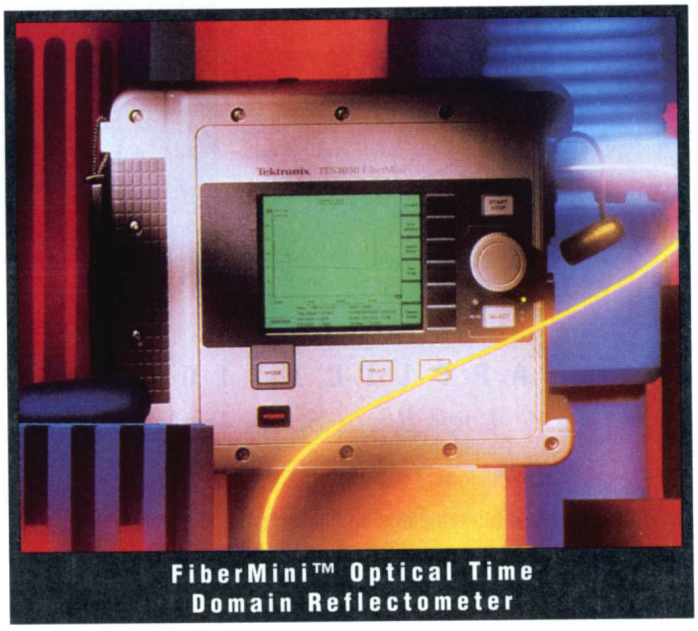
See page 264.



TelScout TDR Cable Tester

The TFS3030 FiberMini™ is a portable, user-friendly optical time-domain reflectometer (OTDR) that offers single- or dual-wavelength singlemode fiber analysis. It combines the low price and easy operation of a simple fault finder with capabilities that equal many full-scale OTDRs. For example, its 23 dB measurement range accurately reports more events across greater fiber lengths—up to 65 km—than any other mini-OTDR. Significantly, the TFS3030 delivers all this performance at a price typically 25% below that of competitive products.

See page 258.



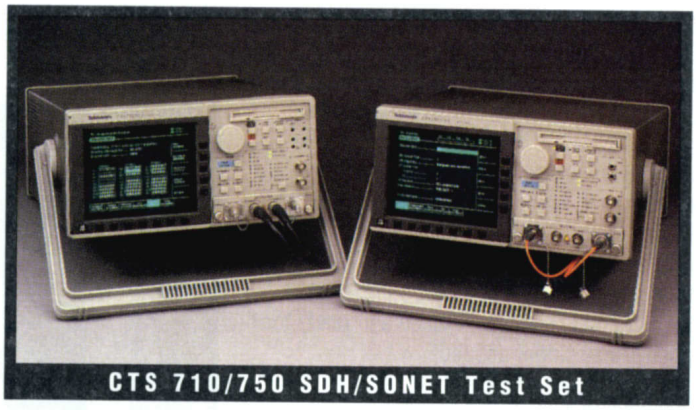
FiberMini™ Optical Time Domain Reflectometer

# Telecommunications



The CTS 710/750 SDH/SONET Test Set provides full SDH/SONET test capabilities in a portable package for use in installation and maintenance operations. Designed to meet the telecommunications industry's demand for an easy-to-use instrument that can automatically run the full suite of SDH/SONET tests (bit error rate, alarm simulation/response, etc.), the CTS 710/750 includes many firmware-based productivity features. In addition, its built-in floppy disk drive automates user-written Pass/Fail test procedures.

See page 268.



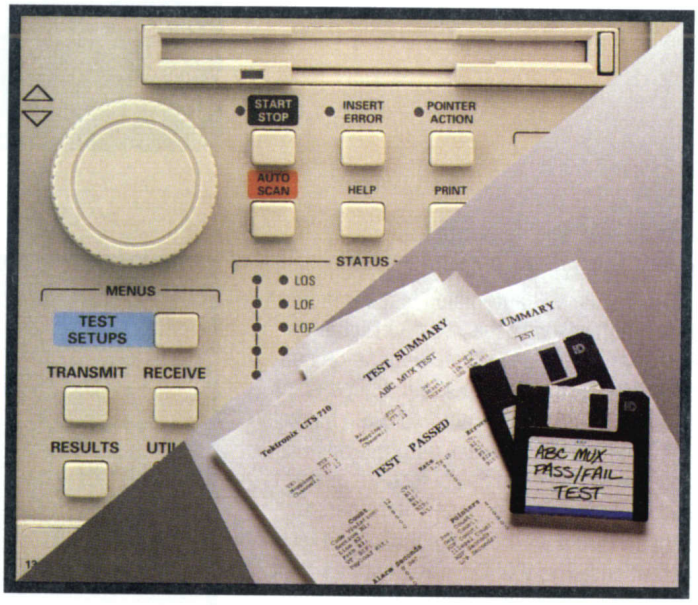
CTS 710/750 SDH/SONET Test Set

*Tektronix SDH/SONET craft tools make it easy to meet telecom standards in the field, and document compliance.*

## • APPLICATIONS SPOTLIGHT •

### *Affordable Craft Tool Automates Network-Wide SDH/SONET Test Procedures*

The rapid growth of digital telecommunications network installations has spawned a requirement for a cost-effective, easy-to-use SDH/SONET test tool that craft people can use with minimal training. The CTS 710/750 addresses the SDH/SONET test need and facilitates convenient, repeatable testing in the field.




*Standardized field tests are distributed on disk.*

SDH/SONET test results are regarded as proof of both network signal quality and standards compliance. Test regimes must be consistent, easy to perform, thorough, and well-documented. The most fundamental test is of course the Pass/Fail test, a routine check that encompasses a subset (for example a bit error rate test) of the many network tests that are defined. Traditionally, these test procedures are developed by network engineers in an evaluation lab, then distributed on paper for implementation in the field. Compliance with these written tests, and therefore compliance with the SDH/SONET standard itself, has been subject to individual skill levels and interpretation at the test site.

The CTS 710/750 paves the way for more automated, repeatable Pass/Fail tests, implemented to the same standards at every field site. The process begins when Network Engineers prescribe an SDH/SONET test plan in accordance with their network's specific topology. The test regime typically includes initial instructions, a test setup, pass/fail criteria, and final instructions. The appropriate tests are developed on a CTS 710/750 in the evaluation lab then distributed to the test sets in the field on ordinary DOS floppy disks. In the field, these disk-based tests become a menu choice, accessible with just a few keystrokes on the CTS 710/750 front panel. The disk can also be used to store test results for analysis at the evaluation lab.

# Systems

*Tektronix instrumentation working in computer-controlled systems helps you gather data, enforce consistent test plans, and perform more comprehensive tests.*

The 3054 DSP System increases the time resolution of real-time spectrum analysis to 12.5 µseconds—the fastest in the industry. This, coupled with its wideband analysis capability (DC to 10 MHz) offers unprecedented capability for use in signal surveillance, radar, and electronic warfare. The system's bank-of-filters analysis architecture provides high amplitude accuracy, low spectral leakage, and anti-aliased output. The resulting spectral data is clean and ready for post-processing if desired.

See page 301.




**3054 Digital Signal Processing System**

The VX4428 Quad ARINC 429 Module is a versatile VXI automated test component that interfaces with the Mark 33 Digital Information Transfer System found on commercial aircraft. It houses four independent bidirectional (transmit and receive) channels and offers programmable output levels (valuable for receiver sensitivity testing), error injection, and a wide variety of triggers to synchronize it with other modules and test operations. The VX4428 also supports the VXI Fast Handshake protocol, which saves test time by speeding up data transfers to and from the test system controller. See page 334.

See page 315.

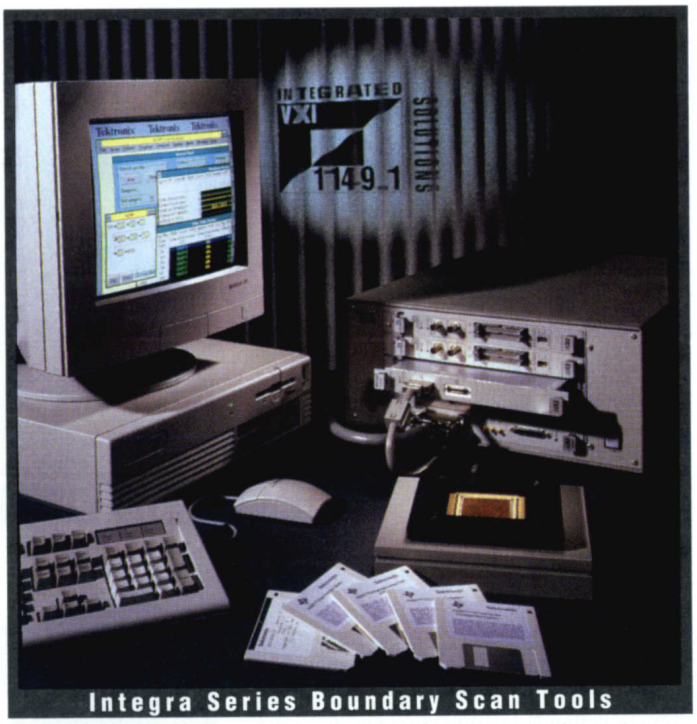


**VX4428 Quad ARINC 429 Module**

# Systems

The Integra Series' inaugural product is an integrated IEEE 1149.1 Boundary Scan test solution that combines a full-featured VXI-based scan module (the Tektronix VX4491) with industry-accepted ASSET™ development software. The Integra package links design to test with software tools to take advantage of reusable design code, development tools to create both engineering and production tests, and hardware to run the most exhaustive scan patterns efficiently

See page 326.



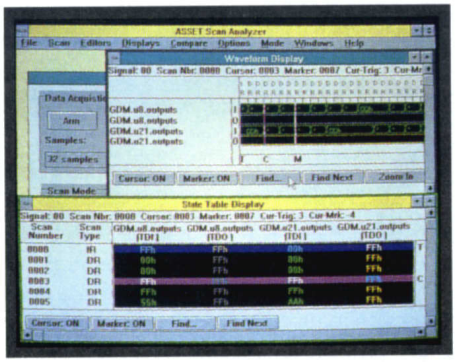

Integra Series Boundary Scan Tools

*A truly integrated boundary scan solution adds value throughout the design, prototype, and production cycle.*

## • APPLICATIONS SPOTLIGHT •

### *Integrated VXI Boundary Scan Solution Takes On Million-bit Test Patterns, Saves Costly Test Time*

Boundary scan (IEEE std 1149.1) has emerged as the method of choice for testing otherwise inaccessible circuit nodes on multichip modules (MCMs) and high-density surface mount circuit boards. But some designers are apprehensive about scan, feeling that it may cost more in test time than it saves in fault coverage. Why? Multimillion-bit test patterns. Serial protocols that defy conventional (parallel) test pattern development programs. No means of acquiring and re-using design vectors for production test. And time-to-market is ticking away.




*The scan analyzer speeds boundary scan test development.*

The Integra VXI scan solution is architected to save test time without sacrificing fault coverage. The VX4491 module's memory capacity of 16 MB is among the industry's largest, and is further bolstered by a built-in data compression algorithm that achieves typical compression ratios of 5:1. A dedicated internal DSP engine decompresses the data without a test time penalty. Equally important, the VX4491 uses Tektronix' unique Fast Data Channel (FDC) to speed up the transfer of this huge volume of information from the controller.

Integra's ASSET VXI test development software is equally dedicated to saving time–both test time and test development time. Data from circuit topology files, parallel vectors from the EDA database, and Serial Vector Format files can be acquired by the ASSET Test Vector Development System. Ancillary software tools are designed to feel familiar and intuitive. For example, the Scan Analyzer is like a specialized logic analyzer with scan-oriented triggering and display features (see photo). An optimized debugger offers single-step and interactive modes to pinpoint faults quickly. And of course, the whole ASSET VXI programming environment runs under Windows™ 3.1 for maximum ease of use.

# More Test & Measurement

*Application-specific measurement tools complement Tektronix' array of high-performance lab and service instruments.*

Three new hand-held digital multimeters extend the Tektronix family of DMMs to eight. Whether you are a hobbyist, laboratory technician or an industrial maintenance engineer, one of these eight meters is sure to fit your measurement needs and your budget. All Tektronix handheld DMMs are designed and manufactured to comply with safety standards established by UL and IEC.

See page 404.



Handheld Digital Multimeters

The J1823 Luminance Head brings small-area luminance measurement capability to the Tektronix J17 Photometer. The J1823's high resolution is essential for tasks like measuring the contrast of individual pixels on CRTs or LCD displays; the instrument's superior accuracy makes it ideal for measuring roadway glare or sign reflectance, where accurate readings are a matter of safety. With its wide focusing range, the J1823 is suited for a broad variety of luminance measurements.

See page 421.



J1823 Luminance Heads

Solving automotive electrical and electronic problems with the 222A oscilloscope is now even easier with the new Option 1A Automotive Test Package. The option includes special probes and adapters that provide a fast, positive connection to common automotive signals and sensor outputs such as Anti-Lock Brake system (ABS). It also includes a self-study training course to acquaint you with the scope and its use in automotive applications.

See page 118.

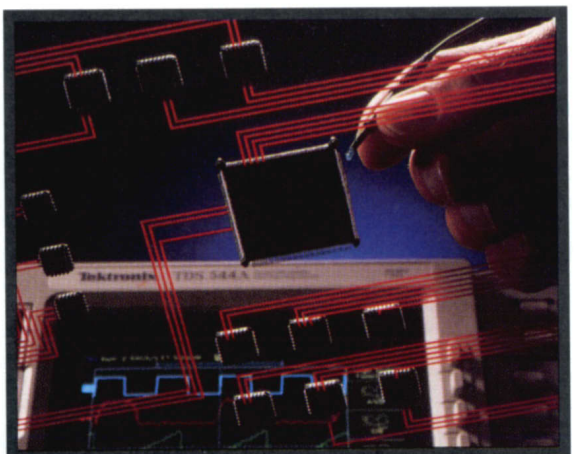


222A/Option 1A Automotive Test Package

# SMD Probes

The Tektronix SMD probe family is scaled to be compatible with current surface-mounted IC packages. Three probe models are available. Each model is performance matched to either the TDS, TAS, 2400 and 11000 series oscilloscopes. Designed to produce minimum device loading of today's circuits, SMD probes and Tektronix oscilloscopes create a unique solution to the "small" challenges faced by circuit designers.

See page 450.



P656XAS SMD Probe Series

SureFoot™ is an integral probe tip and miniature guide that enables fault-free hand-probing of fine-pitch SMD packages. Using the IC's leads as guides, SureFoot's non-conductive tines align with the leads before the probe tip can contact the device, thus preventing the probe tip from shorting adjacent pins.

SureFoot probe tips are provided in two versions. The first is compatible with EIAJ 0.5 mm lead spacing. A second version is compatible with the smaller EIAJ 0.65 mm and JEDEC 25 mil packages.

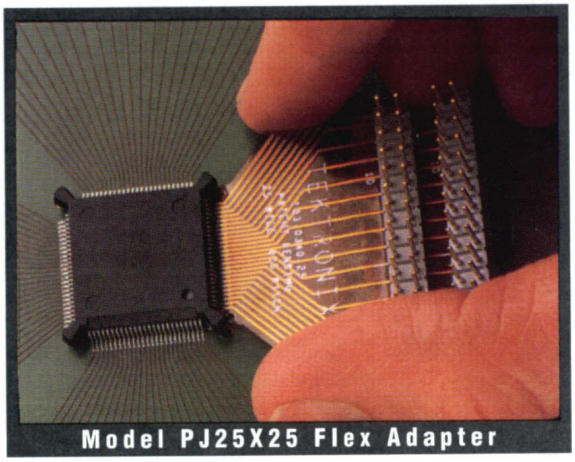
See page 454.



SureFoot™ Probe Tip/Miniature Guide

The FlexLead™ Adapter is an inexpensive solution for probing fine pitch JEDEC and EIAJ quad flat-pak IC packages. Designed for use with the Tektronix TLS Logic Scope and logic analyzers as well as the TDS, TAS, and 2400 Series oscilloscopes, FlexLead can flex and bend to allow connection to ICs on densely-packed circuit boards. The adapter can be easily removed after use, without damaging the device being tested.

See page 452.



Model PJ25X25 Flex Adapter

*Meaningful measurements simply aren't possible without secure, high-quality connections to the test point(s). Tektronix probing solutions range from conventional "pencil" styles to specialized multi-pin IC probe adapters.*

# Accessories

*Printers, instrument carts, accessories...if it's related to electronic measurement instrumentation, it's available from Tektronix.*

The Video Display Clamp Pod provides improved video signal measurements for the TDS 400/500/600 Series oscilloscopes equipped with the Video Trigger Option. The pod eliminates 60-cycle hum artifacts from the video signal as it is displayed on the scope screen, and is compatible with NTSC, PAL, and most HDTV (component and composite) signals.

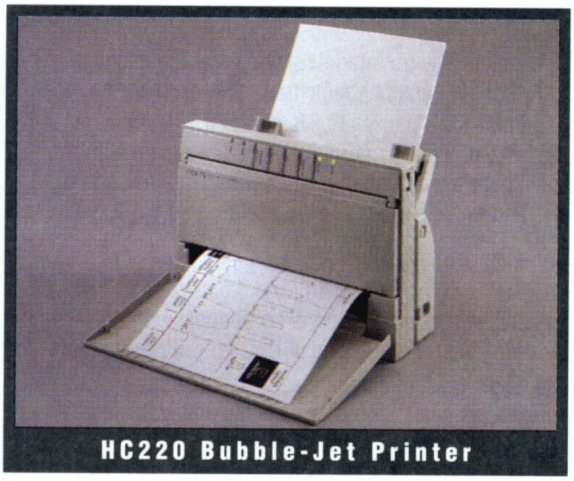
See page 57.



Video Display Clamp Pod

The HC220 Bubble-Jet Printer is the right choice for affordable laser-quality black & white printing of oscilloscope screen displays. The 360 dot-per-inch printer, shown here with the optional sheet feeder, is light, compact and quiet. It's compatible with most current Tektronix oscilloscopes, as well as conventional PCs and other instruments fitted with a Centronics port.

See page 497.



HC220 Bubble-Jet Printer

The K465 Instrument Tower is one of the new generation of workstation carts from Tektronix. Three rack-width shelves and a convenient wire storage bin offer a stable yet portable workspace. The combination of a straight shelf, a tiltable shelf with positive lock and a three-quarter shelf make this an ideal solution for workspace problems where multiple pieces of equipment are involved.

See page 506.



K465 Instrument Cart

# Computer Graphics and Television



*Tektronix' strengths in data capture and display extend throughout a broad product line that includes computer peripherals as well as television broadcast and measurement equipment.*

When understanding image content is critical, the Phaser IISDX offers crisp, photographic-quality, dye sublimation color printing on your desktop. Its powerful RISC CPU processes large photographic files at about the same speed as a dedicated raster printer, but with all the convenience and shareability you expect from a network PostScript printer.

See page 536.



Phaser™ IISDX Color Printer

The SGS17C Color Stereoscopic Display provides unsurpassed stereo viewing with lightweight, passive glasses and can be used with any stereo ready workstation or computer. It features a high contrast, five section stereo shutter with a wide viewing angle which allows several users to view the monitor at the same time.

See page 544.



SGS17C Color Stereoscopic Display

The CMP500 NTSC Cable Television Measurement Package is a complete baseband video and RF measurement package for cable television monitoring and proof of performance testing. It can make all the FCC baseband and RF measurements, as well as many others required to ensure high picture quality.

See page 530.



Cable TV Measurement Package/System

# 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 have benefits and tradeoffs. The following pages present Tektronix' analog and digitizing oscilloscope solutions.

The oscilloscope section begins with a general reference section on Pages 36-42. Our digitizing oscilloscopes begin on page 43, providing information for the TDS Series, 11000 Series, (including plug-ins), DSA Series, 2400 Series, 2200 Series, and 200 Series Oscilloscopes.

The analog oscilloscopes begin on page 120 with the TAS Series, followed by the 2400 Series and 2200 Series.

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

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# Oscilloscope Reference

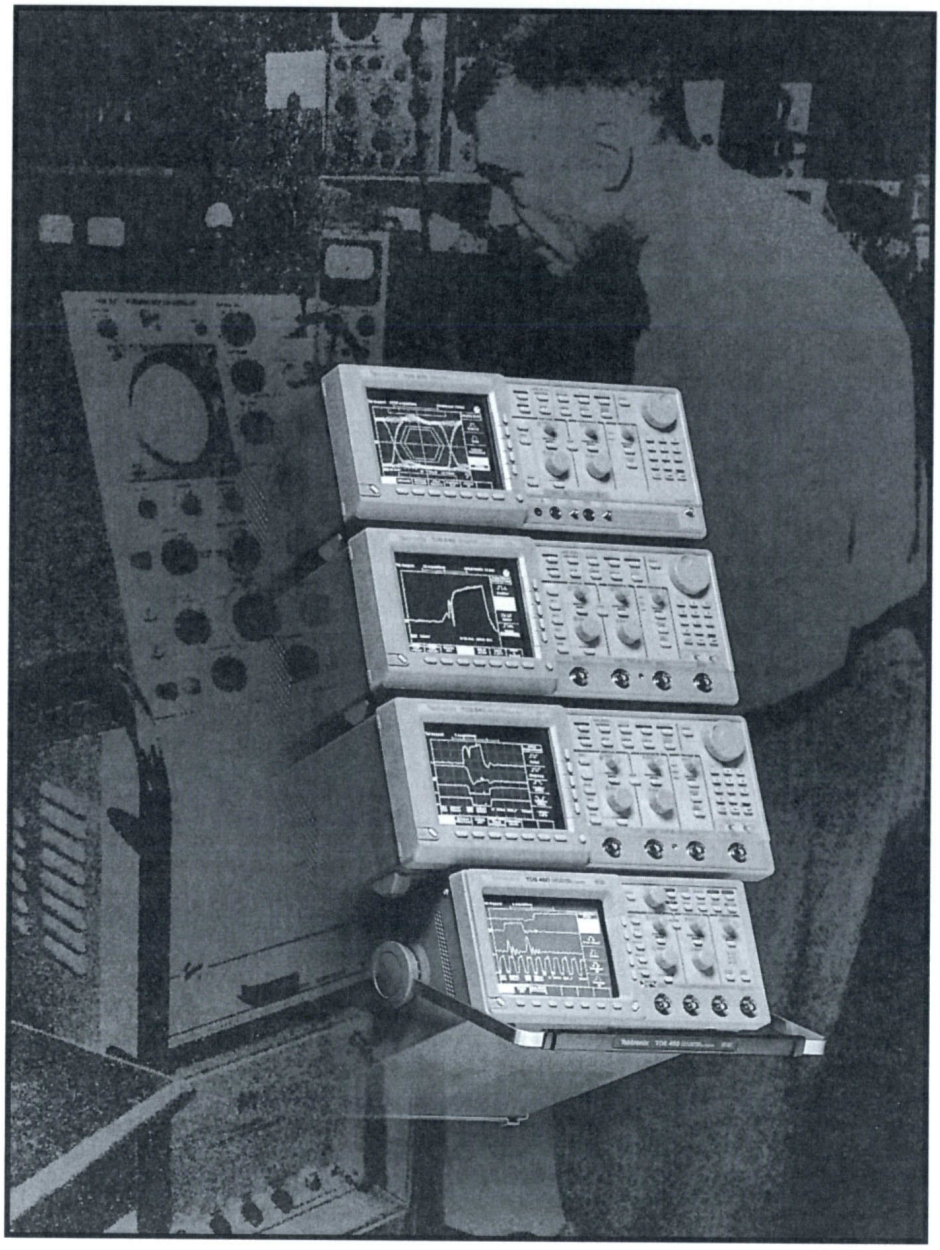
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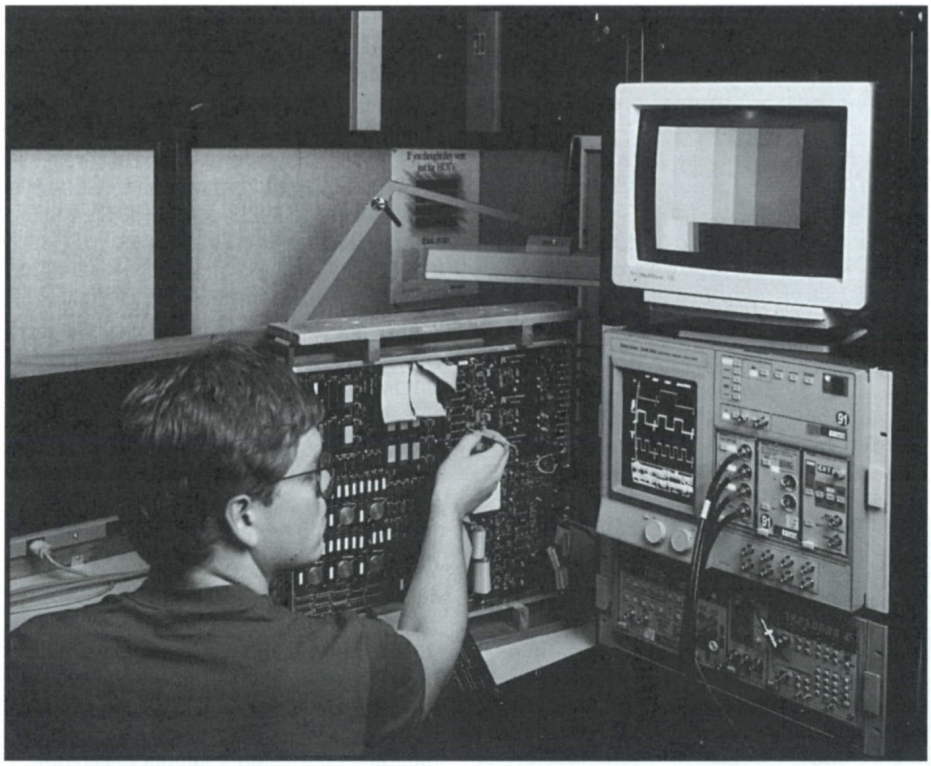
## Tektronix Quality and Reliability

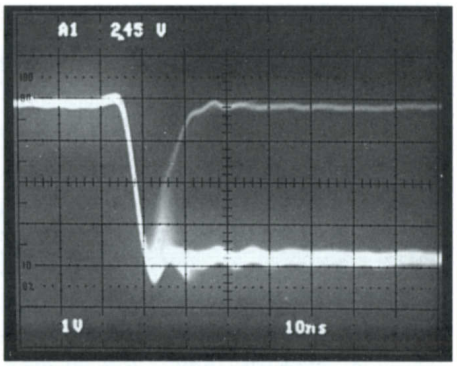
Oscilloscopes are the window through which we view the electronic world. They are fundamental to developments in research, design, manufacturing and service. Tektronix and oscilloscopes are synonymous. We've grown up together. There is no trick we haven't tried, no technology we haven't applied to widening that window in search of a clearer and more accurate view.

Customers continually challenge us to improve. We respond by combining existing features for specific applications or by developing new features to keep ahead of ever-changing needs. On the following pages, you'll find our response to those challenges; a wider selection of oscilloscopes and waveform digitizers than you can find anywhere else.

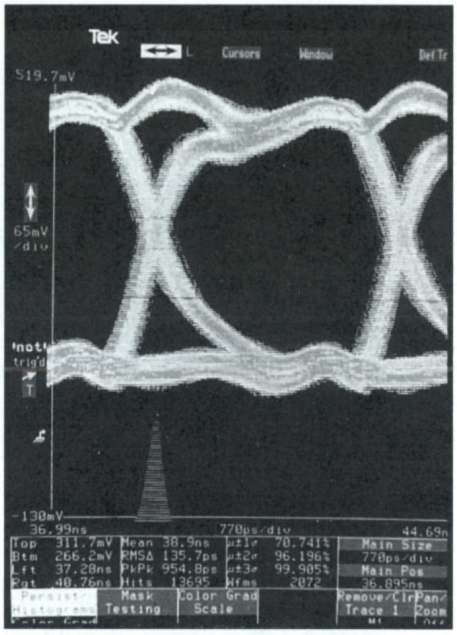
# Oscilloscope Reference








*The microchannel plate CRT in the 2467B BrightEye™ displays low repetition rate*




- 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 644A 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.
- High performance analog scopes like the 2467B BrightEye™ with a micro-channel plate CRT to brightly display single shot or low repetition rate signals up to 400 MHz.
- A selection of over 40 general and special purpose scopes and digitizers.
- 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.

These products include many innovative features designed to help our customers improve their productivity and reduce operating costs. We have two new oscilloscope platforms in this catalog, the TDS Series of digitizing oscilloscopes and the TAS Series of analog oscilloscopes. They 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 60 MHz Current Measurements
- Affordable Digital Signal Processing
- BrightEye™ Microchannel Plate CRTs to clearly show infrequent events.
- Color-graded displays which give a statistical look at jitter and noise.

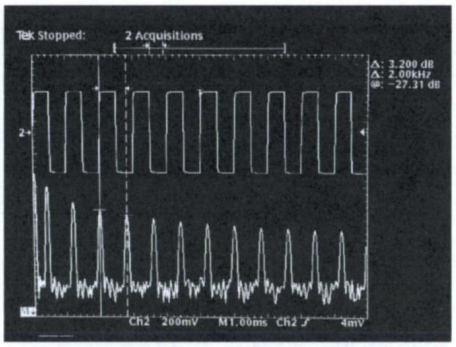
For complete information on all Tektronix oscilloscope accessories, please see pages 424-514.

## Tektronix Quality and Reliability

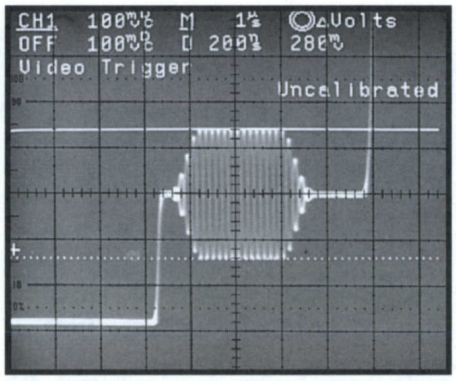
Tektronix oscilloscopes' quality and reliability are unmatched. Designs are thoroughly scrutinized and tested to insure compliance with all applicable safety and environmental standards. Calibration is traceable to national standards and conforms to military procedures. Our service network is designed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

*Continued on next page.*

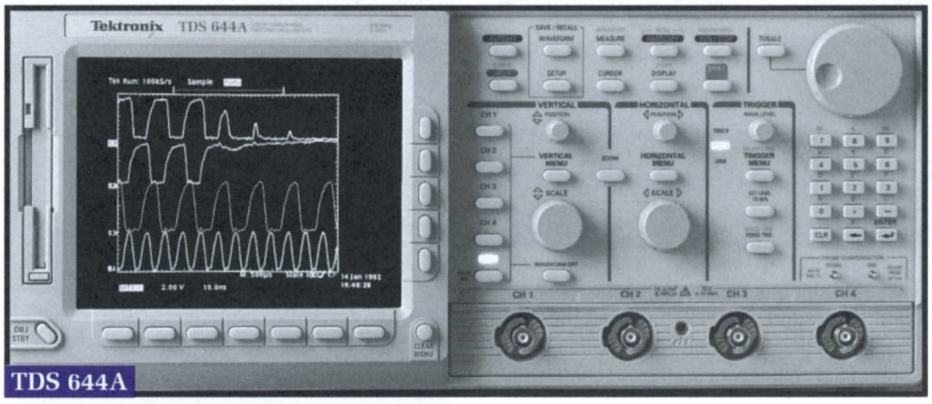
# Oscilloscope Reference
## General Trends



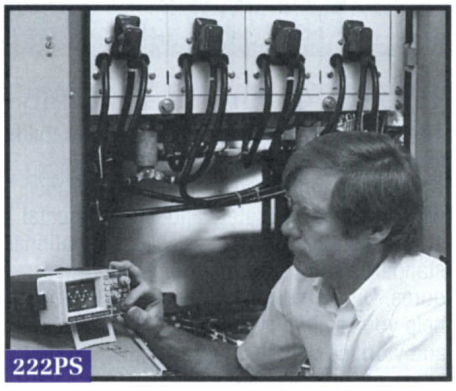

*Tektronix' exclusive TriStar™ DSP engine brings simultaneous time and frequency domain analysis to mid-range scopes in the TDS 400, TDS 500A, TDS 600A and TDS 800 products.*




*The new TAS 400 Series of analog scopes provides powerful features such as cursor measurements and auto-setup in an easy to operate and low-cost package.*




*The new TDS 644A features powerful logic triggering and 2 GS/second sampling on all four channels at once. A color monitor and graphic user interface helps make it a powerfully simple digital design tool.*




*The 220 family of hand-held DSOs helps make measurements in difficult environments safely and accurately.*

### General Trends in Oscilloscope Development

Today you will find more and more special purpose oscilloscopes. Examples include the 222 PowerScout, a hand-held digitizing scope with isolated inputs for safe and accurate troubleshooting of AC power distribution systems and 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 and the DSA 600 include powerful digital signal processing engines which can give you simultaneous time and frequency domain displays with fast updates.

Our scopes are 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.

### New Models for 1994

The new TDS 500A and TDS 600A pick up where their TDS 500 and TDS 600 predecessors left off with high performance acquisition, flexible triggering, powerful processing, and easy-to-learn graphical user interface and have added several exciting new capabilities. The TDS 524A, 544A, and 644A 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™ 200e color printer, or cut and paste screen images directly into word processing documents. The TDS 520A, 540A, 620A, and 640A are monochrome versions offering the same features at an even lower price.

# Oscilloscope Reference
## Selection Guide



### TDS 320

The new Digital Real-Time TDS 320 is the first low-cost oscilloscope to feature "oversampling." This advanced high-speed sampling technique enables the TDS 320 to digitize at 500 MS/s – twice the rate of any 100 MHz DSO on the market today. The TDS 320 is ideal for price-sensitive service, education and design markets.

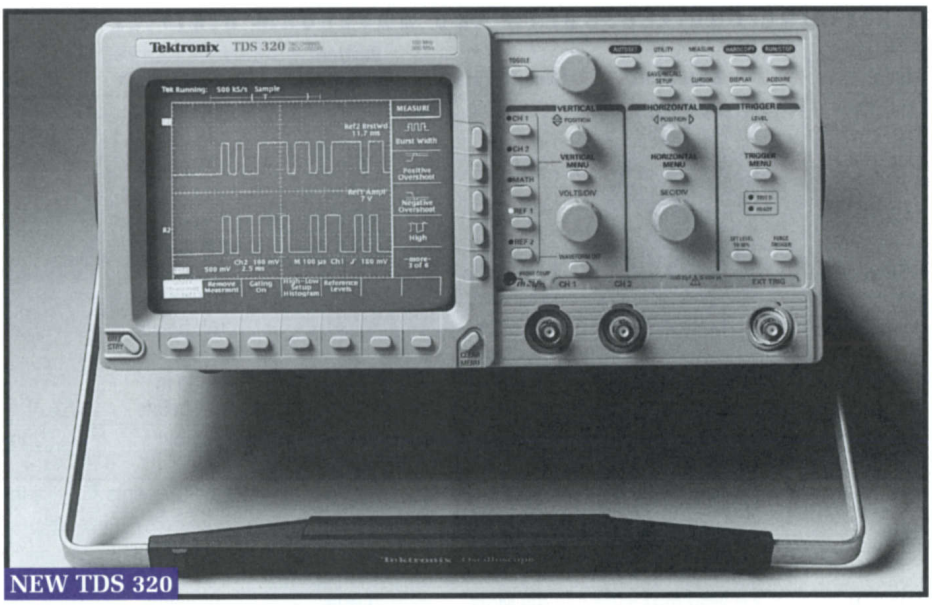
### TAS 400 Series New Analog Scope Platform for the 90's

We've completely updated the analog oscilloscope to make it easier to use, more reliable and more powerful and still kept the price low. Tektronix' commitment to the analog scope user shows in these exciting new products.

The P6205 is a very popular new FET probe perfectly suited to probing higher speed digital devices with minimal loading effects. It comes standard with the TDS 600 scopes or can be purchased separately for a very reasonable price.

### Selecting an Oscilloscope

Sometimes, 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 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.




NEW TDS 320

**OSCILLOSCOPE SELECTION GUIDE**

| Storage/Analog | Bandwidth | Repetition Rate | Models |
|---|---|---|---|
| Storage | >500 MHz | Repetitive | 11801B<br>CSA 803A<br>CSA 404<br>TDS 820<br>11403A<br>DSA 601A, DSA 602A |
| | | Nonrepetitive | SCD 1000<br>SCD 5000<br>DSA 601A, DSA 602A<br>RTD 720A |
| | ≤500 MHz | Repetitive | TDS 520A, TDS 524A, TDS 540A, TDS 544A<br>TDS 460, TDS 420<br>TDS 310, TDS 320, TDS 350<br>2232, 2221A, 2214,2212,2201<br>222A, 222PS, 224 |
| | | Nonrepetitive | RTD 710A<br>TDS 520A, TDS 524A, TDS 540A, TDS 544A<br>TDS 460, TDS 420<br>TDS 620A, TDS 640A, TDS 644A<br>TDS 310, TDS 320, TDS 350<br>2232, 2221A, 2214,2212,2201<br>222A, 222PS, 224 |
| Non-storage | ≤500 MHz | Repetitive | TAS 465, TAS 475, TAS 485<br>2465B, 2445B<br>2252, 2247A, 2205 |
| | | Nonrepetitive | 2467BHD |

# Oscilloscope Reference
## Selection Guide

### 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 | 5K points | 1 to 4 | GPIB, RS-232C, Centronics | 274 |
| CSA 404 | Up to 3 GHz | 20 MS/s | 10-Bits | 10K points | 1 to 12 | GPIB, RS-232C, Centronics | 278 |
| 11801B | DC to 50 GHz | 200 kS/s | 8-Bits | 500 to 5K points | 1 to 136 | GPIB, RS-232C, Centronics | 87 |
| DSA 600A | Up to 1 GHz | 1 to 2 GS/s maximum | 8-Bits | 20K to 30K points | 1 to 8 | GPIB, RS-232C, Centronics | 70 |
| 11403A | Up to 3 GHz | 20 MS/s maximum | 10-Bits | 10K points | 1 to 8 | GPIB, RS-232C, Centronics | 74 |
| TDS 800 | 6 to 8 GHz | n/a | 14-Bits | 500 to 15K points | 2 | GPIB (RS-232C, Centronics Opt.) | 50 |
| TDS 600A | 500 MHz | 2 GS/s | 8-Bits | 2K points | 2 to 4 | GPIB, RS-232, Centronics | 52 |
| TDS 500A | 500 MHz | 1 GS/s maximum | 8-Bits | 500 to 50K points | 2 to 4 | GPIB, RS-232, Centronics | 52 |
| TDS 400 | 150 to 350 MHz | 100 MS/s | 8-Bits, up to 15-Bits with Hi-Res | 500 to 60K points | 4 | GPIB, RS-232, Centronics | 58 |
| TDS 310 | 50 MHz | 200 MS/s | 8-Bits | 1K points | 2 | GPIB, RS-232 Centronics | 61 |
| TDS 320 | 100 MHz | 500 MS/s | 8-Bits | 1K points | 2 | GPIB, RS-232 Centronics | 61 |
| TDS 350 | 200 MHz | 1 GS/s | 8-Bits | 1K points | 2 | GPIB, RS-232 Centronics | 61 |
| 2400 DSOs | 150 to 300 MHz | 100 to 500 MS/s | 8-Bits | 1K points | 2 | GPIB | 104 |
| 222A/222PS | 10 MHz | 10 MS/s | 8-Bits | 512K points | 2 | RS-232 | 115 |
| 224 | 60 MHz | 10 MS/s | 8-Bits | 1K points | 2 | RS-232 | 115 |
| RTD 710A<br>RTD 720A | 500 MHz | 200 MS/s to 2 GS/s | 8 to 10-Bits | 128K points to 32 M points | 2 | GPIB | 142<br>139 |
| SCD 1000<br>SCD 5000 | 1 GHz to 4.5 GHz | 200 GS/s | 11-Bits | 1K points | 2 | GPIB | 136 |

### ANALOG PLUS DIGITAL OSCILLOSCOPES

| Model | Bandwidth | Sample Rate | Record Length | Vertical Resolution | Channels | Computer Interfaces | Time Bases | Page |
|---|---|---|---|---|---|---|---|---|
| 2232 | 100 MHz | 100 MS/s | 1K to 4K points | 8-Bits | 2 | GPIB & RS-232 Opt. | Dual | 105 |
| 2221A | 100 MHz | 100 MS/s | 1K to 4K points | 8-Bits | 2 | GPIB & RS-232 Opt. | Single | 105 |
| 2212 | 60 MHz Analog | 20 MS/s | 4K points | 8-Bits | 2 | GPIB & RS-232 Opt. | Single | 110 |
| 2201 | 20 MHz Analog | 10 MS/s | 2K points | 8-Bits | 2 | RS-232 hardcopy | Single | 112 |
| 2214 | 20 MHz Analog | 16 MS/s | 16K points | 8-Bits | 4 | RS-232C hardcopy | Single | 108 |

### ANALOG OSCILLOSCOPES

| Model | Bandwidth | Channels | Time Base | Basic Cursors Setup | Computer Interfaces | Page |
|---|---|---|---|---|---|---|
| 2400B | 200 to 400 MHz | 2 + 2 AUX | dual | yes | GPIB Opt. | 124 |
| 2200 | 20 to 100 MHz | 2 or 2+2 | single or dual | 2252<br>2247A | GPIB, Centronics on 2252 only | 129 |
| TAS 400 | 100 to 200 MHz | 2 or 4 | dual | yes | no | 120 |

# 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.

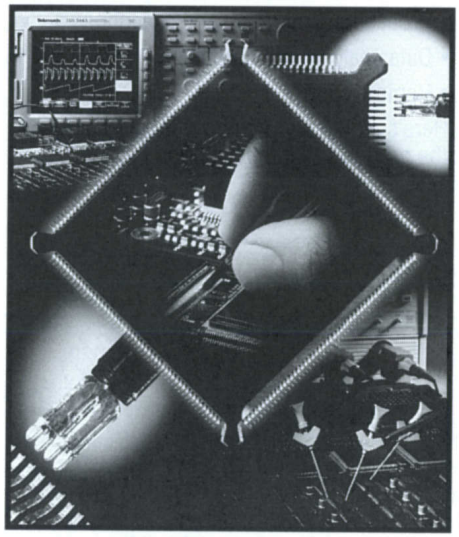
Tektronix offers several software solutions to these data management and control problems with software for:

- 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 that they support.

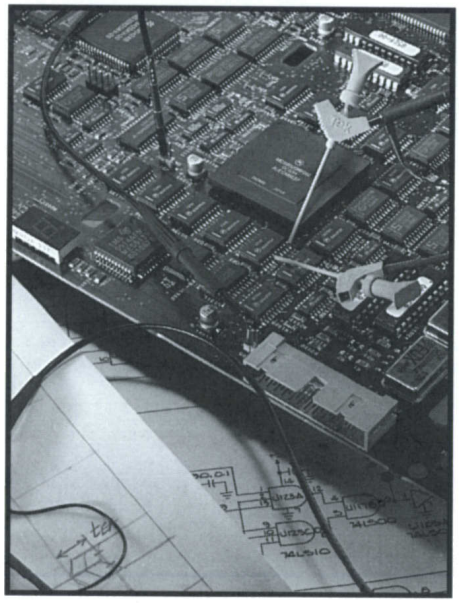
| Product Name | Product Number | Description | Oscilloscopes Supported |
|---|---|---|---|
| Tektronix TMS/IPG | S3FT100 | Interactive Procedure Generator | TDS Series, 11400A, CSA 404, 2430A, 2440, 2200 DSOs |
| Tektronix TMS/RTG | S3FT110 | Run Time Generator | TDS Series, 11400A, CSA 404, 2430A, 2440, 2200 DSOs |
| Tektronix TMS GPIB/VXI Instrument Libraries | S3FT300/200 | Front Panel Editor | TDS Series, 11400A, CSA 404, 2430A, 2440, 2200 DSOs |
| LabWindows/Advanced Analysis Libraries | S3FG910/912 | Data acquisition, analysis, and instrument control | TDS Series, 11400A, CSA 404, 2430A, 2440, 2200 DSOs, RTD 710 |
| LabVIEW PC Windows<br>LabVIEW Sun SPARC | S3F6919<br>S3F6920 | Data acquisition, analysis, & graphics | TDS Series, DSA 600, 11801B, CSA 803A, 11400A, CSA 404, 2430A, 2440, 2200 DSOs, 220 Family DSOs, RTD 710A RTD 720A |
| WaveWriter™ | S3FT400 | Waveform capture generation and editing | TDS Series, 11400A, CSA 404, 2430A, 2440, 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 Spread Sheet Analysis Tools | 2200 Series<br>TDS 300/400/500/600/800 Series<br>2400 Series, CSA, DSA and 1100 Series |

# Oscilloscope Reference
## Accessories



### New Probes and Accessories

Tektronix continues to dedicate research and development resources to helping customers find ways to connect oscilloscopes to new devices and packages. You will find some innovative new probes and connecting schemes that quickly and cleanly couple to all kinds of devices.

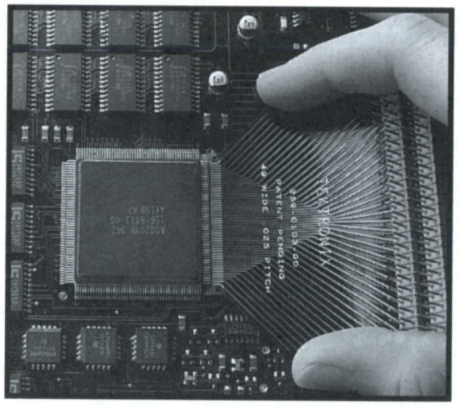


**SMALL GEOMETRY PROBES**
**P656(X)AS SERIES**

A new set of probes (P656(X)AS series) now allows the digital designer an "off-the-shelf" direct access solution for probing surface mount packages. The SMD Probes are designed with Tektronix Oscilloscopes forming a measurement system optimized for low circuit loading, fast transient response and maximum bandwidth. See page 450.

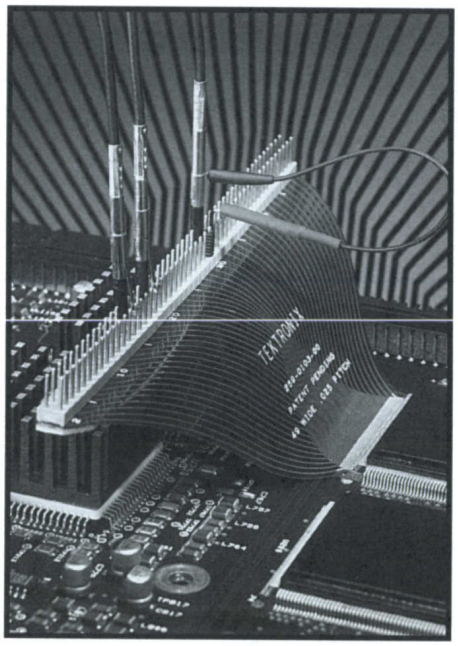
**SureFoot™ SF500 AND SF200 SERIES**

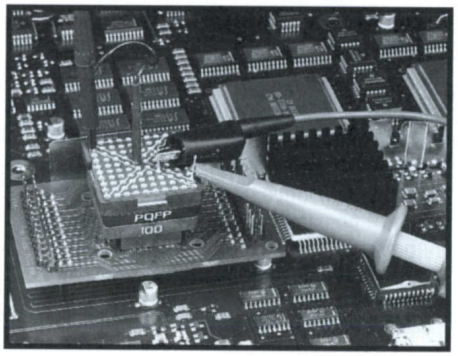
This new integral probe tip and guide system enables fault-free hand probing of 0.5 mm, 0.65 mm, 25 mil and 50 mil pitch packages. Side by side pin access is achieved by the offset stacking one SureFoot™ to another. SureFoot™ is available for the P656(X)AS series and the P6203, P6204 and P6205 Active FET probes. See page 454.



**FlexLead™ ADAPTERS**
**THE PJ(JEDEC) AND PE(EIAJ) SERIES**

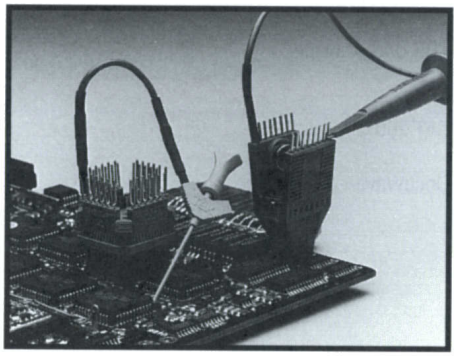
The new FlexLead™ Adapter provides quick and easy hands-free access to fine pitch QFD packages minimizing the risk of damage to the device under test both electrically and mechanically. FlexLead™ provides a standard 100 mil interface (signal-ground pairs) which allows convenient access for oscilloscope probes and logic analyzer poddlets. See page 452.





**CLIPS AND INTERCONNECTS**

You will find a complete line of clips and interconnects for all kinds of packages. The SMT KlipChip™ allows logic and scope probes to connect directly to surface mount devices (SMD). There are clips for Plastic Leaded Chip Carriers (PLCCs) and Small Outline Integrated Circuits (SOICs). And the PQFP100/132 provides easy probe access to soldered 100 or 132-Pin Plastic Quad Flat Packs (PQFPs). See page 455.



**FET PROBES**

The P6204, P6205, P6217, and P6207 FET probes prove that today's high speed logic circuits can be probed with minimal loading effects. These active probes provide 500 MHz to 4 GHz bandwidth and high input impedance to insure that what you see is an accurate depiction of what is happening in your circuit. See page 436.

**B-SERIES GENERAL PURPOSE PROBES**

B-Series 15-100 MHz probes set new standards for durability and accuracy for general purpose applications. An entirely new design eliminates wiring and soldered connections, the most common causes of probe failure. See page 443.

# Digitizing Oscilloscopes
## TDS, 11000, DSA, CSA, 2400, 2200, 200 Series

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

### 11000 Series
The Tektronix 11000 Series is a powerful set of analysis tools that alters your fundamental expectations of an oscilloscope. Accuracy, sensitivity, bandwidth, offset, and overdrive recovery are provided by a well-planned instrument family having plug-in versatility and performance.

### DSA Series
The Digitizing Signal Analyzer (DSA) Series incorporates a dedicated digital signal processor (DSP). The DSA Series provides the fastest and most accurate realtime digitizer plus provides signal processing capability previously found only in large computer systems.

### 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.

### 2400 Series
The 2400 Series offers a well balanced combination of performance, automation, and convenience features.

### 2200 Series
The 2200 Series offers digital storage and analog familiarity plus documentation at an affordable price.

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

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**1100 SERIES OSCILLOSCOPES/PLUG-INS**
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11402A 1 GHz Monochrome ....74
11000/DSA Series Plug-in Amplifiers ....80
11801B 50 GHz Digital Sampling ....87
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**DSA SERIES DIGITIZING SIGNAL ANALYZERS**
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DSA 601A 1 GHz ....70

**CSA SERIES COMMUNICATIONS SIGNAL ANALYZERS**
CSA 404 3 GHz Color ....278
CSA 803A Up to 50 GHz Color ....274
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**2400 SERIES DIGITIZING OSCILLOSCOPES**
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**200 SERIES HANDHELD DIGITAL STORAGE**
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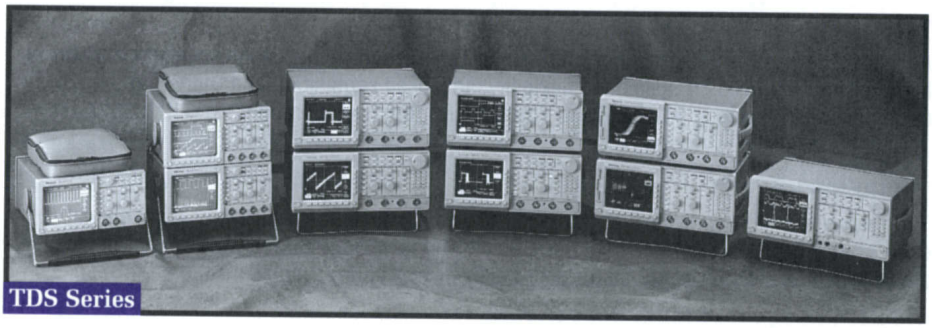
# TDS SERIES

# Digitizing Oscilloscopes

*The breakthrough TDS architecture lends itself to an almost limitless range of price and performance variations.*

**TDS SERIES**

- 50 MHz to 8 GHz bandwidth
- 100 MS/s to 2 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 60,000 Points
- 8 to 12-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
- 3-Year Warranty



TDS Series

## TDS Series

An innovative series of oscilloscopes built upon Tektronix' new 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; 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 2 GS/s and bandwidths from 50 MHz to 8 GHz. TDS couples this performance with wide dynamic range, vertical resolution up to 15 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 and 600A 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 400 an excellent choice for video and display system design. Specialized HDTV triggering is available on the TDS500A and TDS600A. 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 the power of a Motorola 68020 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 400, 500A, 600A 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, online 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 and 600A.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

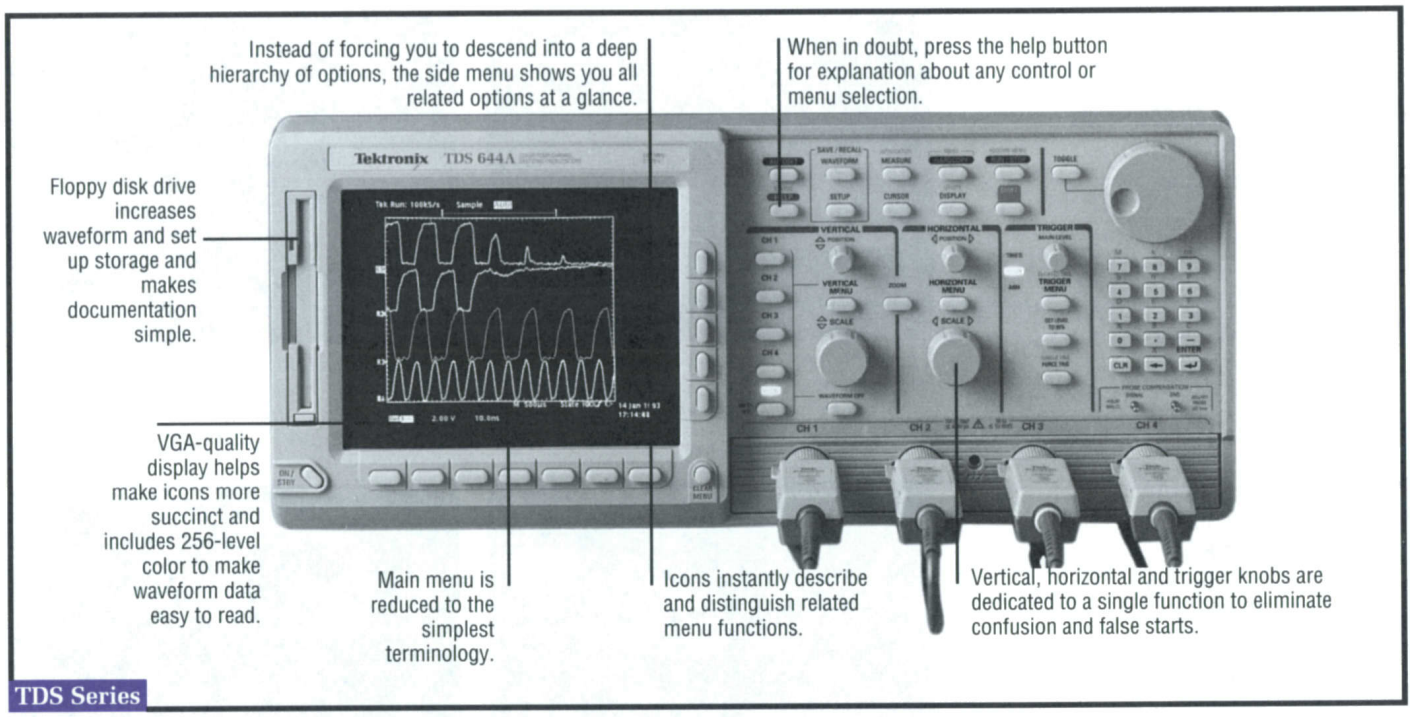
GPIB IEEE-488

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

# Digitizing Oscilloscopes








**TDS Series**

## TDS SELECTION GUIDE

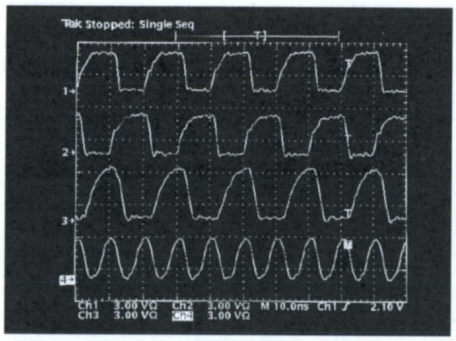
| | TDS 310 | TDS 320 | TDS 350 | TDS 420 | TDS 524A/ TDS 460 | TDS 520A | TDS 544A/ TDS 540A | TDS 620A | TDS 644A/ TDS 640A | TDS 820 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Signal Acquisition System** | | | | | | | | | | |
| Bandwidth | 50 MHz | 100 MHz | 200 MHz | 150 MHz | 350 MHz | 500 MHz | | 500 MHz | | 6-8 GHz |
| No. of Channels | 2 | 2 | 2 | 4 | 4 | 2 | 4 | 2 | 4 | 2 |
| Vertical Resolution | 8-Bits | | | 8-Bits ≥12-Bits w/HiRes or averaging | | 8-Bits ≥12-Bits w/HiRes or averaging | | 8-Bits ≥12-Bits w/averaging | | 14-Bits |
| Vertical Sensitivity | 2 mV-10 V/div | | | 1 mV-10 V | | 1 mV-10 V | | 1 mV-10 V | | 2 mV-200 mV/div |
| Accuracy | ±0.01% | | | ±1.5% | | ±1% | | ±1.5% | | ±0.7% |
| Sample Rate | 200 MS/s on both channels | 500 MS/s on both channels | 1 GS/s on both channels | 100 MS/s on all channels | | 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 GS/s on all Channels | | NA |
| Record Length Per Channel | 1000 pts. | | | 500-15K pts. (60K Opt.) | | 500-15K pts. (50K Opt.) | | 500-2000 pts | | 500-15K pts. |
| Peak Detection | 10 ns | | | 10 ns | | 4 ns | | NA | | NA |
| **Signal Processing Functions** | | | | | | | | | | |
| | Add, Subtract, Average, Envelope | | | Add, Average, Envelope, HiRes, Interpolation (Sin x/x & linear), Multiply, Subtract FFT, Int., Diff | | Add, Average, Envelope, HiRes, Interpolation (Sin x/x & linear), Multiply, Subtract FFT, Int., Diff | | Add, Average, Envelope Interpolation (Sin x/x & linear), Multiply, Subtract FFT, Int, Diff. | | Add, Average, Envelope Interpolation (Sin x/x & linear), Multiply, Subtract. Opt. FFT, Int, Diff. |
| **Triggering** | | | | | | | | | | |
| Trigger Conditioning | HF, LF & Noise Reject | | | HF, LF & Noise Reject | | HF, LF & Noise Reject | | HF, LF & Noise Reject | | NA |
| Trigger Types | Edge, Auto, NTSC, PAL, SECAM video | | | Edge, Auto, Init 50%; Custom; Opt. NTSC, PAL, SECAM video | | Edge, Auto, Init 50%; 4 Input Pattern, State; Glitch and Width (≥2 ns); Runt; Opt. HDTV, NTSC, PAL, SECAM video | | Edge, Auto, Init 50%; 4 Input Pattern, State; Glitch and Width (≥2 ns); Runt; Opt. HDTV, NTSC, PAL, SECAM video | | Edge, Auto, Init 50% |
| **Page** | 61 | 61 | 61 | 58 | 58 | 52 | 52 | 52 | 52 | 50 |

**TDS SERIES**

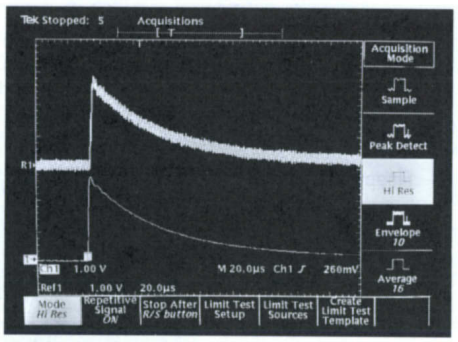
# Digitizing Oscilloscopes

## Powerful Acquisition

- Four Channels of 2 GS/s (TDS 640A/644A)
- Record Lengths of 60,000 Points (TDS 400 Opt. 1M)
- Up to 8 GHz bandwidth (TDS 820 Opt. 1D)



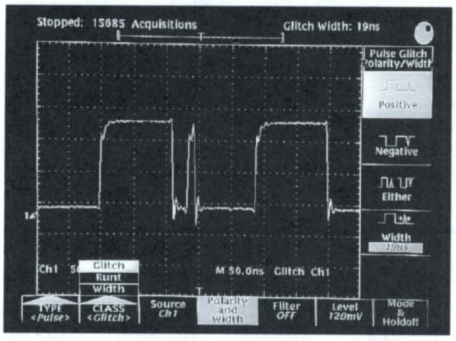

*The TDS 640A/644A provides four channels of 2 GS/s acquisition to capture events with high single-shot resolution.*



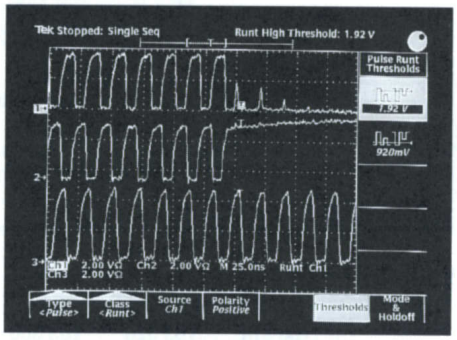

*Hi-Res acquisition mode achieves extremely high signal to noise ratios (SNR) on single shot events by oversampling the input signal (all TDS 400 and TDS 500A models).*

## Advanced Triggering

- Glitch Trigger of 2 ns (TDS 500A/TDS 600A)
- Exclusive Runt Triggering (TDS 500A/TDS 600A)
- HDTV Video Triggering (TDS 500A/TDS 600A)



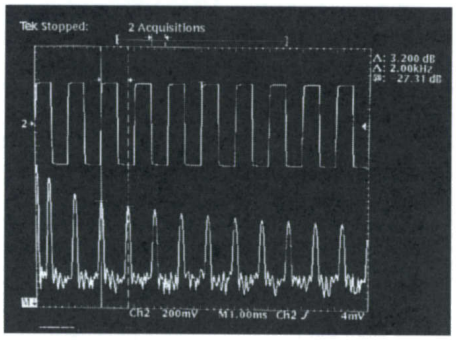

*TDS triggering can capture glitches as narrow as 2 ns to help solve prototype circuit problems quickly (all TDS 500A and TDS 600A models).*



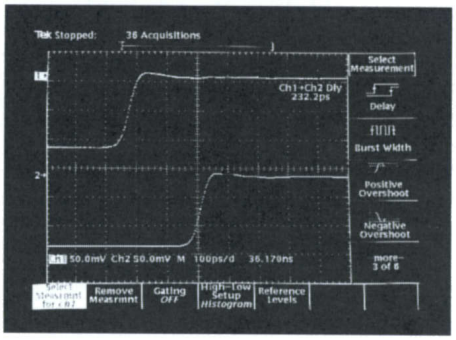

*TDS exclusive runt triggering helps isolate invalid logic levels such as those caused by setup and hold violations (all TDS 500A and TDS 600A models).*

## 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 400, monochrome TDS 500A/600A and the TDS 820, standard on color TDS 500A/600A).*



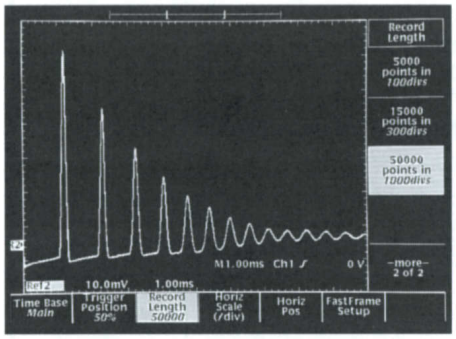

*The TDS 820 provides 0.4 ps timing resolution and channel deskew capability to accurately measure delays in today's high-speed digital systems.*

# Digitizing Oscilloscopes

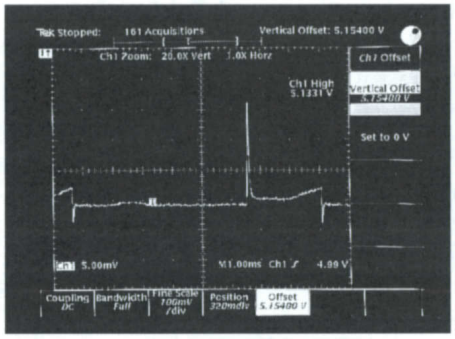




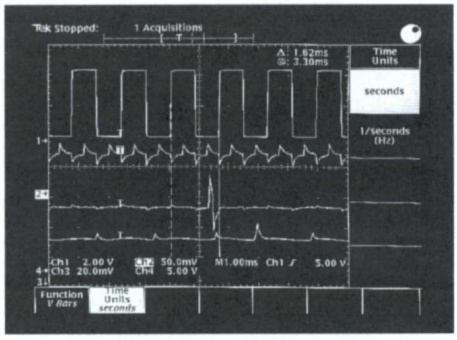
## Powerful Acquisition




*Record lengths of up to 60,000 points (TDS 400 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.*

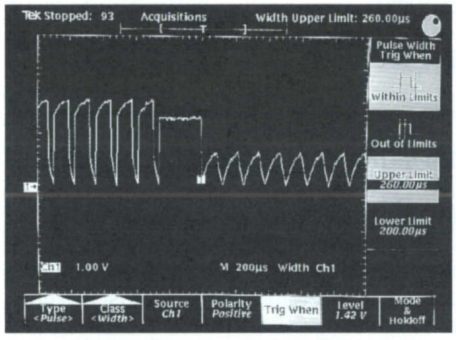



*Calibrated vertical offset allows capture and analysis of small signals riding on top of large DC offsets (all TDS 400, TDS 500A and TDS 600A models).*

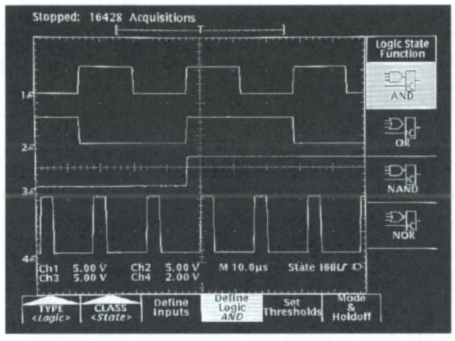



*Four channels help show a time-correlated display of both digital control and analog feedback signals (TDS 420, TDS 460, TDS 540A/544A and TDS 640A/644A).*

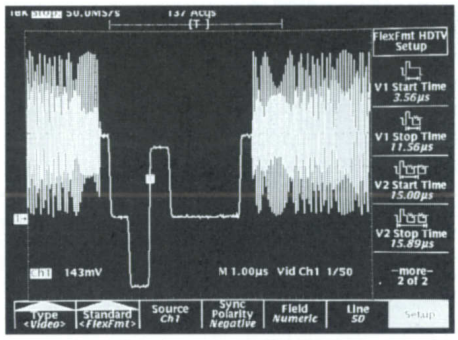
## Advanced Triggering




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

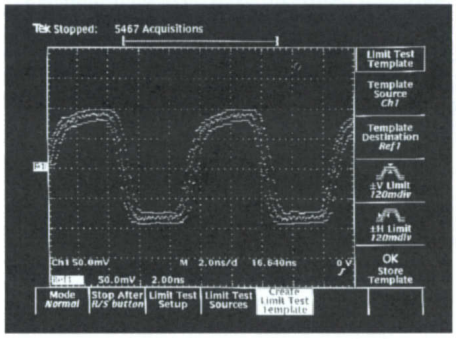



*Logic timing analysis is clearly faster and easier with icon-driven state triggering (all TDS 500A and TDS 600A models).*

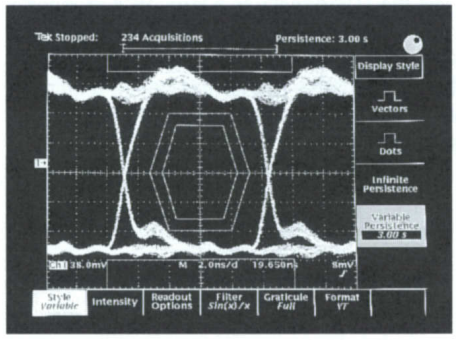



*An optional video trigger features line and field selection on standard and user definable HDTV formats (TDS 500A and TDS 600A).*

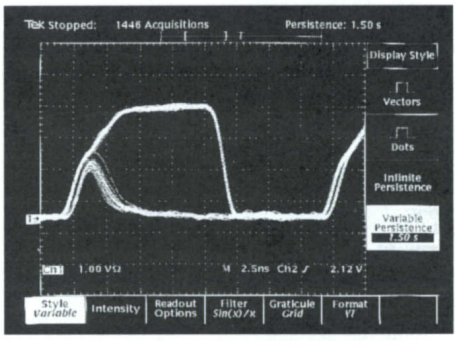
## Powerful Processing




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




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




*A variable persistence display mode lets you get a statistical view of waveform changes with 16 levels of intensity grading (all TDS models) and color grading with color TDS 500A/600A.*

*Continued on next page.*

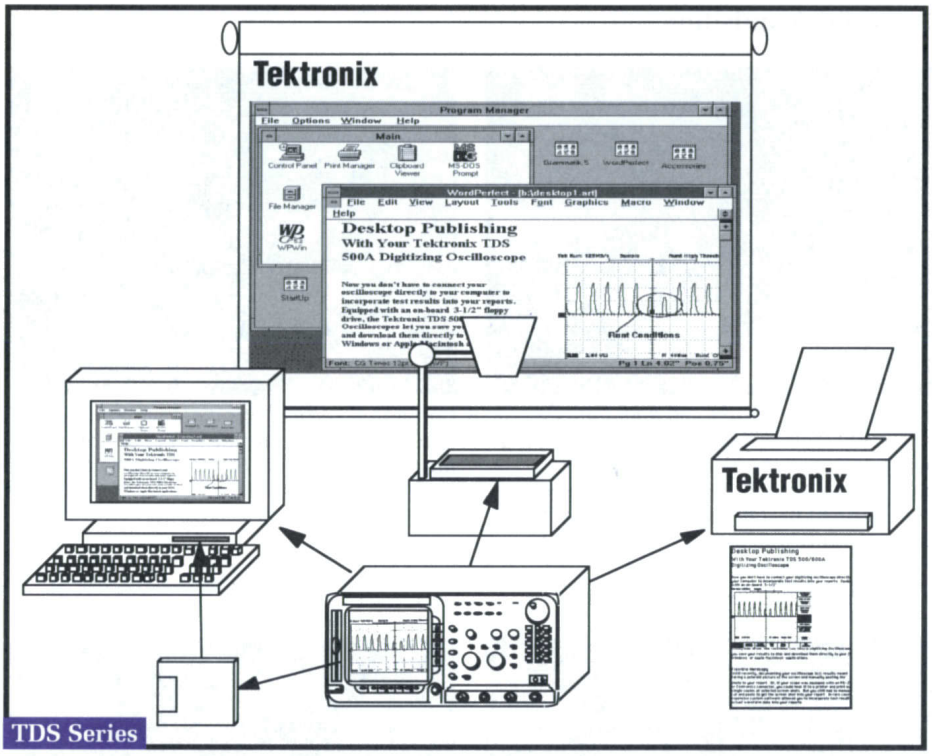
# Digitizing Oscilloscopes
## Documentation



*TDS makes documentation easy.*

**TDS SERIES**

- Hardcopies Directly to Common Printers Including Tektronix Color Printers
- Save Screen Shots in Common Desktop Publishing Formats for Importing Into Documents
- View Waveforms on Large VGA Displays and Overhead Projectors
- Use Raw Data for Additional Analysis




### TDS Documentation

One of the advantages of a digitizing oscilloscope is that it allows capture of waveforms without the need for cameras. TDS scopes provide extensive capabilities which make documentation and presentation of data faster and simpler than ever. You have the choice of making hardcopies of the display directly to a printer, saving them to floppy disk in standard file formats for cut & paste into reports, or transferring the raw data to a PC for analysis. The TDS also enhances the presentation of data by allowing you to connect the TDS directly to a large VGA monitor or overhead projection system for viewing of live waveforms. Moreover, these documentation/presentation capabilities do not require extensive setup and are as easy to use as pushing a button.

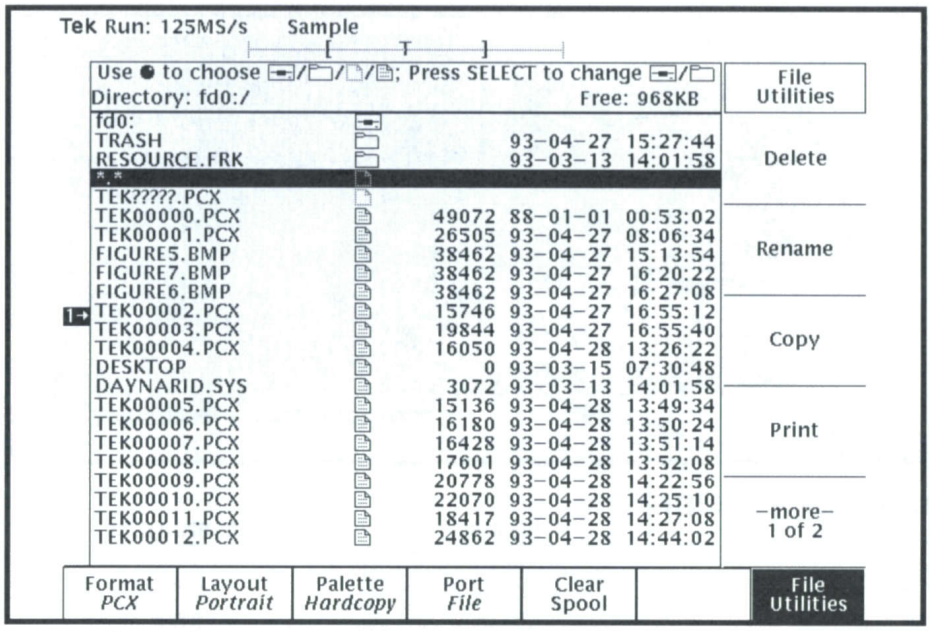
### IMPORTING SCREEN SHOTS INTO REPORTS

What you see on the TDS display — including waveforms, graticules, measurements, cursors, and menus — can be imported directly into word processing application software such as Microsoft Word or WordPerfect. TDS 500A/600A scopes can save the display in common file formats to a DOS format 3.5 in. floppy disk which can be used to transfer these files to a PC and then imported into documentation. File formats include PCX (Paintbrush), BMP (Windows), TIFF, EPS, and Interleaf. The TDS 524A, 544A, and 644A can even save their displays as color images to match what you see on the scope. TDS without an internal floppy drive can transfer image files to a PC via GPIB or by saving to an external controller's (RIC386) floppy drive.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488

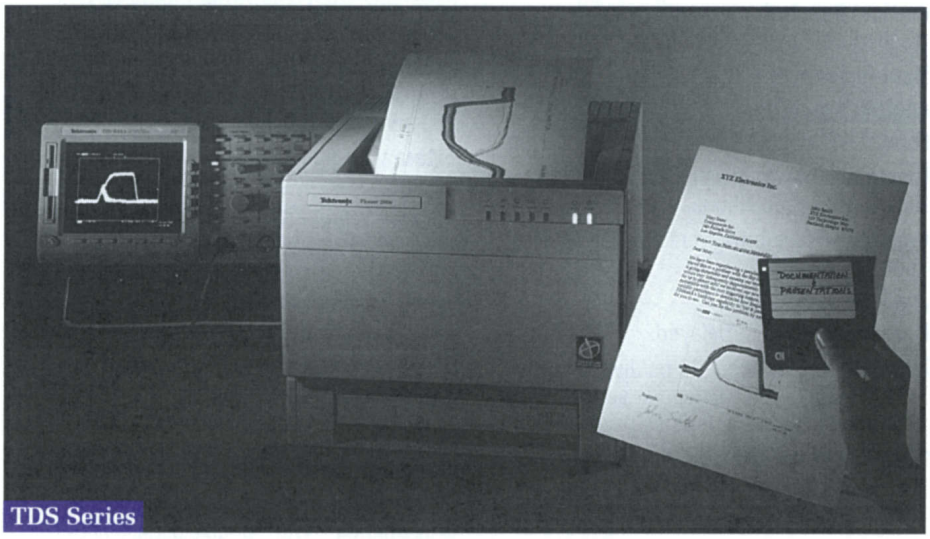
The TDS Series complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.




*TDS 500A/600A Floppy Drive file menu with automatic naming and file format extensions.*

**DIRECT PRINTER ACCESS**

Hardcopies of TDS displays can also be made by hooking up a printer directly to the scope's GPIB, RS232, or Centronics ports. Then it's as simple as pressing the hardcopy button. A buffer in the TDS allows you to print several screens without tying up the scope while waiting for the printer to finish. The TDS supports several printer types including Epson, HP ThinkJet, LaserJet, Seiko DPU 411/412 Thermal Printers, HPGL plotter, and the color TDS 500A/600A can even print to a Tektronix color printer.




*Print directly to a Postscript color printer, such as the Tektronix Phaser™ 200e, or use the DOS format floppy drive to cut and paste screen shots into word processing documents.*

**GROUP PRESENTATIONS**

TDS scopes can make presentation of your data fast and simple. Data can be presented in overhead transparencies and printed in color on the Phaser 200e with the color TDS. For presentation of live waveforms to a group of people, the TDS 400, 500A, and 600A allow viewing on large monitors or even on LCD overhead projection systems. It's as simple as connecting a VGA monitor directly to the TDS VGA-output port. What you see on the scope screen will also be seen on the external display, even in color! This can be very useful for educational applications.

**ANALYSIS OF RAW DATA**

For applications that require raw acquisition data for manipulation by specialized software, the TDS 500A/600A provide the capability to import this data into your PC. Waveforms are saved to floppy disk as reference waveforms, and a utility program called CNVRTWFM converts the reference waveform into ASCII, Spreadsheet, 8-Bit binary, or 16-Bit binary data formats. TDS 400 and TDS 800 data can be saved to a controller's (RIC 386) floppy drive or transmitted via GPIB directly to a PC for conversion by CNVRTWFM.

# Digitizing Oscilloscopes



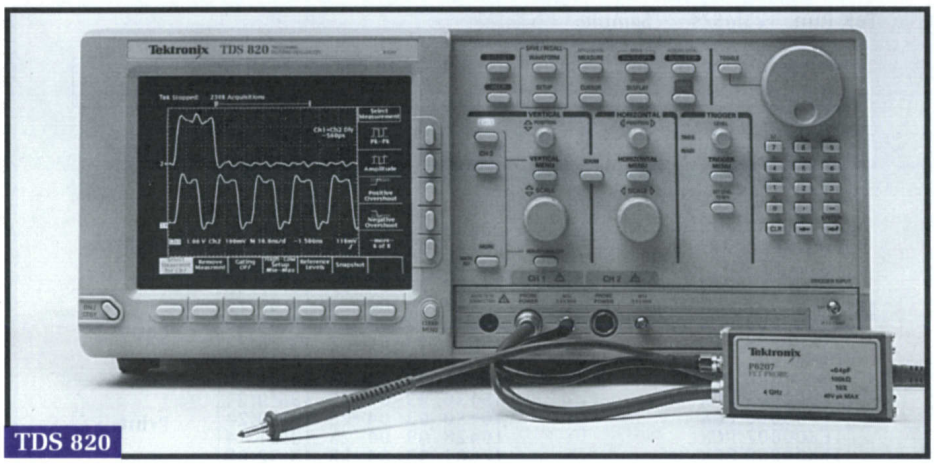
*This high bandwidth, high resolution oscilloscope is ideal for precise device characterization applications and for telecommunications service, manufacturing and installation.*

**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
- 0.4 pF FET Probes Standard

**APPLICATIONS**

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



TDS 820

**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 VDC | 1 V p-p; ±1.5 VDC |
| 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 +15 ps |
| 100 ps | 5 ps |
| 10 ps | 2 ps |

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

**Pre-Trigger View Time** – 1.5 ns (not available with option 1D).

**Minimum Trigger to Sample Delay: TDS 820 with Opt. 1D** – 16 ns.

**TRIGGERING SYSTEM**

**Trigger Sources** – External input, internal rate generator, CH 1, CH 2 (CH 1 and CH 2 sources not available with Opt. 1D).

**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 (Internal trigger source is not available with Opt. 1D).

**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.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The TDS 820 Series complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.

# Digitizing Oscilloscopes





### 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.

**Arithmetic Operators –** Add, Subtract, Multiply, Invert.

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

**Optional Advanced DSP Math Package –** Includes FFT, integrate, and differentiate.

### 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 15K 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 Watts 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 |
| w/ acc. pouch | 236 | 9.3 |
| Width | 445 | 17.5 |
| Depth w/front cover | 432 | 17.0 |
| **Weight** | **kg** | **lb.** |
| Net | 13.2 | 29.1 |
| Shipping | 23.6 | 52.0 |

## ORDERING INFORMATION

**TDS 820 –** 2 Channel 6 GHz Digitizing Oscilloscope.....**$19,900**
**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), sixty 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. 1D –** Delete Delay Lines.....**–$450**
**Opt. 2D –** Delete two P6207 Probes.....**–$2,800**
**Opt. 2F –** Add advanced DSP Math.....**+$1,495**
**Opt. 13 –** RS232/CENTRONICS Hardcopy Interface.....**+$495**
**Opt. 29 –** TD100 Data Manager.....**+$2,495**
**Opt. 1K –** K420 Scope Cart.....**+$695**
**Opt. 1P –** HC100 Plotter with Opt. 1.....**+$1,260**
**Opt. 1R –** Rack Mount.....**+$400**
**Opt. 1S –** Add one static isolation unit SIU800.....**+$1,650**
**Opt. 9C –** NIST & MIL STD-45552A Cal. Certificate.....**+$125**
**Opt. B1 –** Service Manual.....**+$125**

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

**WARRANTY-PLUS SERVICE OPTIONS**
Three years warranty, covering all labor and parts, including CRT, and excluding probes.

**Opt. M2 –** Standard 3-year product warranty plus 2 additional years of repair services for a total of 5 years coverage.....**+$545**
**Opt. M3 –** Standard 3-year product warranty plus 4 years of calibration service and 2 years of repair services for a total of 5 years coverage.....**+$1,395**
**Opt. M8 –** Calibration Service.....**+$570**
**SOFTWARE –** TDS Data Management Software. Order S34TDS1.....*1

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

**PROBES**
**Active –** 3.5 GHz, 0.4 pF/100 kΩ, 1 m. Order P6207.....**$3,495**
**Differential –** 100 MHz, Active Differential, 6 ft. Order P6046.....**$2,295**
**50 Ω Divider –** 9 GHz, 0.15 pF/500 Ω, Tips 1X, 10X. 1 m. Order P6150.....**$995**
**CARTS –** K420 Scope Cart.....**$695**

**CAMERA/HARD COPY DEVICE**
**Camera –** Order C9 with Opt. 1A and Opt. 05.....**$895**
**Hood Adapter –** Order 016-1145-00.....**$70**
**Plotter –** Order HC100 Opt. 01.....**$1,260**

**ADDITIONAL ACCESSORIES**
**Soft-sided Carrying Case –** Order 016-0909-01.....**$210**
With TD100/RIC386. Order 016-1095-00.....**$340**
**Transit Case –** With TD100/RIC386. Order 016-1135-00.....**$625**
**Time to Voltage Converter –** Requires TM 500/5000 Mainframe. Order TVC 501.....**$2,495**

**1 Contact your Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The TDS 820 Series complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.

# TDS 520A TDS 524A TDS 540A TDS 544A TDS 620A TDS 640A TDS 644A Digitizing Oscilloscopes

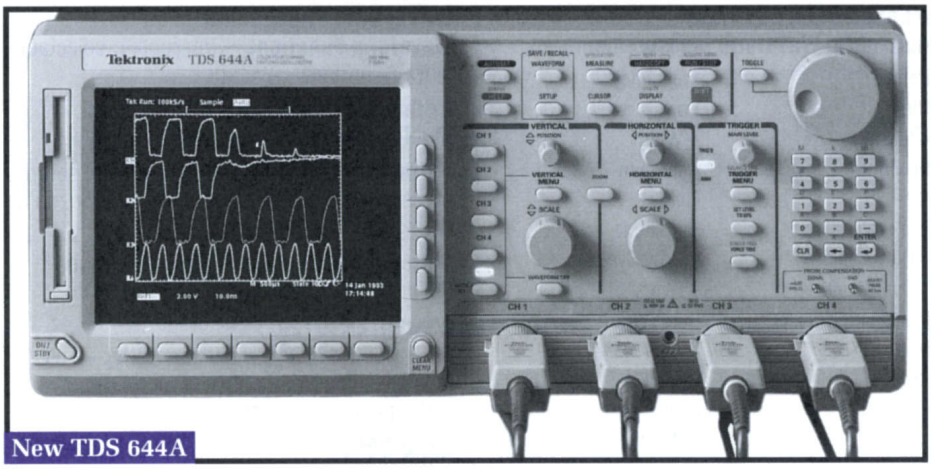
*Designed to keep pace with evolving needs in digital design as well as manufacturing test, R&D and telecommunication applications.*

**TDS 520A/TDS 524A/ TDS 540A/TDS 544A/ TDS 620A/TDS 640A/ TDS 644A**

- 500 MHz Bandwidth
- Sample Rates to 2 GS/s
- 2 and 4 Input Channels
- Time Interval, 2 ns Glitch, Runt, Pattern and State Triggering
- HDTV Video Triggering
- 1 mV/div 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
- Vertical Accuracy to 1%
- FFT, Integration and Differentiation
- 25 Automatic Measurements
- 2 pF FET Probes Standard on TDS 600A
- Color Monitor
- 3.5 in. DOS Format Floppy Drive
- VGA-Output to External Monitor
- Waveform Pass/Fail Testing

**APPLICATIONS**

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




New TDS 644A

**SIGNAL ACQUISITION SYSTEM**

| | TDS 520A/524A/620A | TDS 540A/544A/640A/644A |
|---|---|---|
| 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 | NA | Same as CH 1 and CH 2 |
| AUX 1, AUX 2 (TDS 520A/524A) | 100 mV, 1.0 V, 10 V/div | NA |
| AUX 1, AUX 2 (TDS 620A) | Same as CH 1 and CH 2 | NA |
| Position Range | ±5 Divisions | ±5 Divisions |
| Offset | | |
| CH 1, CH 2 | ±1 V from 1 to 99.5 mV/div<br>±10 V from 100 mV to 995 mV/div<br>±100 V from 1 to 10 V/div | ±1 V from 1 to 99.5 mV/div<br>±10 V from 100 mV to 995 mV/div<br>±100 V from 1 to 10 V/div |
| AUX1, AUX2 (TDS 620A) | | Same as CH 1 and CH 2 |
| CH 3, CH 4 | NA | NA |
| AUX 1, AUX 2 (TDS 520A/524A) | 100 mV/div ±5 V<br>1 V/div ±5.0 V<br>10 V/div ±50 V | |

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

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

# Digitizing Oscilloscopes

**TDS 520A** **TDS 620A**
**TDS 524A** **TDS 640A**
**TDS 540A** **TDS 644A**
**TDS 544A**



## TIME BASE SYSTEM

| | TDS 520A/524A/540A/544A | TDS 620A/640A/644A |
|---|---|---|
| Time Bases | Main, Delayed | Main, Delayed |
| Time/Division Range | 500 ps to 10 s/div | 500 ps to 5 s/div. |
| Time Base Accuracy | ±25 ppm over any interval ≥1 ms | ±100 ppm over any interval ≥1 ms |
| Record Length | 500 to 15000 pts. (50K pts optional) | 500 to 2000 pts. |
| Pre-Trigger Position | 0 to 100% of record | 20% to 80% of record |

## TRIGGER TYPES

| | | |
|---|---|---|
| **Edge** (main and delayed) | | Conventional level driven trigger. Positive or negative slope on any channel or rear panel auxiliary input (Except TDS 520A/524A). Coupling Selections: DC, AC, noise reject, HF reject, LF reject. |
| **Pulse** (main) | Width | Trigger on width of positive or negative pulse either within or not within selectable time limits. Time limits settable from 2 ns to 1 s. |
| | Glitch | Trigger on or reject glitches of positive, negative or either polarity. Minimum glitch width threshold is 2.0 ns, with 200 ps resolution. |
| | Runt | Trigger on a pulse that crosses one threshold but fails to cross a second threshold before returning across the first. |
| **Logic** (main) | Pattern | Specifies a logical combination (AND, OR, NAND, NOR) of the four input channels (Hi, Lo, Don't Care). Trigger when pattern stays True or False for user specified time. |
| | State | Any logical pattern of channels 1, 2 and 3 (AUX 1 on TDS 520A/524A/620A) plus clock edge on channel 4 (AUX 2 on TDS 520A/524A/620A). Triggerable on positive or negative clock edge. |
| **Video** (Optional) NTSC, PAL, HDTV FlexFormat™ | | Trigger on a particular line of individual, 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. |

## MAXIMUM SAMPLE RATE

| | TDS 520A/524A | TDS 540A/544A | TDS 620A | TDS 640A/644A |
|---|---|---|---|---|
| Single Channel | 500 MS/s | 1 GS/s | 2 GS/s | 2 GS/s |
| Dual Channels | 250 MS/s | 500 MS/s | 2 GS/s | 2 GS/s |
| Four Channels | NA | 250 MS/s | NA | 2 GS/s |

## CONFIGURATION

| Feature | TDS 520A/540A TDS 620A/640A | TDS 524A/544A TDS 644A |
|---|---|---|
| Monitor | Mono | Color |
| VGA-out | Mono | Color |
| Floppy Drive | Optional | Standard |
| DSP Math | Optional | Standard |
| RS232 and Centronics | Optional | Standard |

## VERTICAL SYSTEM

**DC Gain Accuracy** – TDS 500A ±1.0%; TDS 600A ±1.5%.

**Vertical Resolution** – 8 bits (256 levels over 10.24 vertical divisions).

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

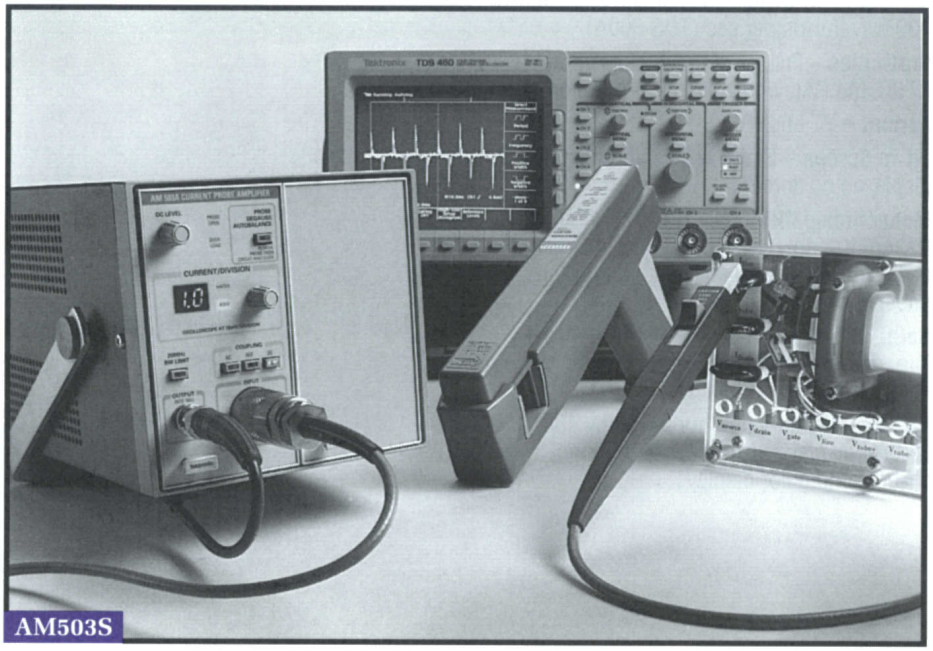
**Input Coupling** – AC, DC or GND.

**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 Volts/div settings.

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


AM503S

• ACCESSORY •

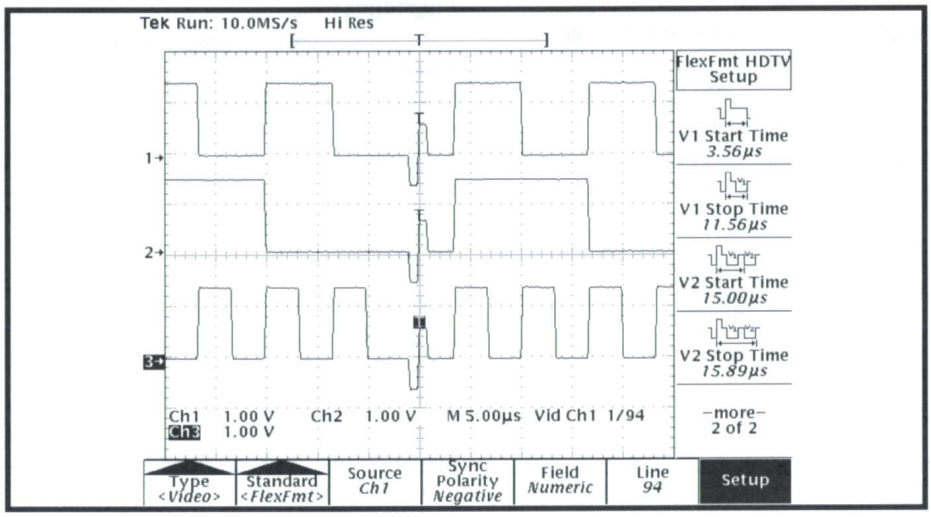
### Current Measurement Power

**AM503S**

- Simultaneous AC/DC broadband current measurement system.
- DC to 50 MHz (20A continuous/100A peak) with A6302 probe.
- DC to 15 MHz (100A continuous/500A peak) with A6303 probe.
- Clip onto conductor without having to break circuit.

*For complete selection information on all Accessory products, see page 424.*

# TDS 520A TDS 620A TDS 524A TDS 640A TDS 540A TDS 644A TDS 544A Digitizing Oscilloscopes




## ACQUISITION MODES

**Peak Detect** (TDS 500A only) – High frequency and random glitch capture. Captures glitches of 4 ns using acquisition hardware at all realtime 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** (TDS 500A only) – Vertical resolution improvement and noise reduction on low-frequency signals, e.g. 15 bits at 5 ms/div and slower.

## TRIGGERING SYSTEM

**Triggers** – Main, Delayed.

**Main Trigger Modes** – Auto, Normal, Single.

**Delayed Trigger** – Delay 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).

**FastFrame™** (TDS 500A only) – Segment acquisition memory into as many as 910 segments for trigger rates over 50,000 per second.

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

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

## DISPLAY

**Waveform Style** – Dots or vectors. Infinite and variable persistence selectable 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** (TDS 524A/544A/644A only) – With variable persistence selected, waveform points gradually decay through the color spectrum, providing historical information.

**Update Rate** – [For 500 point waveforms with infinite persistence display mode selected] 200 waveforms per sec (TDS 500A). 100 waveforms per sec (TDS 600A).

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

**Format** – YT and XY.

**Fit to Screen** – Entire acquisition memory displayed on screen.

**Monochrome CRT Type** (TDS 520A/540A/620A/640A only) – 7 in. diagonal, magnetic deflection. Horizontal raster-scan. P4 White phosphor.

**Color CRT Type** (TDS 524A/544A/644A) – 7 in. diagonal NuColor™ liquid crystal full-color shutter with 256 levels.

**CRT Resolution** – 640 horizontal by 480 vertical displayed pixels for both monochrome and color displays.

## 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 –**

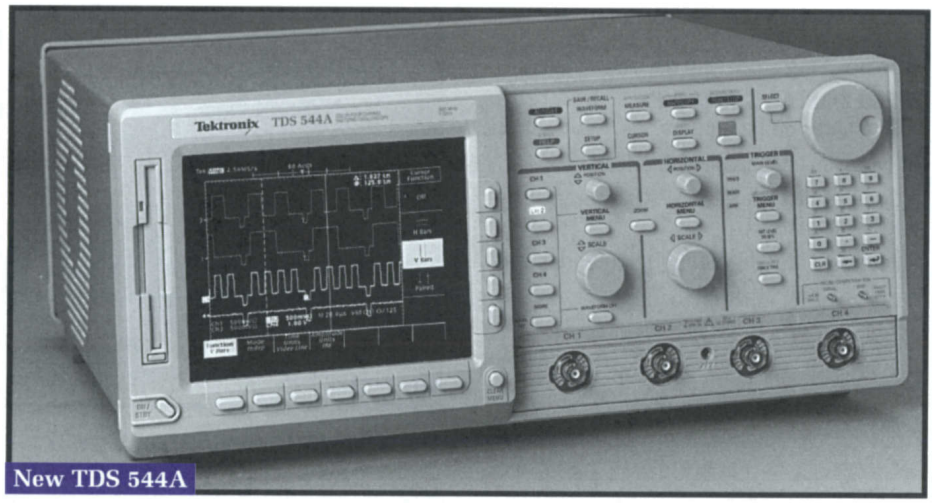
| | |
|---|---|
| Period | Frequency |
| High | Low |
| + Width | – Width |
| Maximum | Minimum |
| Rise | Fall |
| Peak to Peak | Amplitude |
| + Duty cycle | – Duty cycle |
| + Overshoot | – Overshoot |
| Propagation delay | Burst Width |
| Mean | Cycle Mean |
| RMS | Cycle RMS |
| Area | Cycle Area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

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

# Digitizing Oscilloscopes

**TDS 520A** **TDS 620A**
**TDS 524A** **TDS 640A**
**TDS 540A** **TDS 644A**
**TDS 544A**





New TDS 544A

### VERTICAL SYSTEM

**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; IRE and line number with video trigger option.

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

### WAVEFORM PROCESSING

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

**Advanced Waveform Functions** (Optional with TDS 520A/540A/620A/640A) – FFT, Integration, Differentiation.

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

**Arithmetic Operators** – Add, Subtract, Multiply, Divide, Invert.

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

**Waveform Limit Testing** – Compares incoming or math 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.

### HARD COPY/DESKTOP PUBLISHING

**Printer** – Tektronix Phaser, 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). (Centronics and RS-232 are optional with TDS 520A/540A/620A/640A.)

**Floppy Disk Drive** (Optional with TDS 520A/540A/620A/640A) – 3.5 in. 1.44 MB DOS format.

**VGA Output** – 15-Pin analog output. Color for TDS 524A/544A/644A and monochrome for TDS 520A/540A/620A/640A.

### STORAGE

**Waveforms** – (TDS 520A/524A/544A) 4 full 50,000 point records. (TDS 620A/640A/644A) 4 full 2000 point waveforms. 1,436 50K pt. waveforms to 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.

### POWER REQUIREMENTS

**Line Voltage Range** – 90 to 250 V RMS.

**Line Frequency** – 47 to 63 Hz.

**Power Consumption** – 300 Watts max.

### ENVIRONMENTAL AND SAFETY

**Temperature** – Operating: 0 to +50°C. Nonoperating: –40 to +75°C (with floppy drive +4 to +50°C).

**Humidity** – Operating and nonoperating: Up to 95% relative humidity at or below +40°C; to 75% relative humidity from +41 to +50°C. (With floppy drive: 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 J, Class A.

**Safety** – Listed UL 1244, certified to CAN/CSA – C 22.2 No. 231-M89.

### PROBES

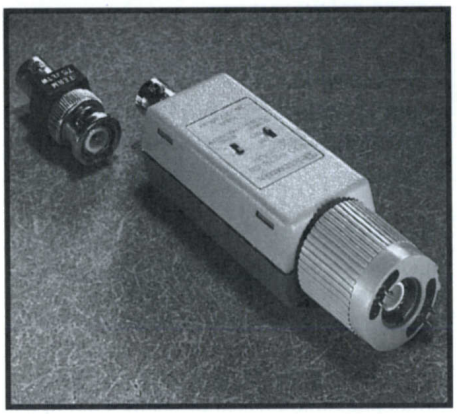
**P6205 Active Probe** – 10 x, 2 pF, 750 MHz FET (standard with TDS 600A).

**P6139A Passive Probe** – 10 x, 8 pF, 500 MHz (standard with TDS 500A).

### 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 |

# TDS 520A TDS 620A TDS 524A TDS 640A TDS 540A TDS 644A TDS 544A Digitizing Oscilloscopes



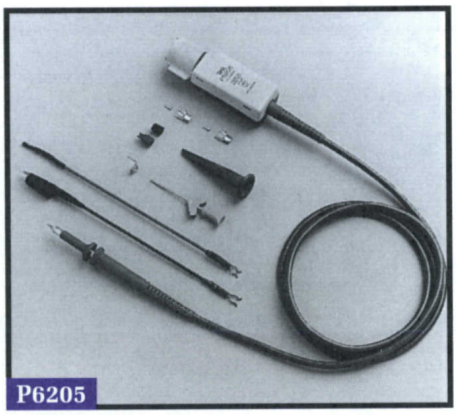
• ACCESSORY •

## Video Triggering Enhancement

**VIDEO DISPLAY CLAMP POD**

- Eliminates 60 Hz hum.
- Removes undesirable DC offsets.
- Compatible with NTSC, PAL, and most HDTV signals.
- For use with TDS 400/500/600 Series with Video Trigger (Opt. 05).

*For complete selection information on all Accessory products, see page 424.*




• ACCESSORY •

## Lower Circuit Under Test Loading

**P6205**

- FET Probe performance at a lower cost.
- <2 pF/1 MΩ provides lower circuit loading than conventional passive probes.
- Wide bandwidth (DC to 750 MHz)

*For complete selection information on all Accessory products, see page 424.*

## ORDERING INFORMATION

**TDS 520A**
2 channel Digitizing Oscilloscope ..... **$8,895**

**TDS 524A**
2 channel Color Digitizing Oscilloscope ..... **$10,895**

**TDS 540A**
4 channel Digitizing Oscilloscope ..... **$14,340**

**TDS 544A**
4 channel Color Digitizing Oscilloscope ..... **$16,790**

**TDS 500 includes:** Two ea P6139A Probes (TDS 520A/TDS 524A); four ea P6139A Probes (TDS 540A/TDS 544A); Quick Reference Guide (070-8711-01); User Manual (070-8710-01); Programmer's Manual (070-8709-01); Front Cover (200-3696-00); U.S. Power Cord (161-0230-01); Performance Verification (070-8712-01).

**TDS 620A**
2 channel Digitizing Oscilloscope ..... **$11,895**

**TDS 640A**
4 channel Digitizing Oscilloscope ..... **$17,550**

**TDS 644A**
4 channel Digitizing Oscilloscope ..... **$19,895**

**TDS 600A includes:** Two ea P6205 FET Probes (TDS 620A); four ea P6205 FET Probes (TDS 640A/644A); Quick Reference Guide (070-8711-01); User Manual (070-8715-01); Programmer's Manual (070-8709-01); Front Cover (200-3696-00); U.S. Power Cord (161-0203-01); Performance Verification (070-8717-01).

**Opt. 05** – Video Trigger, NTSC, PAL, HDTV, FlexFormat™ ... **+$1,495**
**Opt. 9C** – NIST and MIL-STD-45662A Calibration Certificate ... **+$125**
**Opt. 13** (TDS 520A/540A/620A/640A only) – RS-232C and Centronics Type Hardcopy Interfaces ..... **+$495**
**Opt. 1F** (TDS 520A/540A/620A/640A only) – Add 3.5 in. Floppy Disk Drive ..... **+$495**
**Opt. 1K** – K420 Scope Cart Without Power Strip ..... **+$695**
**Opt. 1M** – 50K Memory Length
TDS 520A/524A ..... **+$1,500**
TDS 540A/544A ..... **+$1,950**
**Opt. 1P** – HC100 Four Color Pen Plotter ..... **+$1,260**
**Opt. 1Q** – TDS Tutorial with Quickstart III (U.S. version) ..... **+$225**
**Opt. 1R** – Rackmount ..... **+$400**
**Opt. 2D** – Delete Two Each Standard Probes
TDS 520A/524A ..... **–$550**
TDS 620A ..... **–$990**
**Opt. 2F** (TDS 520A/540A/620A/640A only) – Extended Waveform Math, FFT, Integration, Differentiation ..... **+$995**
**Opt. 2P** (TDS 524A/544A/640A only) – Tektronix Phaser 200e Thermal Wax Transfer Color Printer ..... **+$3,695**
**Opt. 2Q** – TDS Tutorial with Quickstart III (Europe version) ... **+$225**
**Opt. 4D** – Delete Four Each Standard Probe
TDS 540A/544A ..... **–$1,100**
TDS 640A/644A ..... **–$1,980**
**Opt. 4P** – HC220 Canon BJ-10ex Bubble Jet Printer ..... **+$399**
**Includes:** Centronics Cable (012-1250-00).
**Opt. 22** (TDS 520A/524A only) – Two additional P6139A Probes ..... **+$550**
**Opt. 23** (All except TDS 640A/644A only) – Add Two Each P6205 Active Probes ..... **+$990**
**Opt. 24** (TDS 600A only) – Add Four Each P6139A Probes ... **+$1,100**
**Opt. 25** – Add P6563AS, Four SMD Probes ..... **+$790**
**Opt. B1** – Service Manual ..... **+$125**

**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1** – Universal Euro 220 V, 50 Hz ..... **NC**
**Opt. A2** – UK 240 V, 50 Hz ..... **NC**
**Opt. A3** – Australian 240 V, 50 Hz ..... **NC**
**Opt. A4** – North American 240 V, 60 Hz ..... **NC**
**Opt. A5** – Switzerland 220 V, 50 Hz ..... **NC**

See General Customer Information Section for additional description.

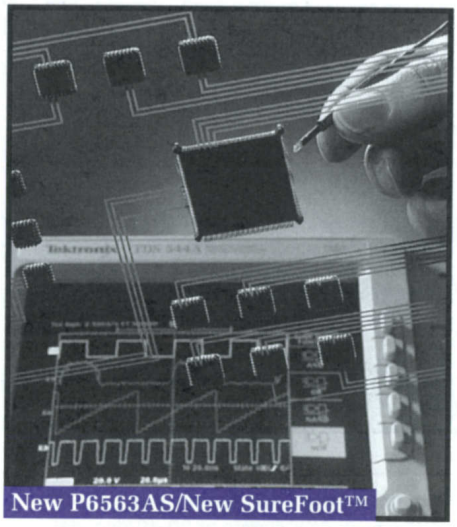
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GPIB IEEE-488 The TDS Series complies with IEEE, and with Tektronix Standard Codes and Formats.

# Digitizing Oscilloscopes

**TDS 520A** **TDS 620A**
**TDS 524A** **TDS 640A**
**TDS 540A** **TDS 644A**
**TDS 544A**




New P6563AS/New SureFoot™

• ACCESSORY •

## Direct Access to SMD Packages

**P6563AS**

- 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.

*For complete selection information on all Accessory products, see page 424.*

• ACCESSORY •

## Easier Access to SMT Circuitry

**SureFoot™**

- Handheld probing made easier.
- No shorting.
- No slipping off.
- Direct tip connection.

## ORDERING INFORMATION

**WARRANTY-PLUS SERVICE OPTIONS**
Three years warranty, covering all labor and parts, including CRT, and excluding probes.

**Opt. M2** – Repair Protection
TDS 520A ..... **+$595**
TDS 524A ..... **+$720**
TDS 540A ..... **+$750**
TDS 544A ..... **+$910**
TDS 620A ..... **+$710**
TDS 640A ..... **+$1,095**
TDS 644A ..... **+$1,190**

**Opt. M3** – Repair Protection Plus Calibration Service
TDS 520A ..... **+$780**
TDS 524A ..... **+$1,010**
TDS 540A ..... **+$995**
TDS 544A ..... **+$1,290**
TDS 620A ..... **+$975**
TDS 640A ..... **+$1,495**
TDS 644A ..... **+$1,620**

**Opt. M8** – Calibration Service
TDS 520A ..... **+$290**
TDS 524A ..... **+$360**
TDS 540A ..... **+$390**
TDS 544A ..... **+$480**
TDS 620A ..... **+$370**
TDS 640A ..... **+$575**
TDS 644A ..... **+$610**

**SOFTWARE**
**TDS Data Manager Software** – for TDS400, TDS500A, TDS600A and TDS800 Scopes with Manual. For use on RIC386 and 2402A controllers or other DOS computers that have a National Instruments PCII/PCIIA GPIB cards. Does not support National Instrument PC-AT or PC-MC GPIB cards.Order S34TDS1 ..... **$795**

**UPGRADES**
**DSP Math (FFT, Integration, Differentiation)** –
TDS5F2F (TDS 500/500A) ..... **$1,295**
TDS6F2F (TDS 600/600A) ..... **$1,295**

**RS 232/Centronics Hardcopy Ports** –
TDS5F13 (TDS 500/500A) ..... **$595**
TDS6F13 (TDS 600/600A) ..... **$595**

**3.5 in. Floppy Disk Drive** –
TDS5F1F (TDS 500A) ..... **$595**
TDS6F1F (TDS 600A) ..... **$595**

**HDTV Video Trigger** –
TDS5F05 (TDS 500A) ..... **$1,995**
TDS6F05 (TDS 600A) ..... **$1,995**

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

**PROBES**
**Active** – 750 MHz, 2 pF/1 MΩ, 1.5 m. Order P6205 ..... **$495**
**Differential** – 100 MHz, Active Differential, 6 ft. Order P6046 ..... **$2,295**
**Surface Mount Device** – 20X, 500 MHz, 5 pF/9.5 MΩ, 1.5 ft. Order P6563AS (four probe set) ..... **$790**
**High Voltage** –
100X, 120 MHz, 1500 V, 2.5 pF/10 MΩ, 9 ft. Order P6009 ..... **$270**
1000X, 75 MHz, 20 kV, 3.0 pF/100 MΩ, 10 ft. Order P6015A ..... **$950**
**General Purpose** –
1X, 15 MHz, 54 pF/1 MΩ, 2 m. Order P6101B ..... **$65**
10X, 500 MHz, 8.0 pF/10 MΩ, 1.3 m. Order P6139A ..... **$275**
**50 Ω Divider** – 50 Ω Inputs, 2 Tips: 10X, 100X. 10X: 3.5 GHz, 1 pF/500 Ω, 1.5 m; 100X: 3 GHz, 1.1 pF/5000 Ω, 1.5 m. Order P6156 with Opt. 25 ..... **$335**
**Logic** – 20 MHz, 17-Bit, Word Recognizer/Trigger. Order P6408 ..... **$500**
**Current** – (AC only), 120 Hz to 60 MHz, 7.5 A peak. Order P6021 ..... **$550**
(AC only), 935 kHz to 120 MHz, 3 A peak. Order P6022 ..... **$595**
(DC & AC), DC-50 MHz System. Includes AM503A, A6302 20A probe, TM502A. Order AM503S ..... **$2,745**
**Carts** – Order K420 ..... **$695**
**Plotter** – With GPIB and Centronics Type Interface. Order HC100 with Opt. 01 ..... **$1,260**
**Monochrome Printer** – With Centronics Type Interface. Order HC220 Canon Bubble Jet ..... **$349**
**Color Printer** – Order Phaser 200e ..... *1

**ADDITIONAL ACCESSORIES**
**Video Display Clamp** – Back porch clamp. Order 013-0278-00 ..... **$335**
**Power Strip** – Four Outlet, 6 ft., Noise/Surge Suppression. Order 131-5342-01 ..... **$45**
**Soft-sided Carrying Case**
TDS 500A,600A,800. Order 016-0909-00 ..... *1
With RIC386. Order 016-1095-00 ..... **$330**
**Transit Case** – With RIC386. Order 016-1135-00 ..... **$550**

*1 *Contact your Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

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

# TDS 420
# TDS 460

# Digitizing Oscilloscopes

*Ideal for digital, analog and video circuit design, electro-mechanical research, biomedical research and design, product service and manufacturing test.*

**TDS 420/TDS 460**

- 150 and 350 MHz bandwidths
- 100 MS/s Sampling Rate on 4 channels
- 15K records standard, 60K optional
- 8-Bit Vertical Resolution
- 10 ns Peak Detect Mode for Glitch Capture
- 25 Automatic Measurements
- Hi-Res Mode for up to 15-Bits of Single Shot Vertical Resolution

**NEW FEATURES**

- V2 Firmware
- Pass/Fail Waveform Testing
- Roll and Triggered Roll Modes
- RS-232 and Centronics Type Interfaces
- Expanded Measurement and Cursor Systems
- Extended Waveform Math Option (FFT)
- Tek Secure®

**APPLICATIONS**

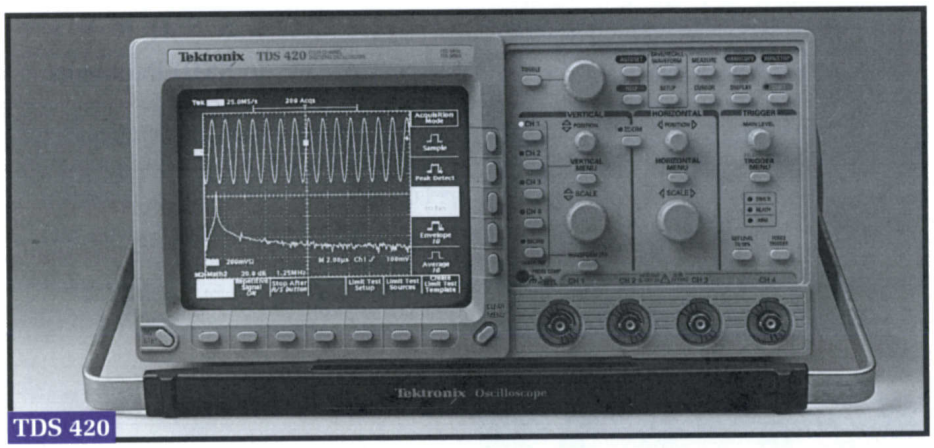
- Electromechanical System Design
- Manufacturing Test and Quality Control
- Medical/Biomedical Research
- Power Suppiy Design
- Product Service and Maintenance

TD

Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. 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.




TDS 420

*Now with V2 Firmware*

**SIGNAL ACQUISITION SYSTEM**

**Bandwidth** – 150 MHz (TDS 420), 350 MHz (TDS 460).

**Channels** – 4.

**Digitizers** – 4.

**Sample Rate** – 100 MS/sec on all channels.

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

**Position Range** – ±5 Divisions.

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

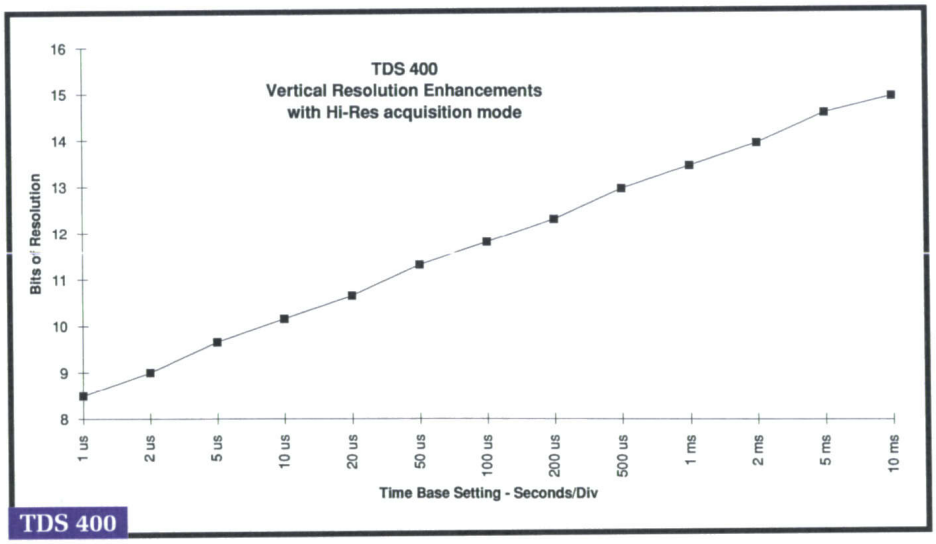
**Peak Detect** – High frequency and random glitch capture. Captures glitches of 10 ns using acquisition hardware at all realtime sampling rates.

**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.15-Bits at 10 ms/div and slower.




TDS 400

# Digitizing Oscilloscopes

## TDS 420
## TDS 460






*Shown with printer pack and advanced waveform options.*

**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 synch 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** – FFT, 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.

**HARD COPY/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** – 60,000 waveform points of non-volatile storage.

**Setups** – 10 front panel setups.

## • ACCESSORY •

### Differential Probing for Single-Ended Inputs

**P6406**
- DC to 100 MHz.
- Typical 10,000:1 CMRR at DC; derating 1,000:1 at 50 MHz.
- Differential 1X/10X attenuation.
- Use with 50 Ω or 1 MΩ systems.

*For complete selection information on all Accessory products, see page 424.*

*Continued on next page.*

# TDS 420
# TDS 460

# Digitizing Oscilloscopes

**CRT**

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

**Resolution** – 640 horizontal by 480 vertical displayed pixels.

**POWER REQUIREMENTS**

**Line Voltage Range** – 90 to 250 V RMS.

**Line Frequency** – 48 to 63 Hz.

**Power Consumption** – 240 Watts max.

**ENVIRONMENTAL & 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

**TDS 420**
Four channel Digitizing Oscilloscope ..... TD **$5,995**

**TDS 460**
Four Channel Digitizing Oscilloscope ..... TD **$7,495**
**Both include:** Two P6138 10X Passive Probes; Reference (070-8035-01); User Manual (070-8034-01); Programmer's Manual (070-8318-05); Performance Verification Document (070-8721-00); U.S. Power Cord (161-0230-01).

**Opt. 02** – Front Cover and Accessories Pouch ..... **+$60**
**Opt. 05** – VideoTrigger with Video Clamp Pod ..... TD **+$995**
**Opt. 13** – RS232 and Centronics Type Hardcopy Interfaces ..... TD **+$495**
**Opt. 1K** – K212 Scope Cart ..... **+$395**
**Opt. 1M** – 60,000 Point Record Length ..... **+$995**
**Opt. 1P** – HC100 4 Pen Color Plotter ..... **+$1,260**
**Opt. 1R** – Rack Mount ..... **+$350**
**Opt. 22** – Two Additional P6138 Probes ..... **+$370**
**Opt. 1T** – Transit Case ..... **+$550**
**Opt. 2A** – Video Trigger and 60,000 Point Record Length ..... **+$1,500**
**Opt. 2F** – Extended Waveform Math; FFT, Integration, Differentiation ..... **+$995**
**Opt. 3P** – Printer Pack with Thermal Printer and RS232 Centronics Type Interfaces ..... **+$695**
**Opt. 23** – Two P6205 FET Probes ..... **+$990**
**Opt. 25** – P6562AS – Four each SMD Probes ..... **+$740**
**Opt. 9C** – NIST and MIL-STD-45662A Calibration Certificate ..... **+$125**
**Opt. B1** – Module Level Service Manual ..... **+$125**

**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1** – Universal Euro 220 V, 50 Hz ..... **NC**
**Opt. A2** – UK 240 V, 50 Hz ..... **NC**
**Opt. A3** – Australian 240 V, 50 Hz ..... **NC**
**Opt. A4** – North American 240 V, 60 Hz ..... **NC**
**Opt. A5** – Switzerland 220 V, 50 Hz ..... **NC**
See General Customer Information Section for description.

**WARRANTY-PLUS SERVICE OPTIONS**
Three years warranty, covering all labor and parts, including CRT, and excluding probes.
**Opt. M2** – Repair Protection.
TDS 420 ..... **+$495**
TDS 460 ..... **+$545**
**Opt. M8** – Calibration Service.
TDS 420 ..... **+$290**
TDS 460 ..... **+$290**

**SOFTWARE**
**DocuWave™** – See page 64 ..... *1
**TDS Data Manager Software** – for TDS 400, TDS 500A, TDS 600A and TDS 800 Scopes with Manual. For use on RIC386 controllers or other DOS computers that have a National Instruments PCII/PCIIA GPIB cards. Does not support National Instrument PC-AT or PC-MC GPIB cards.
Order S34TDS1 ..... *1

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection.

**PROBES**
**Active** – 750 MHz, 2 pF/1 MΩ, 1.5 m. Order P6205 ..... **$495**
**Differential** –
100 MHz, Active Differential, 6 ft. Order P6046 ..... **$2,295**
**High Voltage** –
100X, 120 MHz, 1500 V, 2.5 pF/10 MΩ, 9 ft.
Order P6009 ..... **$270**
1000X, 75 MHz, 20 kV, 3.0 pF/100 MΩ, 10 ft.
Order P6015A ..... **$950**
**SMD** – 10X, 350 MHz. Four Probe Set. Order P6562AS ..... **$740**
**General Purpose** –
1X, 15 MHz, 54 pF/1 MΩ, 2m. Order P6101B ..... **$65**
10X, 350 MHz, 10.0 pF/10 MΩ, 1.3m. Order P6138 ..... **$185**
**50 Ω Divider** – 50 Ω Inputs, 2 Tips: 10X, 100X.
10X: 3.5 GHz, 1 pF/500 Ω, 1.5m 100X: 3 GHz,
1.1 pF/5000 Ω, 1.5m. Order P6156 with Opt. 25 ..... **$335**
**Logic** – 20 MHz, 17-Bit, Word Recognizer/Trigger.
Order P6408 ..... **$500**
**Current** –
(AC only), 120 Hz to 60 MHz, 7.5 A peak. Order P6021 ..... **$550**
(AC only), 935 Hz to 120 MHz, 3 A peak. Order P6022 ..... **$595**
(DC & AC), DC-50 MHz System, includes AM503A, A6302 20A probe. Order AM503S ..... **$2,745**
**Carts** – Order K212 ..... **$395**

**CAMERAS/HARD COPY DEVICE**
**Camera** – Order C9 with Opt. 1A and Opt. 04 ..... **$695**
**Hood Adapter** – Order 016-1154-00 ..... **$75**
**Plotter** – with GPIB and Centronics Type Interface.
Order HC100 with Opt. 01 ..... **$1,260**

**ADDITIONAL ACCESSORIES**
**Video Display Clamp** – Back parch clamp. Order 013-0278-00 ... **$335**
**Power Strip** – Four outlet, 6 ft., Noise/Surge Suppression. Order 131-5342-00 ..... **$45**
**Soft-sided Carrying Case** – Order 016-1158-01 ..... *1

*1 *Contact your Tektronix representative for price information.*

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.

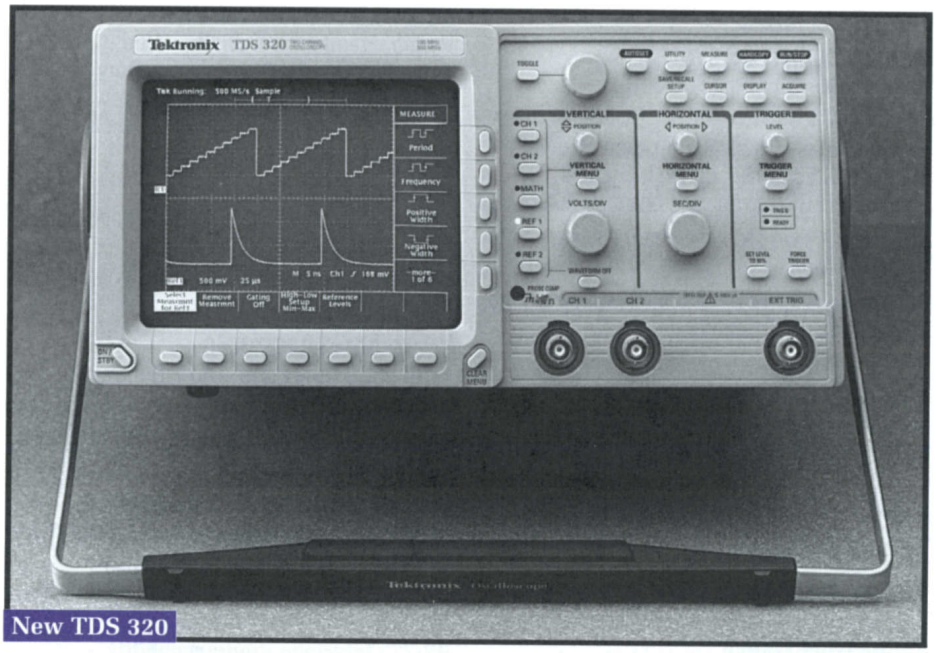
GPIB IEEE-488 The TDS Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Digitizing Oscilloscopes

## 50 MHz, 100 MHz, and 200 MHz Digital Real Time

**TDS 310*1**
**TDS 320**
**TDS 350*1**






New TDS 320

### Digital Real Time

With the introduction of the TDS 300 Series, Tektronix redefines the low-cost digital oscilloscope. By sampling the signal at five times the analog bandwidth (on both channels simultaneously), you can be assured of true acquisitions, free from 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 full bandwidth.

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. Similarly, Dot Accumulate highlights the current acquisition with bright dots. 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.

**1 Availability Pending, Contact your Tektronix Representative for complete information.*

### OVERSAMPLING ELIMINATES 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, 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 realtime, assuring users of accuracy up to the full bandwidth of the scope. This degree of oversampling not only eliminates 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 realtime 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 apparent noise in repetitive signals.

*Continued on next page.*

**TDS 310/ TDS 320/TDS 350**

- 50, 100 and 200 MHz Bandwidths
- 200 MS/sec (TDS 310) 500 MS/sec (TDS 320) 1 GS/sec (TDS 350) Sampling Rate
- Two Input Channels
- 2 mV/div – 10 V/div
- Option 14 Gives GPIB, RS-232 Programmability and Parallel Printer Interface
- 8-Bit Vertical Resolution
- 1K 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

*Acquire high speed transient or single-shot events to their full bandwidth.*

TD

Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.

GPIB IEEE-488

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

**TDS 310*1**
**TDS 320**
**TDS 350*1**

# Digitizing Oscilloscopes

## 50 MHz, 100 MHz, and 200 MHz Digital Real Time

**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 buttons and 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 interface simplifies scope operation without limiting the instrument's capabilities.

**ONE OPTION FOR BOTH COMPUTER INTERFACE AND PRINTER PORT**

Option 14, the communications option, includes both a GPIB and RS-232 I/O interface and a Centronics-type parallel printer port. With this option one can use a remote computer to control the scope for automated testing, or to exchange waveform or measurement data for documentation and analysis.

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

Option 3P, the Printer Pack, 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. Option 14 is included in Option 3P.

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

**1 Availability Pending, Contact your Tektronix Representative for complete information.*

### 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/sec 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 –**

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

**Horizontal Accuracy –** ±0.01%

**TRIGGERING SYSTEM (MAIN ONLY)**

**Trigger Types –** Edge, Video

**Trigger Modes –** Auto, Normal

**Video-Type Trigger Formats and Field Rates –** Triggers on Field 1, Field 2, or Lines; from sync-negative composite video, 525 to 625 lines, 50 MHz to 60 Hz, interlaced or noninterlaced systems, such as NTSC and PAL

**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 ∞) and superimposes the current waveform with bright dots

**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**

**Types –** Horizontal bars, vertical bars, paired (volts @ time)

**Measurements –** Absolute volts, Δ volts, time, and frequency

**WAVEFORM PROCESSING**

**Arithmetic Operators –** Add, Subtract

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

**OPT. 14 (I/O INTERFACE): COMPUTER INTERFACE AND HARD COPY 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

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

**Graphics 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

**NON-VOLATILE 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 Emissions –** 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

# Digitizing Oscilloscopes

## 50 MHz, 100 MHz, and 200 MHz Digital Real Time

**TDS 310*1**
**TDS 320**
**TDS 350*1**



### PHYSICAL CHARACTERISTICS

| | TDS 320/TDS 350 | | Rackmount | |
|---|---|---|---|---|
| **Dimensions** | **mm** | **in.** | **mm** | **in.** |
| Width w/ handle | 362 | 14.25 | 483 | 19 |
| Height w/ feet, pouch | 191 | 7.5 | | |
| w/o pouch | 165 | 6.5 | 178 | 7 |
| Depth (stand alone) | 471 | 18.6 | 472 | 18.6 |
| w/ front cover | 490 | 19.3 | | |
| w/ handle(s) | 564 | 22.2 | 517 | 20.4 |
| **Weight** | **kg** | **lb.** | **kg** | **lb.** |
| Stand alone | 6.8 | 15 | | |
| Net w/ accessories, cover and pouch | 8.4 | 18.5 | 4.5* | 10* |
| Domestic Shipping | 12.7 | 28 | 14.5 | 32 |

** Weight of conversion kit only.*

### • ACCESSORY •

**DOCUWAVE SOFTWARE (S60DWAV)**

- Easy to use – learn in less than 30 minutes.
- Sends, receives, saves waveforms/settings for Tektronix DSOs and Digitizers with GPIB or serial interfaces.
- Sends formatted waveforms to: printer, spreadsheet, desktop publishing software.

*See pages 64-66 for complete information on DocuWave™.*

*For complete selection information on all Accessory products, see page 424.*

### ORDERING INFORMATION

**TDS 310**
50 MHz, Two Channel Digitizing Oscilloscope ..... **$2,295*1**
**Includes:** Two each P6109B 10X Passive Probes; Instruction Manual (070-8568-02); Reference (070-8569-02); US Power Cord (161-0230-01) XYZs of Analog and Digital Oscilloscopes (070-8690-01)

**TDS 320**
100 MHz, Two Channel Digitizing Oscilloscope ..... TD **$2,895**
**Includes:** Two each P6109B 10X Passive Probes; Instruction Manual (070-8568-02); Reference (070-8569-02); US Power Cord (161-0230-01); XYZs of Analog and Digital Oscilloscopes (070-8690-01)

**TDS 350**
200 MHz, Two Channel Digitizing Oscilloscope ..... **$3,995*1**
**Includes:** Two each P6111B 10X Passive Probes; Instruction Manual (070-8568-02); Reference (070-8569-02); US Power Cord (161-0230-01); XYZs of Analog and Digital Oscilloscopes (070-8690-01)

**Opt. 14** – I/O Interface (includes GPIB interface, RS-232, and Centronics-type parallel port, plus Programmer Manual 070-8571-00) ..... TD **+$495**

**Opt. 3P** – Printer Pack (includes Option 14, Thermal Printer, Pouch, Cables for Printer)(Printer is shipped with a 120 V power module only; requires 6 VDC @ 2 A.) ..... TD **+$695**

**Opt. 4P** – Printer Pack (Includes Option 14, Thermal Printer, Pouch, Cables for Printer)(Printer is shipped with a 22V power module: requires 6 VDC @ 2 A.) ..... TD **+$695**

**Opt. 9C** – NIST and MIL-STD-45662A Calibration Certificate... **+$125**

**WARRANTY-PLUS SERVICE OPTIONS**
Three year warranty covering all labor and parts, excluding probes.

**Opt. M2** – Repair Protection
TDS 310 ..... **+$175**
TDS 320 ..... **+$225**
TDS 350 ..... **+$290**

**Opt. M3** – Repair Protection/Calibration Service
TDS 310 ..... **+$300**
TDS 320 ..... **+$385**
TDS 350 ..... **+$495**

**Opt. M8** – Calibration Service
TDS 310 ..... **+$178**
TDS 320 ..... **+$230**
TDS 350 ..... **+$290**

**SOFTWARE**
**DocuWave™** – See page 64. Order S60DWAV ..... ***2**

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

**PROBES**
**High Voltage** – Order P6009 ..... **$270**
1X Passive. Order P6101B ..... **$65**
1X-10X Switchable Passive. Order P6129B ..... **$100**
**TTL Logic** – Order P6408 ..... **$500**
**SMD** – Order P6561AS ..... **$350**
**DC/AC Current Probe System** – Order AM503S ..... **$2,745**
**Cart** – Order K212 ..... **$395**
**Camera** – C-9, Option 04, includes 016-1154-00 Hood. ..... **$650**
**Soft-sided Carrying Case** – Order 016-1158-00 ..... **$140**
**Deluxe Transit Case w/ Retractable Wheels/Handle** – Order 016-1157-00 ..... **$625**
**Carrying Case** – Order 016-0792-01 ..... **$455**
**Front Cover**– Order 200-3232-01 ..... **$10**
**Accessories Pouch** – Order 016-1159-00 ..... **$50**
**Rackmount Kit** – Order 016-1166-00 ..... **$400**
**I/O Interface Field Upgrade Kit** – Includes GPIB, RS-232, Centronics-type Parallel Port, and Programmer Manual. 016-1166-00. Order TDS3F14 ..... **$495**
**TVC 501 Time Interval to Voltage Converter** – Requires TM 500/TM 5000 Power Module Mainframe. Order TVC 501 ..... **$2,495**
**TDS4F5P Printer Pack** – With Thermal Printer (Printer is shipped with a 120 V US power module only; requires 6 VDC @ 2 A.) Order TDS4F5P ..... **$495**
**Cables, RS-232** –
To connect to a computer with a 9-Pin RS-232 connector, 2M. Order 012-1379-00 ..... **$80**
To connect to a computer with a 25-Pin RS-232 connector, 1M. Order 012-1380-00 ..... **$75**
To connect to a RS-232 printer or plotter, 9ft.. Order 012-1398-00 ..... **$37**

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

**1 Availability Pending. Contact your Tektronix Representative for complete information.*

**2 Contact your Tektronix representative for price information.*

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.

# Scope Data Management Software



*Makes publishing and archiving your waveform information simple.*

**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
- Graph Up to Four Waveforms on the PC Monitor with Cursors and Zoom

## DocuWave™ Software

New 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. Designed to be Windows friendly, 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 the GPIB or RS-232 interfaces
- Exports waveforms to be imported by analysis and spreadsheet programs
- Displays up to four waveforms with cursors and graphic zoom
- Sends waveforms 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.

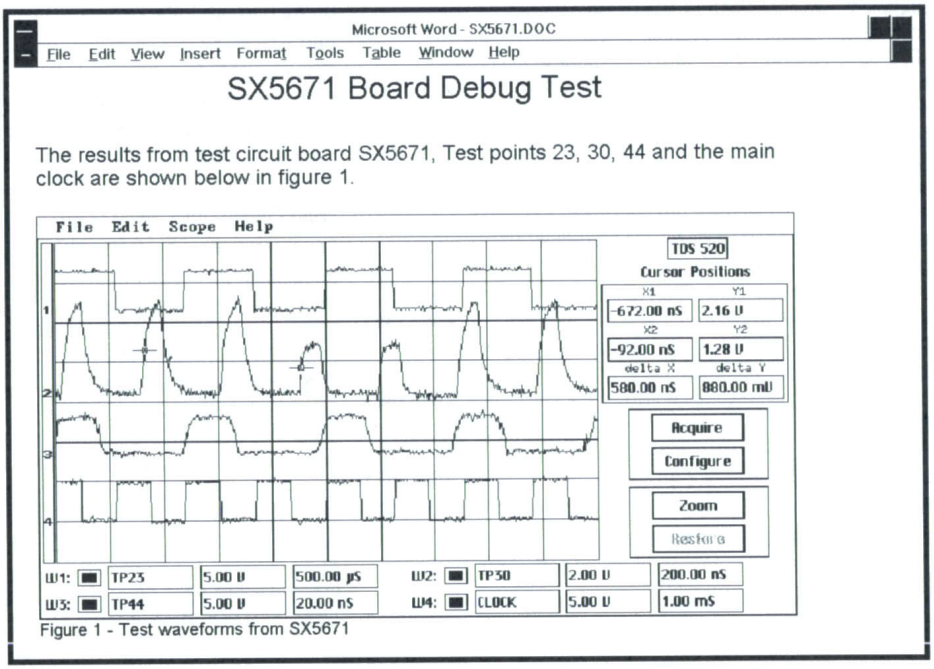


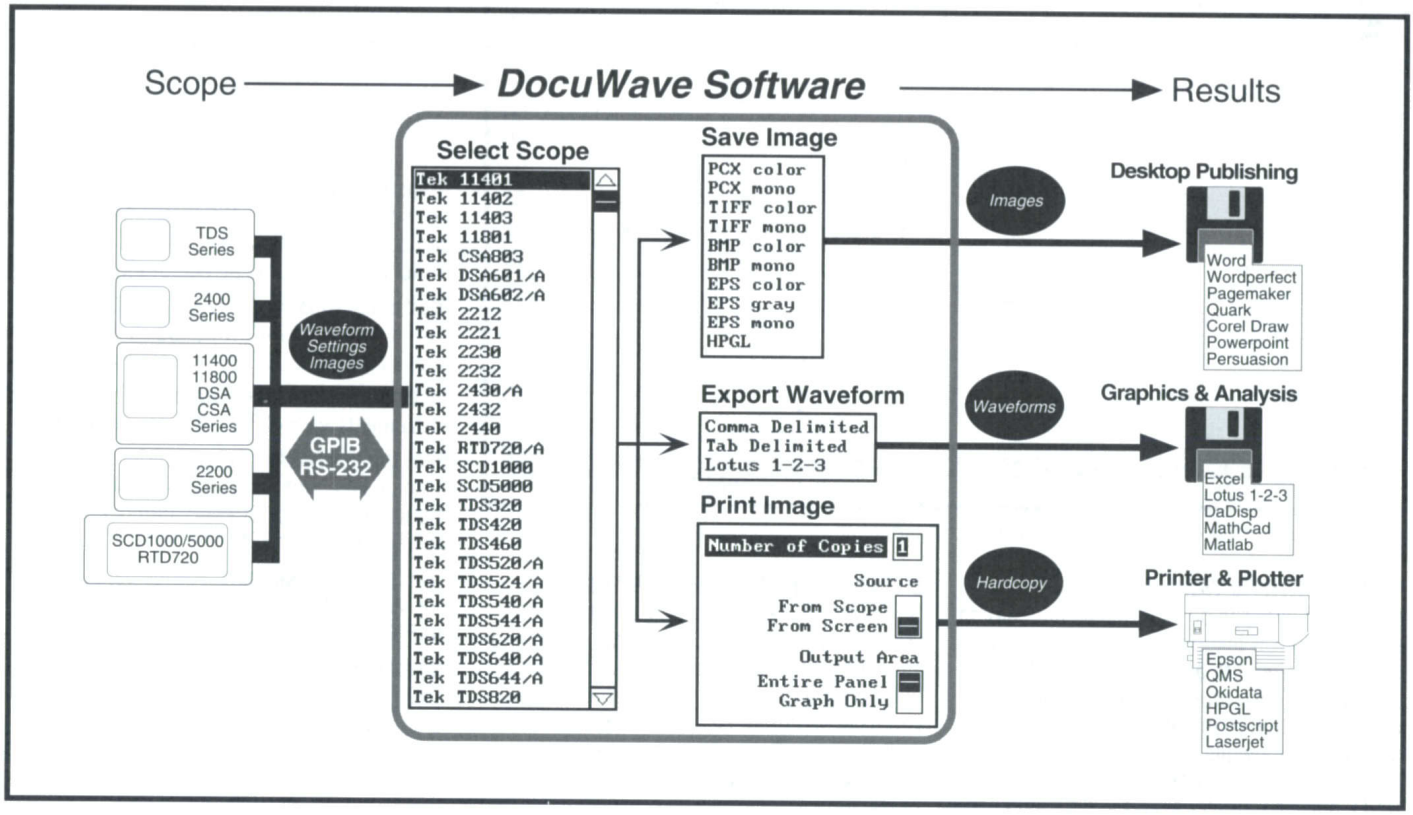
Figure 1 - Test waveforms from SX5671

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Scope Data Management Software

DocuWave™






**HARDCOPY THAT'S NOT HARD**

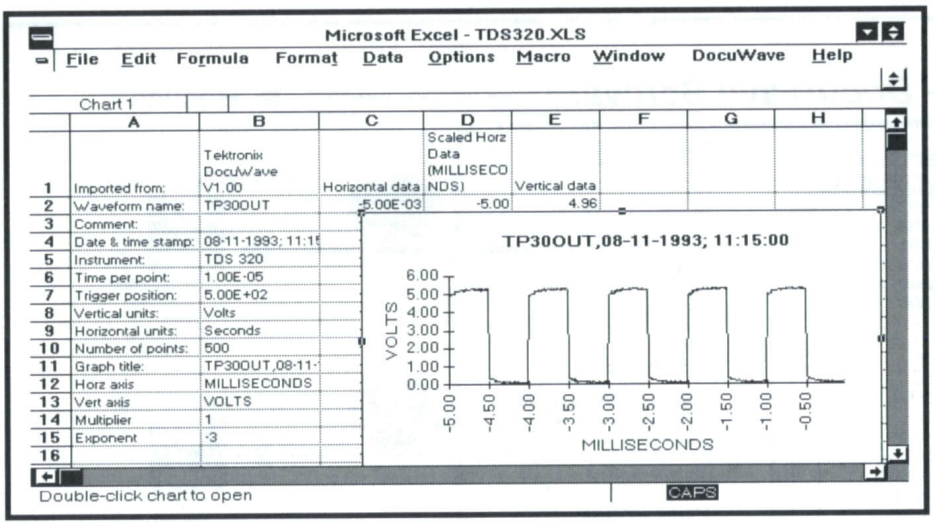
DocuWave can print to popular printers like Epson, Okidata, HP, NEC and plotters using the serial, parallel or GPIB port on your PC. If your scope has printer formats, you can also print the scope images through DocuWave.

**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 RS-232 interfaces are supported, you can select the instrument interface best suited for your application.

DocuWave™

# Scope Data Management Software




| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | Imported from: | Tektronix DocuWave V1.00 | Horizontal data | Scaled Horz Data (MILLISECONDS) | Vertical data | | | |
| 2 | Waveform name: | TP30OUT | -5.00E-03 | -5.00 | 4.96 | | | |
| 3 | Comment: | | | | | | | |
| 4 | Date & time stamp: | 08-11-1993; 11:15 | | | | | | |
| 5 | Instrument: | TDS 320 | | | | | | |
| 6 | Time per point: | 1.00E-05 | | | | | | |
| 7 | Trigger position: | 5.00E+02 | | | | | | |
| 8 | Vertical units: | Volts | | | | | | |
| 9 | Horizontal units: | Seconds | | | | | | |
| 10 | Number of points: | 500 | | | | | | |
| 11 | Graph title: | TP30OUT,08-11- | | | | | | |
| 12 | Horz axis | MILLISECONDS | | | | | | |
| 13 | Vert axis | VOLTS | | | | | | |
| 14 | Multiplier | 1 | | | | | | |
| 15 | Exponent | -3 | | | | | | |
| 16 | | | | | | | | |

*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 8 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 Tektronix 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, ≥500 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.

**Digital oscilloscopes support:** All TDS, 11400, 11800, DSA/CSA, 2400, & 2200 series scopes and RTD 720 & SCD series digitizers.

**Instrument interface support:** GPIB, National Instruments IEEE-488.2 interface and RS-232.

**Desktop publishing formats:** Monochrome & color TIFF, monochrome & color PCX, monochrome & color BMP, monochrome, greyscale & 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).

## ORDERING INFORMATION

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

**S60DWAV**
DocuWave software on 3.5 in. and 5.25 in. floppies with user manual. .....*1

**S60G210**
DocuWave software bundled with National Instruments PC GPIB IEEE 488.2 interface card. .....*1

**S60G220**
DocuWave software bundled with National Instruments AT GPIB IEEE 488.2 interface card. .....*1

*1 *Contact your Tektronix representative for price information.*

# 11000, DSA, CSA Series Digitizing Oscilloscopes

## 11000 Series

The Tektronix 11000 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. Multi-processor 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-232C or GPIB interfaces.

## DSA Series

The Digitizing Signal Analyzer (DSA) Series incorporates a dedicated digital signal processor (DSP) making it the most powerful instrument in the 11000 Series. The power of this new class of instrument is two-fold: It provides the fastest and most accurate real time digitizer and it provides signal processing capability previously found only in large computer systems. The dedicated DSP allows simultaneous real time FFT and time domain display, fast averaging at 180 waveforms/second, signal dejitter, and much more.

## 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 of the CSA 803A and CSA 404 include histograms, mask testing, and a color-graded display; allowing you to perform accurate measurements such as jitter, noise, and phase.

### 11000, DSA, CSA SERIES SELECTION GUIDE

| | | |
|---|---|---|
| **11400 Series** | High Accuracy | 11403A<br>11402A |
| **11800 Series** | High Bandwidth, High Resolution, High Accuracy | 11801B |
| **CSA Series** | High Speed, Digital/Optical, Communications, TDR (CSA 803A) | CSA 803A<br>CSA 404 |
| **DSA Series** | High Speed Single Shot w/DSP | DSA 601A<br>DSA 602A |

CONTENTS


**11000 SERIES OSCILLOSCOPES/PLUG-INS**

11402A 1 GHz Monochrome....74
11403A 3 GHz Color....74
11000/DSA Series Plug-in Amplifiers....80
11801B 12.5 to 50 GHz Digital Sampling....70
IPA310 Interconnect Parameter Analyzer....92
11801B/CSA 803A Sampling Heads....96

**DSA SERIES DIGITIZING SIGNAL ANALYZER**

DSA 602A 1 GHZ....70
DSA 601A 1 GHZ....70

**CSA SERIES COMMUNICATIONS SIGNAL ANALYZERS**

CSA 404 3 GHz Color....278
CSA 803A Up to 50 GHz Color....274
CSA 907A Bit Error Rate Tester....292

**ACCESSORIES**

Probes....425
SMD Adapters....450
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Plotter/Printer....496
Cameras....499
Instrumentation Carts....504

# 11000 Series DSA Series CSA Series High Performance Digitizing Oscilloscopes

*A technology for every application.*

*Power and flexibility through modular architecture.*

**11400A SERIES**
- 3 GHz Bandwidth
- 10-Bit Vertical Resolution
- Up to 12 Acquisition Channels
- Powerful Processing

**11801B**
- DC to 50 GHz Bandwidth (7 ps Risetime)
- 8 Channels, Expandable to 136
- Automatic Statistical Measurements, Histograms and Mask Testing

**DSA 600A SERIES**
- 1 GHz Bandwidth
- 2 GS/s Single Shot Acquisition
- Fast & Extensive Signal Processing

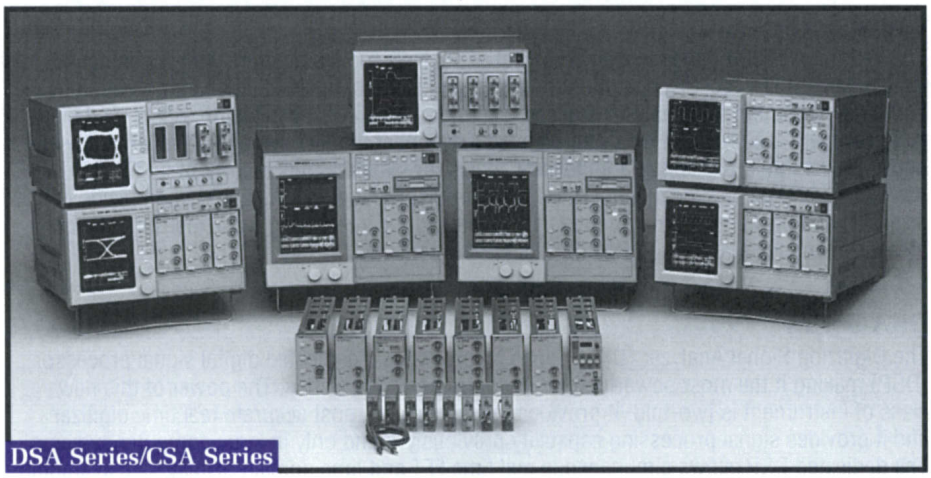
**CSA 404**
- Input Signal Conditioning
- 3 GHz Bandwidth

**CSA 803A**
- DC to 50 GHz Bandwidth (7 ps Risetime)
- High Resolution and Repeatability
- Automatic Statistical Analysis
- 38 Standard Communication MASKS
- 10 GHz Triggering
- TDR and FFT

**CSA 907A**
- SDH/SONET, FDDI Pattern Generation
- 150 kHz to 700 MHz Internal PLL Clock Source
- PRBS Patterns: $2^{(7,15,17,20,23)}-1$
- Optional 128K Bit Programmable Word Memory
- PC Based Frame Editing Software

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The 11000, DSA, CSA Series comply with IEEE Standard 488.1-1987, RS-232C, and with Tektronix Standard Codes and Formats.



DSA Series/CSA Series

## 11400A Series

The 11400A Series Digitizing Oscilloscopes use Random equivalent-time sampling technology to digitize and display repetitive signals with up to 14-Bit resolution and 1% vertical accuracy. Continuously updated measurements and statistics provide the confidence required in automated test environments.

## 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 11000 Series.

## DSA 600A Series

Providing real-time digitizing at 2 GS/s, the Digitizing Signal Analyzers are the most powerful members of the 11000 Series. These instruments contain a dedicated digital signal processor that processes waveforms at unprecedented speeds.

The DSA offers live FFT, signal dejitter, fast averaging at more than 180 waveforms per second, and more. For the highest level of performance in single-shot acquisition and signal processing, the DSA Series provides the measurement solution.

## CSA 404 and CSA 803A

The CSA 404 and CSA 803A Communications Signal Analyzers are designed for viewing communication signals up to 3 GHz and 50 GHz respectively.

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 analysis 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).

## CSA 907A

The CSA 907A Bit Error Rate Tester is a stimulus-response system that features a highspeed serial pattern generator, the CSA 907A TX, and a companion error detector, the CSA 907A Rx. Each unit is portable, and can be used in a lab, production testing, or field environment. The CSA 907A Bit Error Rate Tester can be used to evaluate transmission quality of high speed modules and systems for a variety of testing applications including SDH/SONET, FDDI, and satellite communications.

## Accuracy

Measurement accuracy sets the 11000 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 11000 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 11000 Series provides worry-free and effortless automatic internal calibration of the instrument. The instruments continually monitor themselves for accuracy.

# High Performance Digitizing Oscilloscopes





## Flexibility and Power

The 11000 Series continues the plug-in versatility of the Tektronix 7000 Series. 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 11000 Series of oscilloscopes offer more versatility than any other oscilloscope. No other oscilloscope can provide the performance, accuracy, sensitivity, bandwidth, filtering, offset, or overdrive recovery of the 11000 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 (up to 32K points in the DSA 600A) 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 DSA 600A Series uses the Tektronix TriStar Digital Signal Processor (DSP). These processors provide unsurpassed signal acquisition and analysis. This not only yields very fast waveform update rates, but also provides the power to define and display, at "live" speeds new waveforms based on complex mathematical relationships to other waveforms. Nowhere else will you find this power and flexibility.

The CSA 803A and CSA 404 offer 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 11000 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 10 different signal processing options are available. The DSA 600A Series with its TriStar Digital Signal Processor provides 14 different options; including averaging at 180 waveforms per second, signal 2, "live" FFT, and single-shot smoothing.

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

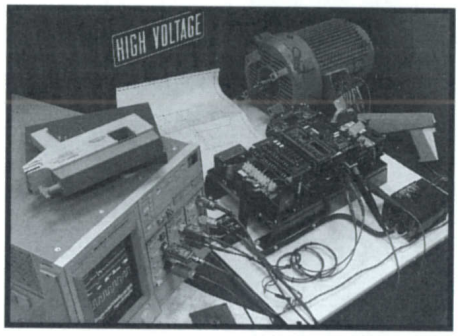
## Automation

Each 11000 Series Oscilloscope provides both RS-232C and IEEE 488 Standard interfaces. The 11000 Series provides ideal solutions both for low-cost benchtop automation and for rackmount production applications.

Tektronix offers several compatible software packages to support the 11000 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.

## Hard Copy Support

You can also print date and time stamped 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.




### 11000 SERIES SELECTION GUIDE

| Instrument | Bandwidth | Maximum # of Channels | Sample Rate | Maximum Record Length | Vertical Resolution | Digitizing Technology |
|---|---|---|---|---|---|---|
| DSA 601A | 1 GHz | 1 to 8 | 1 GS/s | 20K | 8-Bits | Real Time |
| DSA 602A | 1 GHz | 1 to 8 | 2 GS/s | 3K | 8-Bits | |
| 11801B | 50 GHz | 136 | 200 kS/s | 5K | 8-Bits | Sequential |
| CSA 803A | 50 GHz | 4 | 200 kS/s | 5K | 8-Bits | Equivalent Time |
| 11403A/CSA 404 | 3 GHz | 1 to 8 | 20 MS/s | 10K | 10-Bits | Random |
| 11402A | 1 GHz | 1 to 8 | 20 MS/s | 10K | 10-Bits | Equivalent Time |

• ACCESSORY •

## Voltage times Current = Power

**A6302/A6303/P6135A**

- Capture current with the A6302 or A6303 and an 11A16.
- Capture voltage with a P6135A pair combined with an 11A33.

*For complete selection information on all Accessory products, see page 424.*

# DSA 601A
# DSA 602A

# Digitizing Signal Analyzers

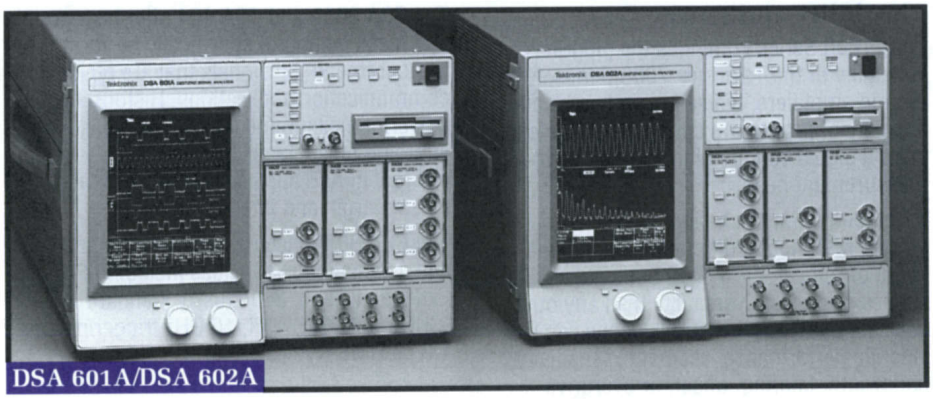
*The DSA 600A Series Analyzers provide the ultimate combination of signal acquisition, processing and display performance for repetitive and highspeed transient-capture applications.*

**DSA 601A/602A**

- 1 GHz Bandwidth
- 1 mV/Div to 10 V/Div
- 2 GS/s Sampling Rate
- 150 MHz Differential Amp
- 50 MHz Current Amplifier
- Multi-Standard Video Trigger
- Bandwidth and Number of Channels are Based on Amplifier Selected
- Operating Mode and Amplifiers Selected Determine Number of Channels that can be Acquired

**APPLICATIONS**

- Research
- Design & Debug
- Characterization
- Automated Testing


DSA 601A/DSA 602A

## DSA 601A and DSA 602A

The DSA 600A Series Digitizing Signal Analyzers provide the ultimate combination of signal acquisition, processing and display performance for repetitive and high-speed transient-capture applications. The DSA 600A Series Digitizing Signal Analyzers provide the ultimate combination of signal acquisition, processing and display performance for repetitive and high-speed transient-capture applications.

Their 1 GHz bandwidth, 2 GS/s single-shot sample rate, long waveform memory, 1 to 8 channel versatility and superb amplifier performance capture events with unsurpassed accuracy. Sophisticated signal processing features transform and combine signals to reveal key phenomena at visually live speeds. The DSA often replaces combinations of instruments through its plug-in flexibility and high-speed signal processing and display features.

In research applications, the DSA provides the bandwidth, sample rate and signal fidelity necessary to deliver accurate results. Signal processing features such as FFT and histograms present the data in the most revealing formats. For circuit design and system debugging, the sophisticated trigger system quickly isolates anomalies such as runt pulses, metastable logic states, setup/hold time violations, and slew-rate errors.

In sequential event applications such as pulsed-laser, radar and ultrasonics, partitioned, non-volatile memory captures each event for further analysis. Display-scan events from memory to find and analyze significant features or examine statistics of the entire collection to determine trends. Transport publication-ready results with the built-in floppy disk.

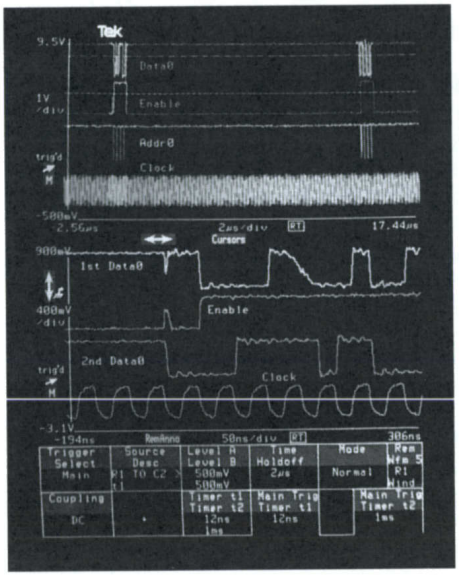



*Figure 1. Isolate setup/hold time violations, metastable states and glitches quickly with time-qualified triggering. Apply the window time base to zoom in for more details. Signal paths are time-matched to probe tips for accuracy.*

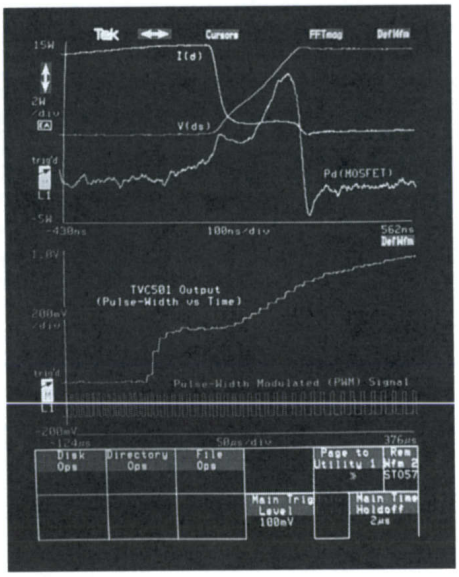



*Figure 2. Capture periodic or transient current and voltage signals and accurately compute instantaneous power. Apply FFT to examine harmonics or switching noise. The TVC 501 directly demodulates pulse-by-pulse PWM.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The DSA Series complies with IEEE Standard 488.1-1987, RS-232C, and with Tektronix Standard Codes and Formats.

# Digitizing Signal Analyzers





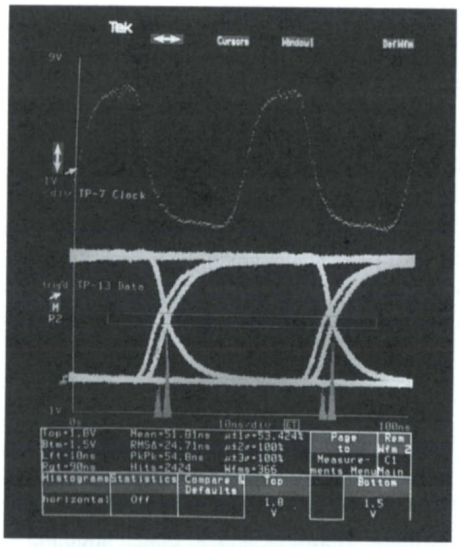



*Figure 3. Analyze digital communications using variable persistence display modes. View in X-Y format for constellation display. Apply horizontal or vertical histograms to analyze jitter. Use cross-correlation for accurate propagation time measurements in extreme-noise environments.*

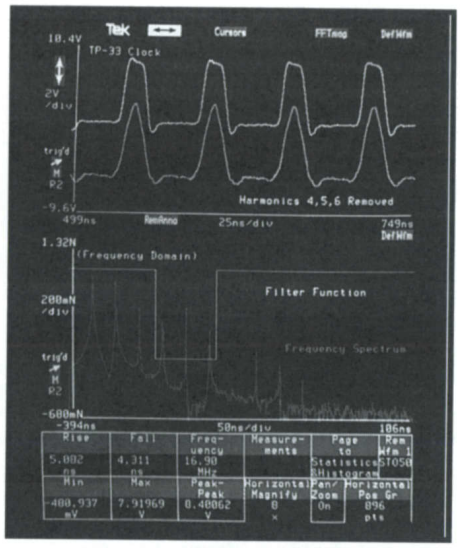



*Figure 4. Apply signal processing to perform simulations. Edit the frequency spectrum of a live signal by multiplying its FFT by a filter function. Transform the result back to time-domain using IFFT and see the effects of the digital filter on the live signal. Convolution is also available for filtering.*

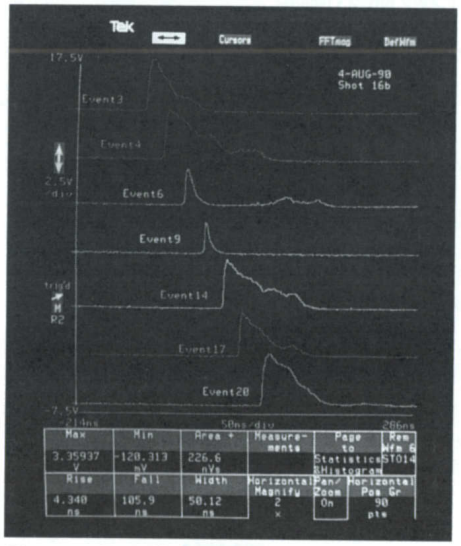



*Figure 5. Rapidly capture a sequence of transient events and store them in non-volatile memory. Scan for significant events and apply measurements to individual waveforms or the entire collection. Annotate, hardcopy and transport publication-ready results on 1.44M MS-DOS compatible floppy disk.*

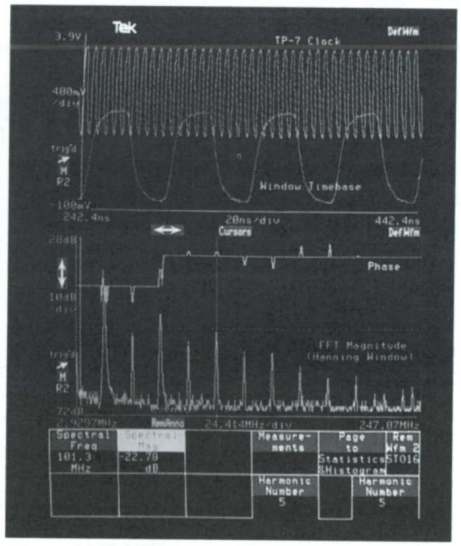



*Figure 6. Simultaneously view time and frequency-domain displays of signals at live speeds. Apply harmonic or peak-search cursors for efficient, high-accuracy readout of spectral magnitudes and frequencies. Display magnitude and phase information for repetitive or transient events.*

**QUICKSTART TRAINING PACKAGE**
QuickStart contains application examples, and is a complete and portable training package. It can serve several users for thorough self-study or as a quick, easy reference.

The package comes complete with the QuickStart board, workbook, board reference, and power plug. This package is available to purchasers at no additional charge.

## Characteristics

**VERTICAL SYSTEM**

**Delta DC Volt Accuracy** – ≤1% for an 8-division signal.

**Vertical Resolution** – 8-Bits. Resolution can be increased to 14-Bits with signal averaging or smoothing.

**Bandwidth** – To 1 GHz. Determined by the plug-in used. See page 78.

**Wide Dynamic Range** – 1 mV/div to 10 V/div.

**HORIZONTAL SYSTEM**

**Time Bases (Main and Window)**

**Sweep Speeds** – 50 ps/div to 100 s/div.

**Record duration** – 512 ps to 1024 s in 1-2-5 sequence.

**Time Base Accuracy** – +0.005%, –0.015%: 0 to 45°C. ±0.005% 20° to 30°.

**Record Length** – DSA 601A: 512 to 20,480 pts (single shot); 512 to 32,768 pts (repetitive); DSA 602A: 512 to 32,768 pts (both single shot and repetitive).

**Sampling Rate** – DSA 601A: 1 GS/s max; DSA 602A: 2 GS/s max.

**Main Record Positioning** – The main record is positioned with respect to the main trigger point. At maximum pretrigger, all points except the last point in the main record precede the trigger point. At maximum post trigger, all points except the first point in the main record follow the trigger point.

**Window Time Base** – The main record plus two window records may be acquired and displayed. The window records may be different lengths and can have a different time/div than the main record.

**Window Record Positioning** – The window records may be positioned with respect to their own trigger points on the main record. Window triggers may be delayed from the main trigger by time or events.

**Multi-Trace Pan and Zoom** – Multiple traces may be panned and zoomed simultaneously.

**Display Interpolation** – Zoomed waveforms can be displayed using either sin (x)/x or linear interpolation, or using a dots-only display without any interpolation.

*Continued on next page.*

# DSA 601A
# DSA 602A

# Digitizing Signal Analyzers

**Waveform Memory –** More than 210K points of volatile memory shared between acquired and stored waveforms.

**Settings Memory –** Nonvolatile memory for approximately five settings.

**TRIGGERING SYSTEM**

**Range –** ±Full Screen.

**Bandwidth –** 1 GHz max: 500 MHz for extended triggering.

**Coupling and Sensitivity –** DC Coupled: 0.4 div from DC to 10 MHz, increasing to 1 div at maximum trigger bandwidth.

DC Noise Reject Coupled: 1.2 divs from DC to 10 MHz, increasing to 3 divs at maximum trigger bandwidth.

DC HF Reject Coupled: 0.5 divs from DC to 30 kHz.

AC Coupled: 0.4 div from 60 Hz to 10 MHz, increasing to 1 div at maximum trigger bandwidth.

AC Noise Reject Coupled: 1.2 divs from 60 Hz to 10 MHz, increasing to 3 divs at max trigger bandwidth.

AC HF Reject Coupled: 0.5 div from 60 Hz to 30 kHz.

AC LF Reject Coupled: 0.5 div from 80 kHz to 10 MHz, increasing to 1 div at max trigger bandwidth.

**Holdoff Range –** Main record min: 2 µs or less; max: 500 s. Window Record min: 35 ns; max: 1000 s.

**WAVEFORM PROCESSING**

**Waveform Functions –** Absolute value, average (exponential & summation), convolution, correlation, delay, dejitter, differentiate, envelope, exponential, FFT filter, IFFT integrate, interpolate, logarithm, natural log, pulse, signum, smooth, and square root. Live waveforms can be changed by using adjustable parameters.

**Arithmetic Operators –** Add, subtract, multiply, and divide.

**FFT –** Magnitude and phase; real and imaginary; inverse FFT, correlation, and convolution; six window functions; typical noise floor: –60 dB; –70 dB with averaging.

**Act on Delta –** Save, repeat, chime, SRQ, and hardcopy.

**Histograms –** Vertical or horizontal histograms generated from a user-defined portion of any waveform. Statistical information is provided for histogram data.

**MEASUREMENT SYSTEM**

**Amplitude –** Min, max, mid, mean, p-p, gain, RMS, overshoot, undershoot, area +, area –, and energy.

**Timing –** Rise, fall, width, delay, main-to-window trigger time, period, propagation delay, cross, phase, frequency, duty cycle, and skew.

**FFT –** Fundamental track, harmonic amplitude, frequency, and total harmonic distortion.

**Statistics –** Available for any measurement listed above for both live acquisitions and groups of stored waveforms.

**Cursors –** Single or dual dots, split or paired mode, horizontal and vertical bars, and measurement-zone delimiters. Delta volts, delta time, 1/delta time, and slope.

**INPUT/OUTPUT SYSTEM**

**Ports –** Centronics, GPIB, and RS-232C ports standards. Fully GPIB and RS-232C programmable.

**Data Transfer Rates –** Up to 100 waveforms per second. Up to 60 measurements per second.

**DISK DRIVE**

One 3.5 inch microfloppy disk drive, 1.44 MB or 720 KB formatted capacity, depending on disk used. MS-DOS compatible formatting.

**CRT AND DISPLAY FEATURES**

**CRT –** 10 in. diagonal, color, magnetic deflection. Vertical raster-scan orientation.

**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 72 Hz.

**Maximum Power Consumption –** DSA 601A: 465 W max; DSA 602A: 585 W max.

**ENVIRONMENTAL AND SAFETY**

**Temperature:** (Mainframe) – Operating: 0° to +45°C. Nonoperating: –40° to +75°C.

**Disk Drive –** Operating: 5° to +45°C. Nonoperating: –22° to +60°C

**Humidity:** (Mainframe) – Operating and Nonoperating: Up to 95% relative humidity; up to +45°C.

**Disk Drive –** Operating: Up to 80% relative humidity; up to +30°C. Nonoperating: Up to 90% relative humidity; up to +40°C.

**Altitude, Vibration, Shock, Bench Handling –** Operating and Nonoperating: meets MIL-T-28800C, Type III, Class 5.

**Electromagnetic Compatibility –** Referenced to MIL-STD-461B. Meets FCC part 15, subpart J, class A. Meets VDE 0871/6.78 for Class "B."

**Safety –** Listed UL 1244; Certified to CSA-C22.2 No. 231-M89.

## PHYSICAL CHARACTERISTICS

| | Benchtop | | Rackmount | |
|---|---|---|---|---|
| **Dimensions** | **mm** | **in.** | **mm** | **in.** |
| Width | 457 | 18.0 | 482 | 19.0 |
| Height | 328 | 12.9 | 311 | 12.3 |
| Depth | 678 | 26.7 | 678 | 26.7 |
| **Weight≈** | **kg** | **lb.** | **kg** | **lb.** |
| Net | | | | |
| DSA 601A | 30.9 | 68.0 | 36.7 | 81.0 |
| DSA 602A | 32.7 | 72.0 | 38.6 | 85.0 |
| Shipping (domestic) | | | | |
| DSA 601A | 48.5 | 107.0 | 55.3 | 122.0 |
| DSA 602A | 49.4 | 109.0 | 56.7 | 125.0 |

## SINGLE-SHOT ACQUISITIONS

| | DSA 601A | | DSA 602A | | |
|---|---|---|---|---|---|
| **Sample Rate** | **500 MS/s** | **1 GS/s** | **500 MS/s** | **1 GS/s** | **2 GS/s** |
| **Number of Channels** | 2 | 1 | 4 | 2 | 1 |
| **Time Resolution** | 2 ns | 1 ns | 2 ns | 1 ns | 500 ps |
| **Record Length** | 512 to 10K pts | 512 to 20K pts | 512 to 10K pts | 512 to 20K pts | 512 to 32K pts |

# Digitizing Signal Analyzers



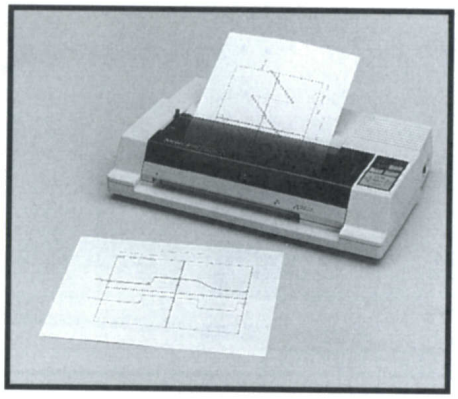
• ACCESSORY •

## Low Cost, Four Color Plotting

**HC100**

- Compatible with GPIB, RS-232, Centronic 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 424.*



## ORDERING INFORMATION

**DSA 601A**
Digitizing Signal Analyzer ..... **$27,000**
**Includes:** Tutorial Manual (070-7249-01), User Reference (070-7250-01), Programmer Ref. (070-7251-01), Command Ref. (070-7252-02), Service Reference (070-7254-01), Compact (3.5 mm) Probe Tip-to-BNC Adapter (013-0226-00), Power Cord, U.S., 120 V (161-0066-00).

**DSA 602A**
Digitizing Signal Analyzer ..... **$32,635**
**Includes:** Same as DSA 601A.

**Opt. 1C** – Cable Feedthrough Connectors. ..... **+$200**
**Opt. 1R** – Rackmount ..... **+$300**
**Opt. 4C** – Non-Volatile RAM. Adds over 450,000 points of non-volatile storage ..... **+$1,500**
**Opt. 1P** – HC100 Four-Color Plotter with Opt. 01 ..... **+$1,260**

**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1** – Universal Euro 220 V, 50 Hz ..... **NC**
**Opt. A2** – United Kingdom 240 V, 50 Hz ..... **NC**
**Opt. A3** – Australian 240 V, 50 Hz ..... **NC**
**Opt. A4** – North American 240 V, 60 Hz ..... **NC**
**Opt. A5** – Switzerland 220 V, 50 Hz ..... **NC**
See General Customer Information Section for additional description.

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M7** – Calibration Service
DSA 601A ..... **+$1,085**
DSA 602A ..... **+$1,350**
**Opt. M9** – Repair Protection
DSA 601A ..... **+$800**
DSA 602A ..... **+$1,000**

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

**PROBES**
**Passive Probe (1 MΩ input) –**
400 MHz, 11.3 pF/10 MΩ, 1.5 m
(11A32, 11A33, 11A34 only). Order P6134C ..... **$230**
6 MHz, 105 pF/1 MΩ, 6 ft.;
200 MHz, 14 pF/10 MΩ, 6 ft.
(11A32, 11A33, 11A34 only). Order P6063B ..... **$340**

**50Ω Divider (Zo) Probe Set –**
**Includes:** 3.5 GHz, 1 pF/500Ω, 10X; 3 GHz, 1.1 pF/5000Ω, 100X; 1.5 m. Order P6156 Opt. 25 ..... **$335**
**Bias-Offset Probe** – 10X, 1.5 GHz, 1.6 pF/500 Ω; 1.5 m. Order P6231 ..... **$750**
**Active Probes –**
10X, 750 MHz, 2 pF/1 MΩ, 1.5 m. Order P6205 ..... **$495**
10X, 1 GHz, 1.9 pF/10 MΩ, 1.5 m. Order P6204 ..... **$1,550**
10X, 4 GHz, 0.4 pF/100 kΩ, 1 m. Order P6217 ..... **$3,495**
**Differential Probe –**
10X, 150 MHz Differential Pair, 1.5 m. (11A33 only) Order P6135A ..... **$750**
FET 1X/10X, DC – 100 MHz, 1000:1 CMRR. Order P6046 ..... **$2,295**
**Current Probe** – (11A16 only)
DC – 50 MHz, 0-20 A (DC + peak AC). Order A6302 ..... **$795**
DC – 15 MHz, 0-100 A (DC + peak AC). Order A6303 ..... **$1,435**
25 kHz – 1 GHz, 0.7 A peak pulse. Order CT-1 ..... **$295**
**Optical-to-Electrical Converters**
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
**Cart** – Order K475 ..... **$895**
**Power Strip** – Four Outlet, 6 ft., Noise/Surge Suppression. Order 131-5342-01 ..... **$45**
**Cables –**
GPIB, 2 m. Order 012-0630-00 ..... *1
GPIB, 2 m. Order 012-0991-00 ..... TD **$170**
RS-232C, 10 ft. Order 012-0911-00 ..... **$100**
Centronics, 10 ft. Order 012-0555-00 ..... *1
**Blank Panels** – Plug-in. Order 016-0829-00 ..... **$195**

**CAMERA/HARD COPY OUTPUT PRINTER**
**Pen Plotter** – Four Color. Order HC100 with Opt. 01 ..... **$1,260**
**Camera** – Order C9 with Opt. 11 ..... **$660**
**Printer** – Monochrome, Cannon BJ-10EX Bubble Jet. Order HC220 ..... **$349**

**1 Contact your Tektronix representative for price information.*
**2 See page 283 for complete selection information.*

TD
Product available within 24 hours through TekDirect
Call 1-800-426-2200.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488
The DSA 601A/602A complies with IEEE Standard 488.1-1987, RS-232C, and with Tektronix Standard Codes and Formats.

# 11403A
# 11402A

# Digitizing Oscilloscopes
## 3 GHz

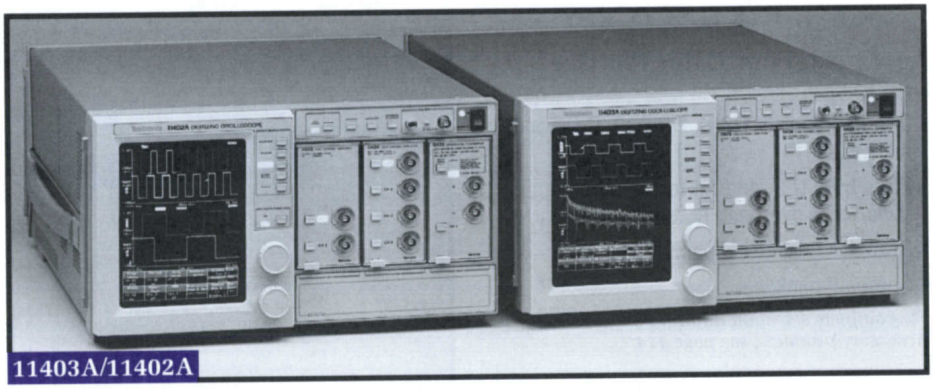
*The 11400 Series combine high bandwidth and exceptional accuracy with excellent vertical and horizontal resolution.*

**11403A/11402A**

- 3 GHz Bandwidth
- 2 GHz Trigger Bandwidth
- 10-Bit Vertical Resolution, 14-Bits with Averaging
- Acquire Up to Six Channels at 1 GHz Concurrently
- Deskew Nulls Out Channel Timing Differences – Including Probes
- Internal Calibration Capability for a Vertical Error of 1% or Less
- Bandwidth and Number of Channels are Based on Amplifiers Selected
- Operating Mode and Amplifiers Selected Determine Number of Channels that can be Acquired

**APPLICATIONS**

- Device Characterization
- Power Supply Design
- Production Testing



11403A/11402A

### 11403A and 11402A

The Tektronix 11400 Digitizing Oscilloscope Series is as much a milestone in oscilloscope simplicity as it is in oscilloscope performance. It lets you concentrate on the measurement, without having to understand the internal operation of an oscilloscope.

The 11400 Series are fully programmable oscilloscopes whose dual time bases, 10 ps horizontal resolution and 10-Bit vertical resolution – up to 14-Bit with averaging – help redefine the standards of oscilloscope accuracy. Now with the introduction of the 11403A, the standard is higher than ever. It now offers even more convenience and power with built-in FFT, automatic Pass/Fail testing, and measurements on multiple waveforms.

The 11400 Series approach to user interfaces promises more thorough analysis in fewer steps. The touch screen, intuitive menu system, one-button autoset, sequencing capability and large waveform display let you think more about the measurement and less about how the oscilloscope works.

Controls are grouped around the display screen to minimize distractions. Most controls are built into a menu system on the touch screen. Touch the "Define Waveform" icon, for example, to get selections for averaging, differentiation, integration, envelope, signum, smoothing, and square root.

Select a trace, a trigger, a measurement or other function just by touching the appropriate area of the screen or by selecting from the menus. As your selection changes, the functions of the two front panel knobs change accordingly – to let you set time per division, set record lengths, or zoom and pan around a digitized record.

Even with eight traces, the update rate is faster than that of other digitizing oscilloscopes.

Press the Autoset button and the oscilloscope will autoset on a signal vertically and horizontally, and obtain a stable trigger. You can get a triggered display of either multiple cycles or a rising edge without knowing anything about the signal. Or, assign the IDENT button on the oscilloscopes probes to initiate an autoset or to sequence through a series of stored test setups – your hands and eyes never leave the job.

If accuracy is the bottom line in your application, the 11400 Series Oscilloscopes are clearly the instruments to consider first.

### 11403A/11402A APPLICATIONS

| | |
|---|---|
| **Device Characterization** | With precision equivalent-time sampling of repetitive signals and unsurpassed accuracy and repeatability, these oscilloscopes are ideal tools for the component engineer and device designer. |
| **Power Supply Design** | With AC coupling, fast overdrive recovery, high vertical resolution, and one-touch measurements, these oscilloscopes are an excellent choice for power supply design. 11000 Series plug-in amplifiers have a wide range of calibrated offset, and can recover quickly from up to 8000 divisions of overdrive. The new 11A16 Current Amplifier plug-in gives direct reading of current and its deskew capabilities allow high accuracy instantaneous power calculations using the waveform processing capabilities of the 11403A and 11402A. |
| **Production Testing** | High accuracy, full programmability, the flexibility and performance of 11000 Series plug-ins, and fast ATE throughput give the production test user significant cost savings. Speed manual adjustment of circuit performance with the Pass/Fail testing feature. Coupled with the multiple waveform measurement capabilities, the Pass/Fail testing feature makes the 11400 a stand-alone testing system. |

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The 11403A, 11402A complies with IEEE Standard 488.1-1987, RS-232C, and with Tektronix Standard Codes and Formats.

# Digitizing Oscilloscopes
## 3 GHz

**11403A**
**11402A**

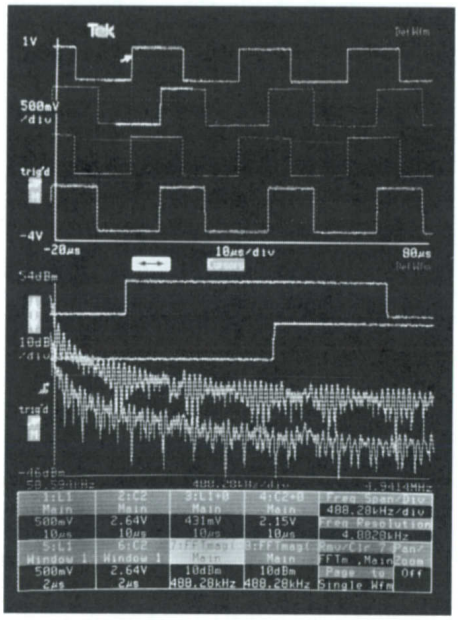



*Figure 1. FFT display and measurements in the 11403A offer additional analysis power to the engineer or scientist.*

## Acquisition & Analysis Power

From the engineering bench to the production line, the 11403A and 11402A give you the power to acquire, measure, process and output waveforms with a standard of accuracy exclusive to the 11400 Series.

The 11403A has a full-color display that let you easily distinguish between multiple waveforms. Main waveforms are displayed in up to four different colors, with one additional color designated for window waveforms. The 11402A has a high-resolution monochrome display for large, sharp view of your signals.

Equipped with three plug-in compartments and dual time bases, the 11403A and 11402A can continuously acquire and display 8 signals from up to 12 input channels. Dual time bases permit simultaneous capture and display of up to two window records for each main record acquired. Main and window records in the 11400 oscilloscopes are analogous to main sweep and delayed sweep acquisitions in analog oscilloscopes. Window acquisitions can be positioned anywhere within the main record and allow detailed analysis of critical areas of the main waveform.

The 11403A and 11402A incorporate extensive triggering capabilities including selectable AC or DC coupling, AC or DC noise reject, as well as high and low frequency reject. Pretrigger or posttrigger details can be viewed on the main trace. 2 GHz trigger bandwidth (11A81) lets you trigger on extremely fast transitions.

### THE USER INTERFACE

The 11403A and 11402A's comprehensive analysis functions, and instrument controls – including plug-ins and probes – are accessible to the user through a minimum of front panel buttons, two user-assignable control knobs, and an easy-to-operate, touch-screen interface.

### ADVANCED ANALYSIS WITHOUT DELAY

"Live" update of the display and waveform measurement parameters lets you observe phenomena as they occur, and allows complex mathematical transformations and functions to be applied to the acquired data in near real time.

Advanced waveform calculations such as differentiation, integration, square root, logarithm, and absolute value are available at the touch of an on-screen selector. No more waiting for results while an external pro-cessor works on the acquired data. All measurements and calculations are continuously updated as the instrument acquires the signal.

Built-in statistical analysis capability lets you get a better picture of how a signal varies over time – providing min, max, mean, and standard deviation for all selected measurements. Dedicated digital signal processing hardware provides acquisition enhancement functions such as averaging and smoothing to selectively remove noise from the display, giving you visibility into the true behavior of circuits and devices never before seen without extensive delayed signal processing.

The 11403A offers additional analysis power beyond the 11402A. It adds FFT display and measurements – a useful tool for the design engineer and scientist. You can create FFT magnitude or phase displays of the acquired waveform and use the automatic Spectral Frequency, Spectral Magnitude, and THD (Total Harmonic Distortion) measurements for a complete analysis of your signals.

### MEASUREMENT SYSTEM

The 11403A and 11402A offer one of the most comprehensive sets of automatic measurements available today. All measurements can be programmed over the GPIB or RS-232C interfaces, eliminating operator error and enhancing test repeatability.

The 11403A and 11402A measurement system is especially useful in automated test applications where the oscilloscope can acquire waveforms, make the measurements, and report the results to the host controller. Measurement results can be processed more rapidly and use much less memory space than the raw waveform data.

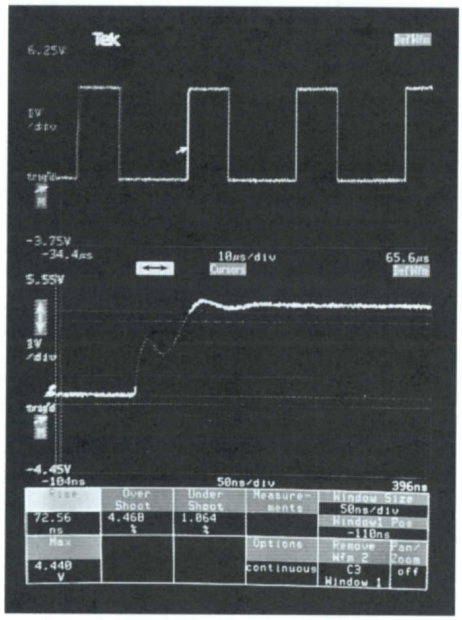



*Figure 2. In the Annotation Mode, horizontal cursor bars and highlighting serve to focus your attention on the portion of the waveform being measured.*

### ANNOTATIONS

All of the 11403A and 11402A measurements are fully annotated to clearly identify the portion of the waveform being measured, and to show the locations of the measurement thresholds (see Figure 2). The measured portion of the waveform is highlighted and horizontal and vertical lines are used to track the upper and lower limits of the measured portion, and the 10% as well as 90% values.

All critical measurement limits are easily adjusted and displayed in the measurement pop-up menus. For example, if you want rise time measurements from 20% to 80% instead of from 10% to 90%, you simply set these levels with the control knobs, or with an on-screen numeric key pad. Values can be set in relative (percent) or absolute terms.

*Continued on next page.*

# Digitizing Oscilloscopes
## 3 GHz



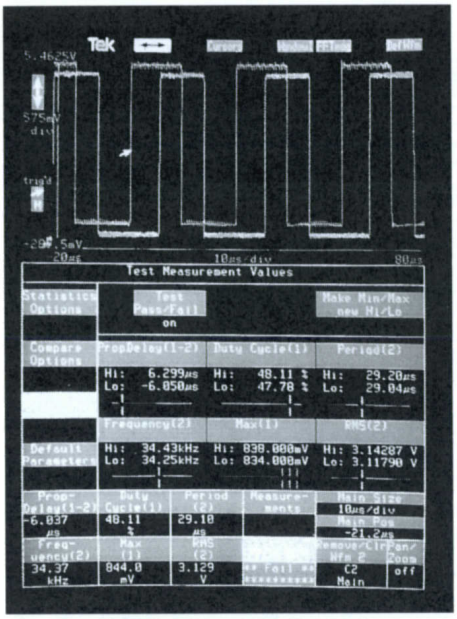



*Figure 3. Pass/Fail testing offers a fast, easy method of adjusting circuit operation or sorting parts in production applications.*

### PASS/FAIL TESTING

Both the 11403A and 11402A offer Pass/Fail testing on measurements. ATE and production test applications can use Pass/Fail testing to speed throughput and simplify circuit adjustment. Maximum and minimum limits are set for each active measurement, then the instrument gives indication of whether the signals Pass or Fail. A horizontal scale with a vertical bar serves as visual indication of where the measurement fell between the set limits. If the test failed, the scale indicates whether the signal was high or low.

### MULTIPLE WAVEFORM MEASUREMENTS

Adding to the capabilities of the 11403A and 11402A measurement system is the ability to make any measurement on any waveform. You can assign measurements to specific waveforms, use the same measurement for several waveforms, and have the results all on one display. For example, you could measure the skew on all four outputs of a buffer simultaneously. When you combine multiple waveform measurements with Pass/Fail testing, you can greatly simplify production testing and circuit adjustment.

### PLUG-IN MODULARITY

The 11403A and 11402A are equipped to handle up to three 11000 Series plug-ins. (For a list of plug-ins and characteristics, see page 78.) Several plug-ins are available, offering a range of bandwidths, channels, and input impedances to choose from. Plug-in installation is a simple matter of sliding each unit into place. Plug-ins are controlled through the mainframe, either from the touch screen interface, or via the IEEE 488 or RS-232C.

### RECORD LENGTH

Record length is selectable from 512 to 10,240 points, providing the ability to capture and analyze repetitive events in high detail.

### WAVEFORM MEMORY AND NONVOLATILE STORAGE

The standard 11403A and 11402A are equipped with 512K of volatile waveform acquisition and display memory, and 128K 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.

For users who require additional memory, Option 2D adds an additional 768K of non-volatile memory for storage of waveforms and settings. This provides a total of 896K of non-volatile memory – enough for approximately 450 waveforms of 1K point record length.

### DOCUMENTATION

Documenting your results with the 11403A and 11402A is as easy as pressing one button. HARDCOPY sends a high-resolution copy of the current screen, complete with label and time and date stamp, through your choice of a standard Centronics parallel printer, RS-232C, or GPIB port to any compatible printer or plotter – including the Tektronix 4696 and 4693D color printers, and HC100 color plotter (see Figure 4).

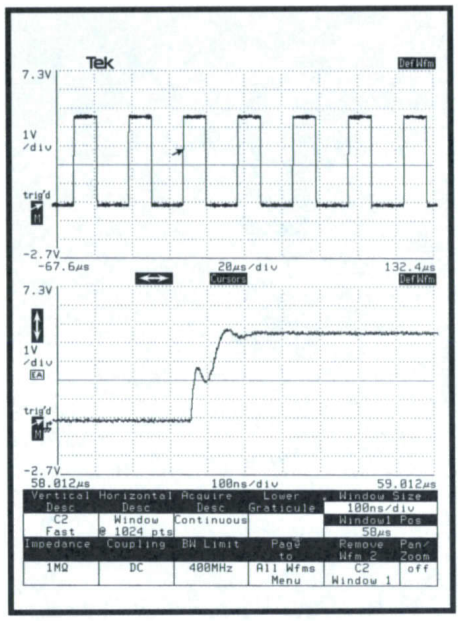



*Figure 4. 11400 hardcopy output.*

## Applications

### DEVICE CHARACTERIZATION

The 11403A and 11402A are designed for precision, equivalent-time sampling of repetitive signals. Their unsurpassed accuracy and repeatability make them the ideal tools for the component engineer and device designer.

Dual built-in time bases allow windowing for detailed timing analysis of devices. Time A to B measurements can be made with 200 ps resolution single shot, or 10 ps resolution with repetitive acquisitions. Multiple signal acquisition and display eliminates the need to multiplex channels, and allows you to see cause and effect relationships on the same screen. For critical applications, the 10-Bit vertical resolution can be increased to 14 Bits with averaging.

The 11403A offers a unique level of analysis power when Option 1S, Statistical Database Analysis Package, is added. With this option, the 11403A can make direct jitter and noise measurements on your incoming signals. It builds up a history – a statistical database – of acquisitions and provides histograms, measurements, special color graded displays, and mask testing options which allow you to more fully characterize and analyze your circuitry than ever before. These techniques are excellent for analyzing random data such as computer bus data streams, making timing analysis on digital signals, and characterizing metastability. And the color display of the 11403A lets you easily distinguish among multiple waveforms.

# Digitizing Oscilloscopes

## 3 GHz

**11403A**
**11402A**



### POWER SUPPLY DESIGN

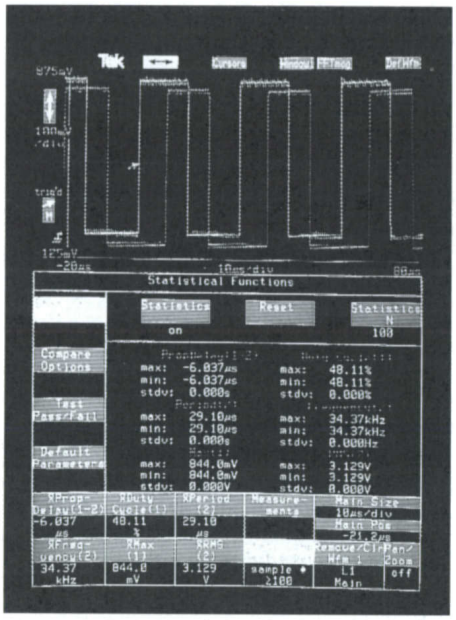
The 11403A and 11402A with 11000 Series plug-ins provide AC coupling, fast overdrive recovery, high vertical resolution, and one-touch measurements; making this combination an ideal tool for power supply design. 11000 Series plug-in amplifiers have a wide range of calibrated offset, and are unsurpassed in their ability to recover quickly from up to 8000 divisions* of overdrive.

The 11403A and 11402A can extend the sensitivity and offset of the plug-ins by increasing their normal 10-Bit vertical resolution to 14-Bits with high-precision averaging. With this kind of resolution, and the 11A33 Differential Comparator plug-in, small signals riding on larger signal swings or high DC voltages (such as ripple and noise) can be easily spotted and isolated. The 11A16 current amplifier provides AC + DC current measurement with scaled and calibrated results. Directly measure current waveforms or multiply voltage and current to create an instantaneous power trace. Time deskew at the probe tips eliminates phase errors between voltage and current traces, maintaining accuracy even on fast switching transitions.

### PRODUCTION TESTING

ATE and production test users reap many benefits from the 11403A and 11402A. Full programmability and commands optimized for fast operation ensure the highest throughput in ATE applications. Flexibility of configuration and high performance of 11000 Series plug-ins mean a production testing system can be tailored to fit your needs today – and expanded tomorrow as your needs change and grow. Special features like Pass/Fail testing, multiple waveform measurements, and a full range of automatic measurements give the 11403A and 11402A the ability to perform many more functions than ordinary oscilloscopes and can even replace other test equipment. The high accuracy of the 11403A and 11402A provides an extra margin of safety for your tests, and their fast measurements reduce test times which saves you money.

**With an 11A33.*




### STATISTICAL ANALYSIS

Statistical analysis of measurements provides maximum, minimum, mean, and standard deviation for up to six measurements at once. This feature is useful for statistical quality control, ATE test development, and device characterization.

## Characteristics

### VERTICAL SYSTEM WITH ENHANCED ACCURACY:

**ΔVDC Accuracy –** ≤1% for an 8-division signal.

**Absolute DC Accuracy –** ≤0.6% when using full scale of the plug-in offset range.

ENHANCED ACCURACY automatically expires when the instrument temperature changes by approximately ±5°C from the temperature of the last calibration. Even if the ENHANCED ACCURACY is not renewed, the accuracy typically remains ≤2%.

11000 Series Probes can be included in calibration. The instrument will prompt you to connect the probes to the CALIBRATOR.

**Vertical Resolution –** 10-Bits (1024 levels). Resolution can be increased to 14-Bits (16384 levels) with signal averaging.

**Equivalent-Time Bandwidth –** 3 GHz max determined by plug-in. See page 78.

### HORIZONTAL SYSTEM

**Time Bases –** Two identical, independent, built-in time bases.

**Record Duration –** 5.11 ns to 1024 s in 1-2-5 sequence.

**Time Base Accuracy –** 100 ps +0.002% of measurement interval.

**Record Length –** 512, 1024, 2048, 4096, 5120, 8192, and 10240 points.

**Sampling Rate –** 20 MS/s max. (single-shot)

**Main Record Positioning –** The main record is positioned with respect to the main trigger point. Pretrigger: One record duration
Posttrigger: One record duration
Resolution: One main record point

*Continued on next page.*

# Digitizing Oscilloscopes
## 3 GHz



**Windows –** The main record plus two window records can be acquired and displayed. The window records can be of a different length (duration) and can have a shorter time/div than the main record. If two window records are used, they have the same duration and time/div settings, but can be positioned independently.

**Window Record Positioning –** The window records are positioned relative to a window trigger point which can be delayed by either time or events relative to the main record's trigger point.

**Main-to-Window Trigger Time Measurements –** The time between the Main record trigger and the Window trigger can be measured precisely, even if each trigger only occurs once. Repetitive events allow this measurement to be averaged for better resolution and accuracy.
Single Trigger Resolution: 200 ps
Repetitive Resolution: 10 ps with averaging
Accuracy: 250 ps +0.002% of measured interval.

**TRIGGERING SYSTEM**
**Range –** ± Full Scale.

**Main Trigger, Coupling and Sensitivity:**
**Jitter** (Typical, CSA 404 only) – 10 ps RMS; 70 ps peak-to-peak.

**DC Coupled –** 0.5 div from DC to 50 MHz; 1.5 div from 50 MHz to 1 GHz.*1

**Noise Reject Coupled –** 1.2 div or less from DC to 50 MHz; 3 div from 50 MHz to 1GHz.*1

**AC Coupled –** 0.5 div from 60 Hz to 50 MHz; 1.5 div from 50 MHz to 1 GHz.*1 Attenuates signals below 60 Hz.

**HF Reject Coupled –** 0.65 div from DC to 30 kHz.

**LF Reject Coupled –** 0.65 div from 80 kHz to 50 MHz; 1.5 div from 50 MHz to 1 GHz.*1

**Window Trigger, Coupling and Sensitivity:**
**DC Coupled –** 0.5 div from DC to 50 MHz; 1.5 div from 50 MHz to 500 MHz.*1

*Note: Using the 11A81 External Trigger Input provides ≥2GHz trigger Bandwidth*

**Noise Reject Coupled –** 1.2 div or less from DC to 50 MHz; 3 div from 50 MHz to 500 MHz.*1

**AC Coupled –** 0.5 div from 60 Hz to 50 MHz; 1.5 div from 50 MHz to 500 MHz.*1 Attenuates signals below 60 Hz.

**HF Reject Coupled –** 0.65 div from DC to 30 kHz.

**LF Reject Coupled –** 0.65 div from 80 kHz to 50 MHz; 1.5 div from 50 MHz to 500 MHz.*1

**Holdoff Range:**
**Main Record –** Min: 490 ns; max: 10 s.

**Window Record –** Min: 20 ns; max: 811 s.

**MEASUREMENT SYSTEM**
**Waveform Processing Functions:**
**Waveform Functions –** Differentiate, integrate, interpolate, smooth, average, envelope, square root, signum, logarithm, natural log, absolute value, and exponential.

**Arithmetic Operators –** Add, subtract, multiply, divide.

**MEASUREMENT SET**
**Amplitude –** Min, max, mid, mean, gain, p-p, undershoot, overshoot, amplitude, noise*2, extinction ratio, and RMS.

**Timing –** Rise, fall, width, delay, main-to-window trigger time, phase, period, duty cycle, skew, jitter*2, propagation delay, cross, and frequency.

**Area and Energy –** Area +, area –, and energy.

**FFT** (11403A only) – Spectral frequency, spectral magnitude, THD (Total Harmonic Distortion).

**Measurement Statistics –** Min, max, mean, and standard deviation of all active measurements.

**Cursors –** Dual dots in split or paired mode, horizontal and vertical bars, measurement zone delimiters.

**INPUTS/OUTPUTS**
Centronics, Type GPIB, and RS-232C ports standard. Fully GPIB and RS-232C programmable.

**Hardcopy Drivers –** Support for 9-Pin and 24-Pin Epson-graphics compatible printers; Tek HC100 and HPGL-compatible plotters; Tek 4693, 4696, 4697 color printers; alternate inkjet printers; bitmap transfer to computers. Draft, high resolution, and reduced modes.

**CRT AND DISPLAY FEATURES**
**CRT –** Magnetic deflection, vertical raster-scan orientation. 7.5-in. diagonal color CRT in 11403A and CSA 404. 9-inch diagonal monochrome CRT in 11402A.

**Colors** (11403A and CSA 404) – Eight-color set; selectable from a palette of 262,144 colors.

**Video Resolution –** 552 horizontal by 704 vertical displayed pixels.

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

**Humidity –** Operating and Nonoperating: Up to 95% relative humidity, up to +50°C.

**Altitude –** Operating and Nonoperating: meets MIL-T-28800C, Type Class 5.

**Shock –** Nonoperating: meets MIL-T-28800C, Section 4.5.5.4.1, Type Class 5.

**Bench Handling –** Operating: meets MIL-T-28800C, Section 4.5.5.4.3, Type Class 5.

**Electromagnetic Compatibility –** Meets the following requirements of MIL-STD-461B - CE-03, Part 4, Curve 1; CS-01, Part 7; CS-02, Part 4; CS-06, Part 5; RE-02, Part 7; RS-01, Part 4; RS-02, Part 5; RS-03, Part 7 (limited to 1 GHz). Meets FCC part 15, subpart J, class A. Meets VDE 0871/6.78 for Class B.

# Digitizing Oscilloscopes
## 3 GHz

**11403A**
**11402A**



### PHYSICAL CHARACTERISTICS

| | Benchtop | | Rackmount | |
|---|---|---|---|---|
| **Dimensions** | **mm** | **in.** | **mm** | **in.** |
| Width | 448 | 17.6 | 482 | 19.0 |
| Height | 238 | 9.4 | 222 | 8.8 |
| Depth | 599 | 23.6 | 550 | 21.6 |
| **Weight ≈** | **kg** | **lb.** | **kg** | **lb.** |
| Net | 19.0 | 41.6 | 22.0 | 48.0 |
| Shipping (domestic) | 28.0 | 62.0 | 31.4 | 68.0 |

**1 At minimum holdoff setting.*
**2 CSA 404 and 11403A option 1S only.*

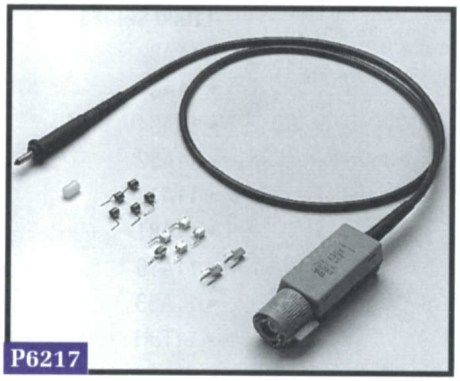
• ACCESSORY •

### Instrument Cart

**K465**

- 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 424.*




• ACCESSORY •

### Maximize Your Signal Acquisition Performance

**P6217 FET PROBE**

- 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 424.*

## ORDERING INFORMATION

**11403A**
1-GHz Color Digitizing Oscilloscope. ..... **$19,950**
**Includes:** Tutorial (070-8190-00); User Reference (070-8191-00); Programmer Reference (070-8192-00); Quick Reference (070-8193-00); Service Reference (070-8194-00); Power Cord, U.S. 120 V (161-0066-00).

**11402A**
1-GHz Monochrome Digitizing Oscilloscope ..... **$17,500**
**Includes:** Same as 11403A except Service Reference (070-7848-00).

**Opt. 1C** – Cable Feedthrough Connectors ..... **+$200**

**Opt. 1R** – Rackmount ..... **+$250**

**Opt. 1S** – (11403A only) Statistical Data Base Analysis Package. Adds statistical data base measurement functions, color graded display, mask testing, direct Jitter and Noise measurements, and histogram analysis ..... **+$2,500**

**Opt. 2D** – Memory Expansion. Adds 768K of non-volatile memory for storage of waveforms and settings. ... **+$1,500**

**Opt. 4D** – DMA Controller
Increases transfer speed over GPIB ..... **+$400**

**INTERNATIONAL POWER PLUG OPTIONS**

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

**Opt. A2** – United Kingdom 240 V, 50 Hz ..... **NC**

**Opt. A3** – Australian 240 V, 50 Hz ..... **NC**

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

**Opt. A5** – Switzerland 220 V, 50 Hz ..... **NC**

See General Customer Information Section for additional description.

**WARRANTY-PLUS SERVICE OPTIONS**

**Opt. M7** – Calibration Service
11403A ..... **+$415**
11402A ..... **+$395**

**Opt. M9** – Repair Protection
11403A ..... **+$1,330**
11402A ..... **+$1,295**

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

**Cart** – Order K465 ..... **$795**

**Power Strip** – Four Outlet, 6 ft., Noise/Surge Suppression.
Order 131-5342-01 ..... **$45**

**Cables** – GPIB, 2 m. Order 012-0991-00 ..... **$170**
RS-232C, 10 ft. Order 012-0911-00 ..... **$100**
Centronics, 10 ft. Order 012-1233-00 ..... **$180**

**Blank Panels** – Plug-in. Order 016-0829-00 ..... **$195**

**CAMERA/HARD COPY OUTPUT PRINTER**
Camera – Order C9 with Opt.11 ..... **$660**
Four-color pen plotter. Order HC100, Opt. 01 ..... **$1,260**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The 11403A, 11402A complies with IEEE Standard 488.1-1987, RS-232C, and with Tektronix Standard Codes and Formats.

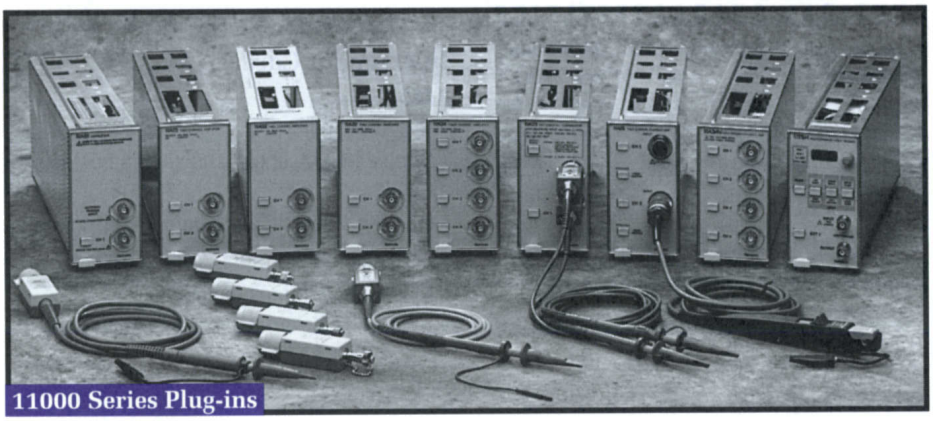
# Plug-in Information



*Wide bandwidth, unsurpassed accuracy, clean response, low noise, and calibrated DC offset with fast overdrive recovery.*

**11000 SERIES**

- 11A32
- 11A34
- 11A34V
- 11A52
- 11A72
- 11A81
- 11A16
- 11A33
- 11T5H



11000 Series Plug-ins

## 11000, DSA Series Plug-ins

A variety of bandwidths, number of channels, coupling and input choices are available. From the 11A72 with 2 channels at 1 GHz bandwidth to the 11A33 differential comparator with 150 MHz bandwidth and 10,000:1 CMRR, the 11000 Series plug-ins offer capabilities for virtually any need. The chart below shows the bandwidth of each of the plug-in units in each of the 11000 Series and DSA 600A Series mainframes.

Control of the 11000 Series plug-ins is accomplished through the mainframe controls, either manually or over the IEEE Standard 488 or RS-232C bus. A single push-button for each channel is the only control on the amplifier plug-in. This button turns the display of the associated channel on and off.

Each of the input channels on all amplifier plug-ins use the TEKPROBE™ interface. This interface allows the mainframe to supply power to active probes (such as the P6204 or P6703A), to sense the type (and, with some probes, the serial number) of the probe, to supply offset voltage to probes so equipped, to detect activation of the probe's ID push-button, and to provide other communication between the probe and the oscilloscope as appropriate to the type of probe.

Three new plug-ins extend the capabilities of the 11000 Series and DSA 600 Series even further. The 11A16 Current Amplifier provides direct measurement of current waveforms. Analysis of power circuits can be more complete than ever before. The 11T5H Multi-Standard Video Trigger and 11A34V High Bandwidth Video Amplifier are companion plug-ins for the high performance video designer. They allow triggering and measurements on video signals for HDTV, medical imaging systems, graphics monitors, and other video systems.

The 11A33 Differential-Comparator Amplifier bandwidth is 150 MHz with any combination of probe and mainframe. The recommended probe for this amplifier is the P6135A matched probe pair.

## 11000 SERIES PROBE PLUG-IN MAINFRAME BANDWIDTH MATRIX

All values are in MHz and are rounded to nearest 25 MHz increment

| | No probe | P6134C | P6562AS | P6231 | P6204 | P6156 | P6701A*1 | P6703A*1 | P6711*1 | P6713*1 | P6205 | P6217 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | passive | SMD | bias/offset | active | passive | optical | optical | optical | optical | active | active |
| | | 10 MΩ | 10 Ω | 450 Ω | 10 MΩ | 500, 5 kΩ | — | — | — | — | 1 MΩ | 100 kΩ |
| | | 11.3 pF | 11 pF | 1.6 pF | 1.9 pF | <1 pF, 10X, | — | — | — | — | <2 pF | 0.4 pF |
| | | 10X | 10X | 10X | 10X | <1.1 pF 100X | — | — | — | — | 10X | 10X |
| 11A32 | 400 | 400 | 350 | 375 | 375 | 400 | 300 | 350 | 175 | 175 | 350 | 375 |
| 11A34 | 300 | 300 | 300 | 300 | 275 | 300 | 250 | 275 | 150 | 175 | 275 | 275 |
| 11A34V | 300 | 300 | 300 | — | — | — | — | — | — | — | — | — |
| 11A52 | 600 | — | — | 550 | 500 | 600 | 375 | 475 | 175 | 200 | 475 | 575 |
| 11A72 | 1000 | — | — | 825 | 700 | 1000 | 450 | 575 | 175 | 200 | 600 | 950 |
| 11A81 | 3000 | — | — | 850 | 700 | — | — | — | — | — | — | 2400 |

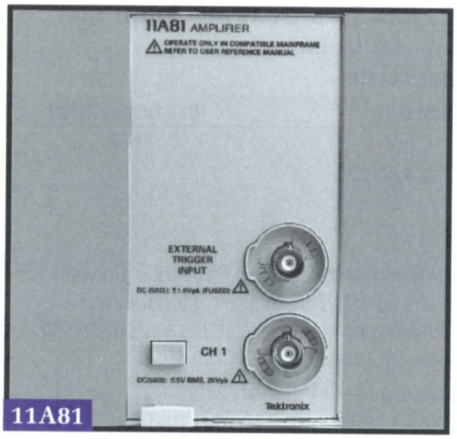
**1 The bandwidths in this chart correspond to –3 dB electrical net system bandwidth. Optical/Electrical converters are often specified at a –3 dB optical point (= –6 dB electrical). To convert to –3 dB optical bandwidth, multiply the bandwidths in this chart by 1.4. For more details on Optical-to-Electrical Converters,* *see page 282.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The 11000 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Plug-In Amplifiers
## 3 GHz






### 11A81 3 GHz Amplifier

The 11A81 is a single channel, high-bandwidth, presampler plug-in designed specifically for the 11403A Digitizing Oscilloscope and the CSA 404 Communications Signal Analyzer. The unique presampler architecture of the plug-in triples the system bandwidth of these mainframes to 3 GHz. A separate trigger input with 2 GHz bandwidth effectively doubles their trigger bandwidth.

Up to three 11A81s can be used together in the 11403A/CSA404 to form a powerful, high bandwidth measurement system for high-speed GaAs or ECL logic device development. Perform voltage measurements to 1% accuracy, sophisticated jitter and noise analysis with histograms, or precise pass/fail evaluations.

Coupled with the CSA 404, the 11A81 allows accurate testing of communications devices, modules and systems with data rates to 625 Mb/sec. This makes the 11A81/CSA 404 combination ideally suited to FDDI and SONET applications. With this comprehensive communications measurement system you can perform eye pattern analysis, create masks for pass/fail testing, or generate constellation diagrams for analysis of digital RF circuits.

The input channel and external trigger input connectors of the 11A81 are standard BNC with TEKPROBE™ interfaces to insure compatibility with a wide selection of high performance probes.

### Characteristics

**Bandwidth –** 3 GHz typical (calculated from rise time using the formula BW = $0.38/t_r$).

**Risetime –** ≤130 ps.

**Deflection Factor –** 10 mV to 1 V/div in 1-2-5 sequence.

**Accuracy –** ΔV: ±(1.0 + 0.01 div.); Offset: ±(0.6% + 0.01 div.); DC Balance: ±0.1 div.

**Offset Range –** ±50 divisions. Resolution: Coarse – 0.25 div; Fine – 0.025 div.

**Overdrive Recovery –** At 10 and 20 mV/div: to within ±(2.0% +0.1 div) within 10 ns from ±1 V step.

**Typical Displayed Noise (RMS) –** 0.025 div from 10 mV/div to 1 V/div.

**Input Impedance –** 50 Ω ±1.0%; VSWR ≤1.45:1 at 10 mV/div, DC to 2 GHz; VSWR ≤1.25:1 at 20 mV/div to 1 V/div, DC to 2 GHz.

**Disconnect Threshold –** DC signal: ±(6 V±1 V); AC signal: 5 Vrms typical (DC to 100 MHz).

**Input Coupling Modes –** DC and OFF.

**Maximum Input Voltage –** 5 Vrms (0.5 W) or 0.25 watt-second pulses not exceeding 25 V peak.

**External Trigger –** Range: ±1 V. Resolution: Fine: ±2 mV/step; Coarse: ±20 mV/step. Accuracy: ±5% of trigger level range. Sensitivity: 40 mV p-p from DC to 200 MHz; increasing to 150 mV p-p at 800 MHz; increasing to 200 mV p-p at 2 GHz. Maximum Safe Input Level: ±1 V.

**Internal Trigger –** Sensitivity: 2.0 div p-p from DC to 625 MHz, typically increasing to 4.5 div p-p at 1 GHz.

**ENVIRONMENTAL CHARACTERISTICS**

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

**Altitude –** Operating: to 4.57 km (15,000 ft.); Nonoperating: to 15.2 km (50,000 ft.).

**MIL Specs –** Meets requirements of MIL-T-28800D, Type III, Class 5 for humidity, shock and vibration. Meets requirements of MIL-STD-461B; FCC Part 15, subpart J, Class A; and VDE 0871/6.78 Class B for electromagnetic compatibility.

**11A81**

- Single Channel
- High-Bandwidth, 3 GHz
- 2 GHz Trigger Bandwidth

*Extreme bandwidth for device characterization or analysis of communications systems to 625 M bit/sec.*

## ORDERING INFORMATION

**11A81**
Single-Channel Amplifier ..... **$5,600**
**Includes:** User Ref. (070-8147-00) and Service Ref. (070-8148-00)
**Opt. 20 –** Includes P6217 active probe ..... **+$3,495**

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M7 –** Calibration Service ..... **+$175**
**Opt. M9 –** Repair Protection ..... **+$325**

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

**PROBES**
**Active –**
1 GHz, 1.9 pF/10 kΩ, 1.5 m. Order P6204 ..... **$1,550**
4 GHz, 0.4 pF/100 kΩ, 1 m. Order P6217 ..... **$3,495**
**50 Ω Divider (Zo) –** 3.5 GHz, 1 pF/500 Ω, 10X; 3 GHz, 1 pF/5000 Ω, 100X;1.5 m. Order P6156 with Opt. 25 ..... **$335**
**Current –**
25 kHz – 1 GHz. Order CT-1 ..... **$295**
1.2 kHz – 200 MHz. Order CT-2 ..... **$255**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

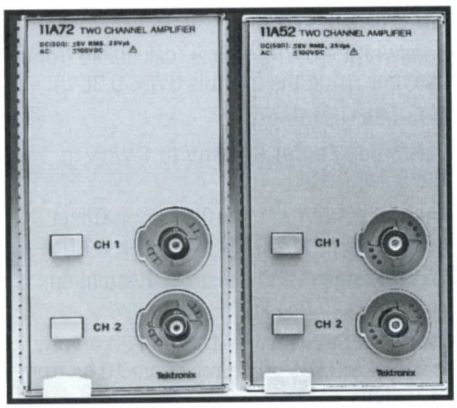
# Plug-In Amplifiers
## High Bandwidth



*High bandwidth amplifiers combined with active probes preserve critical signal phenomena in research and design.*

**11A72**
- 1 GHz
- Two Channels
- 50 Ω Input Impedance
- DC to 1 GHz Bandwidth
- 10 mV to 1 V/Div Calibrated Deflection Factors
- ±25 Division Offset

**11A52**
- 600 MHz
- Two Channels
- 50 Ω Input Impedance
- DC to 600 MHz Bandwidth
- 1 mV to 10 V/Div Calibrated Deflection Factors in 1% Increments
- High-Resolution Calibrated DC Offset
- Fast Overdrive Recovery




### 11A72 Two-Channel Amplifier Characteristics

**Bandwidth –** 1 GHz.

**Deflection Factor –** 10 mV to 1 V/div in 1-2-5 sequence.

**Accuracy –** ΔVolts DC accuracy: With 11400: ±(0.9% +0.01 div) . With DSA 600: ±(1.0% +0.02 div). DC Balance, ±0.1 div. Offset Accuracy, ±(0.4% +0.01 div).

**Offset Range –** ±25 div, 0.025 div resolution.

**Typical Noise (RMS) –** 0.022 div.

**Input Impedance –** 50Ω ±0.5%; VSWR ≤1.45:1 @10 mV/div, DC to 1 GHz; VSWR ≤1.25:1 for deflection factors ≥ 20 mV/div, DC to 1 GHz.

**Disconnect Threshold –** 5 Vrms typical (DC to 100 MHz).

**Input Coupling Modes –** AC, DC, OFF.

**AC Coupled Low Frequency –** –3 dB point; 1 kHz or less from 50 Ω source.

**Max Input Voltage –** DC Coupled: 25 V pk or 5 Vrms. AC Coupled: ±100 VDC additional. Input coupling is set to off when coupled signal exceeds safe limits. Manual reset by selecting either AC or DC coupling.

### 11A52 Two-Channel Amplifier Characteristics

**Bandwidth –**

| Volts/div | Bandwidth (MHz) |
|---|---|
| >10 mV | 600 |
| 5 to 9.95 mV | 400 |
| 2 to 4.98 mV | 250 |
| 1 to 1.99 mV | 200 |

**Calibrated Deflection Factors –** Coarse: 1 mV to 10 V/div in 1-2-5 steps. Fine: between coarse steps in 1% increments of next more sensitive coarse step.

**Accuracy –** ΔVolts DC accuracy: With 11400: ±(0.8% +0.01 div). With DSA 600: ±(0.9% +0.02 div). DC Balance, 1 to 99.5 mV/div: ±(0.2 mV + 0.10 div). Offset Accuracy, 1 to 99.5 mV/div (±1 V range): (0.15% + 0.4 mV).

**Offset Range –** 1 to 99.5 mV/div: ±1 V; Resolution: 25 µV. 100 mV to 0.995 V/div: ±10 V; Resolution: 250 µV.1 to 10 V/div: ±100 V; Resolution: 2.5 mV.

**Overdrive Recovery –** 1 to 99.5 mV/div: To within ±(0.2% +0.1 div) within 20 ns from ±2 V step.

**Typical Noise (RMS) –** 1 to 1.99 mV/div: 0.087 div. 2 to 4.98 mV/div: 0.04 div. 5 to 9.95 mV/div: 0.02 div. 10 mV to 10 V/div: 0.012 div.

**Input Impedance –** 50 Ω ±0.5%; VSWR: < 1.3:1 DC to 500 MHz.

**Input Coupling Modes –** AC, DC, and OFF.

**AC Coupled Low Frequency –** –3 dB point; 1 kHz or less from 50 Ω source.

**Max Input Voltage –** DC Coupled: 25 V pk or 5 Vrms. AC Coupled: ±100 VDC additional. Input coupling is set to off when coupled signal exceeds safe limits. Manual reset by selecting either AC or DC coupling.

## ORDERING INFORMATION

**11A72**
Two-Channel Vertical Amplifier ..... **$4,595**
**Includes:** User Reference (070-7255-00), Service Reference (070-7257-00).
**Opt. 25 –** Includes two P6231 Bias-offset probes. ..... **+$1,500**
**Opt. 27 –** Includes two P6204 Active probes. ..... **+$3,100**
**Opt. 28 –** Includes two P6217 Active probes. ..... **+$6,990**

**11A52**
Two-Channel Vertical Amplifier ..... **$3,500**
**Includes:** User Reference (070-6114-00), Service Reference (070-6786-00).
**Opt. 25 –** Includes two P6231 Bias-offset probes. ..... **+$1,500**
**Opt. 27 –** Includes two P6204 Active probes. ..... **+$3,100**
**Opt. 28 –** Includes two P6217 Active probes. ..... **+$6,990**

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M7 –** Calibration Service
11A72 ..... **+$175**
11A52 ..... **+$145**

**Opt. M9 –** Repair Protection
11A72 ..... **+$325**
11A52 ..... **+$275**

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

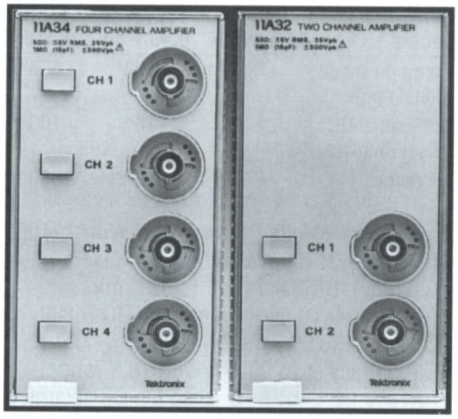
**PROBES**
**Active –**
1 GHz, 1.9 pF/10 MΩ, 1.5 m. Order P6204 ..... **$1,550**
4 GHz, 0.4 pF/100 kΩ, 1 m. Order P6217 ..... **$3,495**
750 MHz, 2 pF/1 MΩ, 1.5 m. Order P6205 ..... **$495**
**50 Ω Divider (Zo) –** 3.5 GHz, 1 pF/500 Ω, 10X; 3 GHz, 1.1 pF/5000 Ω, 100X; 1.5 m. Order P6156 with Opt 25 ..... **$335**
**Current –**
25 kHz to 1 GHz. Order CT-1 ..... **$295**
1.2 kHz to 200 MHz. Order CT-2 ..... **$255**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Plug-In Amplifiers
## High Impedance








### 11A32 and 11A34 Amplifiers

The 11A32/11A34 amplifiers offer switchable 1 MΩ/50 Ω input impedance, fast overdrive recovery and wide offset ranges. The 11A32 is a two-channel unit, and the 11A34 is a four-channel unit.

Two built-in four-pole bandwidth-limit filters (100 MHz and 20 MHz) may be activated to reduce unwanted high-frequency noise at 24 dB/octave for each channel.

Both coarse and fine deflection-factor steps are fully calibrated. At 1 mV/div, the calibrated DC offset can be set with a resolution of 25 µV and a range of ±1 V (equivalent to 16 bits), giving an effective screen height of 2000 divisions and permitting absolute DC measurement accuracies to ±0.4%.

### Characteristics

**Number of Channels** –11A32: Two; 11A34: Four.

**Calibrated Deflection Factors** – Coarse steps: 1 mV to 10 V/div in 1-2-5 sequence. Fine steps: Between coarse steps in 1% increments of next more-sensitive coarse step.

**Bandwidth** –

| Volts/div | 11A32 Bandwidth (MHz) | 11A34 Bandwidth (MHz) |
|---|---|---|
| >10 mV | 400 | 300 |
| 5 to 9.95 mV | 350 | 250 |
| 2 to 4.98 mV | 250 | 200 |
| 1 to 1.99 mV | 200 | 150 |

**Accuracy** – ΔVolts DC accuracy: With 11400: ±(0.9% + 0.012 div). With DSA 600: ±(1.0% + 0.02 div). DC Balance, 1 to 99.5 mV/div: ±(1.0 mV + 0.10 div). Offset Accuracy, 1 to 99.5 mV/div (± 1 V range): (± 0.2% + 0.5 mV). For absolute DC accuracy of single-point measurements using offset, add the Offset Accuracy and DC Balance terms.

**Offset Range** – 1 to 99.5 mV/div: ±1 V; Resolution: 25 µV. 100 mV to 0.995 V/div: ±10 V; Resolution: 250 µV. 1 to 10 V/div: ±100 V; Resolution: 2.5 mV.

**Overdrive Recovery** – 1 to 99.5 mV/div: To within ±(0.3% +0.2 div) within 50 ns from ±2 V step. 100 to 995 mV/div: To within ±1% within 50 ns from ±20 V step. 1 to 10 V/div: To within ±1% within 50 ns from ±200 V step.

**Typical Noise (RMS)** – 1 to 1.99 mV/div: 0.12 div. 2 to 4.98 mV/div: 0.06 div. 5 to 9.95 mV/div: 0.025 div. 10 mV to 10 V/div: 0.014 div.

**Input Impedance** – Switchable: 1 MΩ in parallel with 15 pF, or 50 Ω ±0.5%

**Input Coupling Modes** – AC, DC, and OFF.

**AC Coupled Low Frequency** – –3 dB point, driven from 50 Ω source: less than 10 Hz.

**Maximum Input Voltage** – 1 MΩ mode: 500 V (DC + peak AC). 50 Ω mode: The input impedance is switched to 1 MΩ when the input signal exceeds safe limits. Manual reset by re-selecting 50 Ω input impedance.

**11A32/11A34**

- DC to 400 MHz Bandwidth (11A32)
- Two Channels (11A32) or Four Channels (11A34)
- 1 mV to 10 V/Div Calibrated Deflection Factors in 1% Increments
- Switchable 50 Ω or 1 MΩ Input Impedance
- High-Resolution Calibrated DC Offset
- Fast Overdrive Recovery

*Excellent, medium bandwidth amplifiers. They offer switchable 1 MΩ/50 Ω input impedance, fast overdrive recovery, and wide offset range.*

## ORDERING INFORMATION

**11A34**
Four-Channel Vertical Amplifier ..... **$4,900**
**Includes:** User Reference (070-5921-01), Service Reference (070-6785-02).

**11A32**
Two-Channel Vertical Amplifier ..... **$2,800**
**Includes:** User Reference (070-5922-01), Service Reference (070-6782-03).

**Opt. 3P** – (11A32, 11A34) Includes P6408 Word, Recognizer/Trigger Probe ..... **+$500**

**Opt. 22** – (11A32) Includes two P6134C probes ..... **+$460**

**Opt. 23** – (11A34) Includes four P6134C probes ..... **+$920**

**WARRANTY-PLUS SERVICE OPTIONS**

**Opt. M7** – Calibration Service
11A32 ..... **+$125**
11A34 ..... **+$195**

**Opt. M9** – Repair Protection
11A32 ..... **+$175**
11A34 ..... **+$375**

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

**PROBES**

**Active** –
1 GHz, 1.9 pF/10 MΩ, 1.5 m. Order P6204 ..... **$1,550**
750 MHz, 2 pF/1 MΩ, 1.5 m. Order P6205 ..... **$495**

**Differential** – 100 MHz, active differential, 6 ft. Order P6046 ... **$2,295**

**High Voltage** –
120 MHz, 1500 V, 2.5 pF/10 MΩ, 9 ft. Order P6009 ..... **$270**
75 MHz, 20 kV, 3.0 pF/100 MΩ, 10 ft. Order P6015A Opt. 1R ... **$1,005**

**General Purpose** –
1X, 15 MHz, 100 pF/1 MΩ, 2m. Order P6101B ..... **$65**
1X/10X Switchable, 1X: 6 MHz, 105 pF/1 MΩ, 6 ft; 10 X: 200 MHz, 14 pF/10 MΩ, 6 ft. Order P6063B ..... **$340**

**Current** –
120 Hz – 60 MHz, 7.5A peak. Order P6021 ..... **$550**
935 Hz – 120 MHz, 3A peak. Order P6022 ..... **$595**
1.2 kHz – 200 MHz. Order CT-2 ..... **$255**
DC – 50 MHz System. Includes AM503A, A6302. Order AM503S ..... **$2,745**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

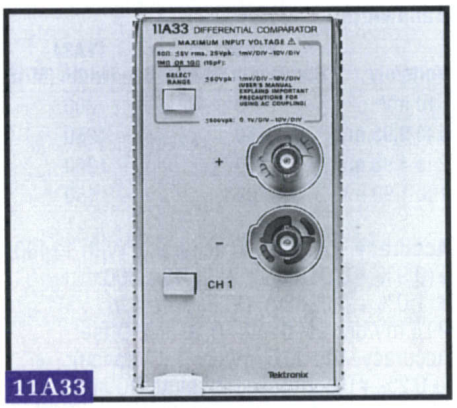
# Plug-in Amplifiers
## Differential Comparator



*Balanced (+ and –) input for applications requiring rejection of common mode signal.*

**11A33**

- DC to 150 MHz Bandwidth
- 1 mV to 10 V/Div Calibrated Deflection Factors in 1% Increments
- Very High Resolution, Calibrated DC Offset 16,000-Division Effective Screen Height
- Differential DC Offset range of ±1 V at 1 mV/Div
- High Common-Mode Rejection
- Fast Overdrive Recovery from Large Input Signals
- Selectable 50 Ω, 1 MΩ, or 1 GΩ Input Impedance




### 11A33 Differential Comparator

As a differential amplifier, the 11A33 provides a balanced (+ and –) input for applications requiring rejection of a common-mode signal. The unit can reject up to 8 V pk-pk of common-mode signal with a CMRR of 10,000:1 from DC to 1 MHz, (derating to 500:1 at 20 MHz 1 V p-p) at a deflection factor setting of 1 mV/div. Differential DC offset is available to null out DC offsets between the two inputs. This offset capability can be used with DC coupling at 1 mV/div to measure a bipolar transistor's Vbe change from self-heating caused by signal changes.

As a comparator amplifier the 11A33 loses its differential capability, but provides an accurate (0.15%) positive or negative internal offsetting voltage covering the amplifier's common-mode signal range. This mode is also known as slideback comparison. A signal of up to ±8 V may be applied to an input at a deflection factor setting of 1 mV/div, and with an opposing VC (offset voltage), small segments of the signal may be observed.

### Characteristics

**Number of Channels –** One.

**Bandwidth –** DC to 150 MHz (DC to 120 MHz at 1 mV/div).

**Calibrated Deflection Factors –** Coarse steps: 1 mV to 10 V/div in 1-2-5 sequence. Fine steps: Between coarse steps in 1% increments of next more-sensitive coarse step.

**VC Range –** 1 to 99.5 mV/div: ±8 V; Resolution: 25 µV; 100 mV to 0.995 V/div: ±80 V; Resolution: 250 µV. 1 to 10 V/div: ±500 V; Resolution: 2.5 mV.

| Deflection Factor | 1 mV to 99.5mV/div | 100 mV to 0.99 V/div | 1 V to 10 V/div |
|---|---|---|---|
| Common-mode Signal range | ±8 V | ±80 V | ±500 V |
| Differential DC Offset range | ±1 V | ±10 V | ±100 V |
| VC range | ±8 V | ±80 V | ±500 V |

**Accuracy –** ΔVolts DC accuracy: With 11400: ±(0.9% +0.01 div). With DSA 600: ±(1.0% +0.02 div). DC Balance, 1 to 99.5 mV/div: ±(0.5 mV +0.10 div). Differential DC Offset Accuracy, 1 to 99.5 mV/div: ±(0.25% + 0.7 mV). VC Accuracy, 1 to 99.5 mV/div (8 V range): ±(0.15% + 0.6 mV). For absolute DC accuracy of single point measurements using VC, add the VC Accuracy and DC balance terms.

**Differential DC Offset Range –** 1 to 99.5 mV/div: ±1 V; 100 mV to 0.995 V/div: ±10 V;1 to 10 V/div: ±100 V.

**Overdrive Recovery –** Recovers to within 0.25% of overdriving signal within 40 ns; to within 2 mV in 100 µs; to within 1 mV in 300 µs. Conditions: 1 to 99.5 mV/div; Overdriving signal steps to 0.0 V from ±8.0 V; Slew rate ≤ 0.5 V/ns.

**Typical Noise (RMS) –** 1 to 1.99 mV: 0.24 div. 2 to 4.98 mV: 0.12 div. 5 to 9.95 mV/div: 0.05 div. 10 mV to 10 V/div: 0.03 div.

**Common-Mode Rejection Ratio –** 1 to 99.5 mV/div: 10,000:1, DC to 1 MHz; 2000:1 at 5 MHz (8 V p-p signal). 100 mV to 0.995 V/div: 1000:1, DC to 1 MHz; 100:1 at 10 to 20 MHz (30 V p-p signal). 1 to 10 V/div: 500:1, DC to 250 kHz (100 V p-p signal).

**Input Impedance –** 50 Ω, 1 MΩ in parallel with 15 pF, or 1 GΩ in parallel with 15 pF from 1 to 99.5 mV/div.

**Input Coupling Modes –** DC, AC, VC, and OFF for each input. VC Coupling internally connects an amplifier input to the comparison voltage.

**Max Input Voltage –** 1 MΩ mode: 1 to 99.5 mV/div: 50 V (DC + peak AC); 0.1 to 10 V/div: 500 V (DC + peak AC). (At 1 to 99.5 mV/div, derate maximum input voltage at 20 dB/decade above 3 MHz; at 100 mV to 10 V/div, derate maximum input volt-age at 20 dB/decade above 1 MHz). 50 Ω mode: The input impedance is switched to 1 MΩ when the input signal exceeds safe limits. Manual reset by re-selecting 50 Ω input impedance. LF Step Response aberrations: 0.1 V/div -110 V/div: less than ±1% after the first 20 ns of input step.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

## ORDERING INFORMATION

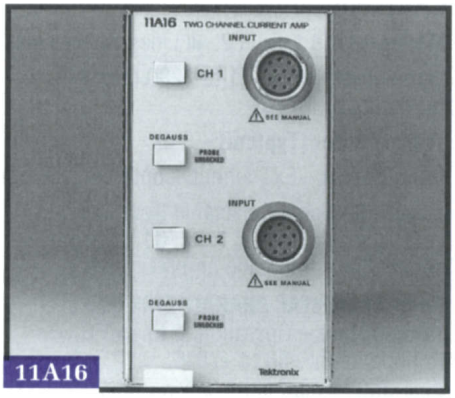
**11A33**
Differential Comparator ..... **$4,100**
**Includes:** User Reference (070-6119-00), Service Reference (070-6784-01).
**Opt. 24** – Includes a P6135A probe pair. ..... **+$750**

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M7** – Calibration Service ..... **+$135**
**Opt. M9** – Repair Protection ..... **+$250**

**RECOMMENDED ACCESSORIES**
See page 424 for complete descriptions and full line of probes and accessories.

# Plug-In Amplifiers
## Current Amplifier






### 11A16 Amplifier

The 11A16 is a two-channel current amplifier plug-in designed to operate with the A6302 and A6303 current probes. With the 11A16 you get a versatile and powerful current analysis and measurement system. It provides direct readout of current levels, and calibration – including timing deskew – of the probe path. Deskewing the current channel means you can now make instantaneous power measurements with higher accuracy than ever before. And those measurements can be programmed over the GPIB for a totally automated system.

### Characteristics

(With A6302 Current probe.)

**Number of Channels –** Two.

**Bandwidth –** 50 MHz (limited by probe).

**Rise Time –** 7 ns or less.

**Deflection Factor –** 1 mA/div to 2 A/div in 1-2-5 sequence.

**Offset Range –** 1 mA/div to 99.5 mA/div: ±1 A; Resolution: 25 µA. 0.1 A/div to 2 A/div: ±10 A; Resolution: 0.025 div.

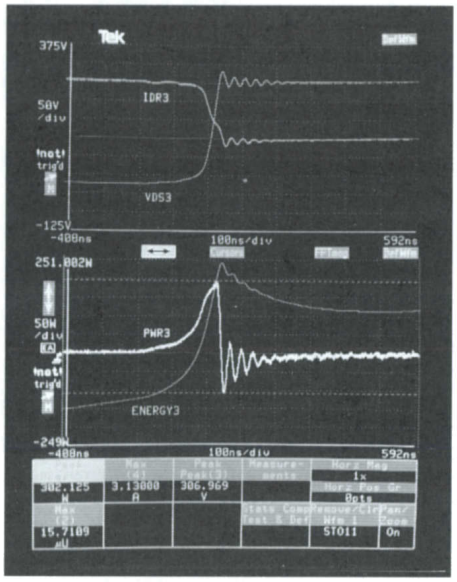
**Input Coupling Modes –** AC, DC, and OFF.

**ENVIRONMENTAL CHARACTERISTICS**

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

**Altitude –** Operating: to 4.5 km (15,000 ft); Nonoperating: to 15 km (50,000 ft).

**Mil Specs –** MIL-T-28800C, Type III, Class 5.




*Make accurate, high-bandwidth power measurements and energy calculations with the 11A16 Programmable Current Amplifier and 11A33 Differential Comparator. Current and Voltage maintain their proper phase relationship to 50 MHz.*

With a sensitivity range of 1 mA/div to 2 A/div (with the A6302 probe) the 11A16 supports a wide variety of applications from medical monitors to machine control to power systems. The 11A16 is an excellent tool for power supply designers. With it, the engineer can make simultaneous measurements on current and voltage waveforms, and use the waveform math capability of the 11000 Series and DSA 600 Series mainframes to calculate instantaneous power. You can verify power circuit design or monitor variations in power use by your target system.

• ACCESSORY •

### Voltage times Current = Power

**A6302**

- Capture current with the A6302/11A16 combination.
- Capture voltage with a P6135 pair and 11A33.

*For complete selection information on all Accessory products, see page 424.*

**11A16**

- Two Separate Channels
- 50 MHz Bandwidth at Probe Tip
- Automatic Deskew, Including Probe, for High Accuracy Power Measurements
- Programmability via IEEE 488.1 (GPIB) and RS-232
- Increased Accuracy from On-Board Amplitude Calibration
- Fully Compatible with 11000/ DSA Series
- Full Use of All 11000 Series Measurements
- Compatible with Tektronix A6302 and A6303 Current Probes
- One Button Probe Degaussing and Offset Adjustment
- Bandwidth Limiting
- AC or DC Coupling

*Fully integrated measurements of AC + DC current. Excellent power measurement system when combined with 11A33 differential amplifier.*

## ORDERING INFORMATION

**11A16**

Two-Channel Current Amplifier ..... **$3,300**

**Includes:** User Reference (070-7763-00), Service Reference (070-7764-00), Current Loop Adapter (015-0601-00), Voltage Converter (015-0598-00).

**Opt. 20 –** Includes two A6302 probes ..... **+$1,550**

**WARRANTY-PLUS SERVICE OPTIONS**

**Opt. M7 –** Calibration Service ..... **+$130**

**Opt. M9 –** Repair Protection ..... **+$260**

**RECOMMENDED ACCESSORIES**

See page 424 for complete selection information on all Accessories.

**CURRENT PROBES**

DC to 15 MHz, 0-52.5A (DC to pkAC). Order A6303 ..... **$1,420**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# 11T5H
# 11A34V

# Plug-In Amplifiers
## Video Trigger/Amplifier

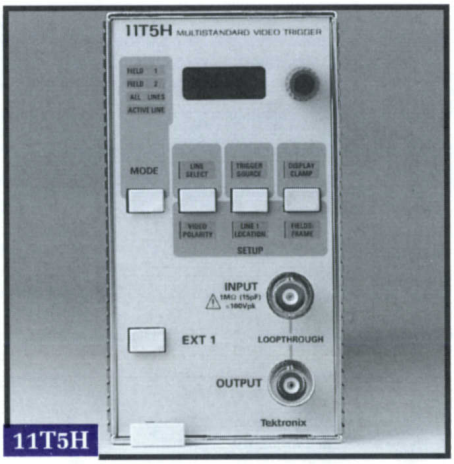
*High bandwidth amplification and specialized triggering for a wide variety of video systems.*

**11T5H**

- Trigger on Individual Lines – Up to 1280 Lines/Frame
- Compatible with All Major TV Standards – Including HDTV
- Fully Programmable via GPIB
- Easy-to-Use Controls
- Operates with Companion 11A34V High Bandwidth Video Amp for a Total System

**11A34V**

- Four 300 MHz Channels
- 75 Ω/1 MΩ Switchable Input Impedance
- Companion Amplifier for 11T5H Multi-Standard Video Trigger




### 11T5H Multi-Standard Video Trigger

The new 11T5H Multi-Standard Video Trigger plug-in offers triggering capability for high performance video applications. It brings the measurement power of the 11000 Series to TV/video applications for the first time.

With the 11T5H, all major TV standards can be triggered on, including new HDTV standards with their high line count and tri-level sync. The 11T5H can handle line rates up to 1280 lines/frame. Engineers designing the latest HDTV components, medical imaging systems, high resolution graphics monitors, or other state-of-the-art video equipment need the power of the 11000 Series with the 11T5H Multi-Standard Video Trigger.

### Characteristics

**Modes –** Field 1, Field 2, All Lines, Active Lines

**Line Select Range –** 1 to 1280 lines or maximum of format

**Trigger Jitter (Typical) –** 3 ns

**Input/Output –** EXT 1 input, loopthrough output

**Trigger Source –** Selectable from EXT 1 (11T5H front panel), L1, L2, C1, C2 from compatible companion amplifier plug-in.

**ENVIRONMENTAL CHARACTERISTICS**

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

**Humidity –** Operating and Non-operating: meets MIL-T-28800C, Type III, Class 5 as described in 3.9.2.2 and 4.5.5.1.2.2.

**Altitude –** Operating: to 4,570 m (15,000 ft.); Nonoperating: to 15,200 m (50,000 ft.).

### 11A34V High Bandwidth Video Amplifier

The 11A34V is specially designed as a companion amplifier for the 11T5H Multi-Standard Video Trigger to meet the needs of TV/video engineers designing medical imaging equipment. HDTV components, high-resolution graphics monitors, and other video systems will find the special features of the 11A34V bring new power to their design tasks. Features include convenient 75 Ω/1MΩ switchable input impedance, display clamping and trigger source signals with the 11T5H Video Trigger. The 11A34V also offers the same high performance of the 11A34: four 300 MHz bandwidth channels, fast overdrive recovery, wide offset and dynamic range, and 1 mV/div to 10 V/div sensitivity settings.

TV and video designers will find the 75 Ω input setting convenient for connection to their circuitry. The 11A34V's four input channels make it easy to view components video signals – R, G, and B can each have a separate input. The 11A34V provides the performance needed for state-of-the-art TV/video design.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

## ORDERING INFORMATION

**11T5H**
Multi-Standard Video Trigger ..... **$2,700**
**Includes:** User Reference (070-7961-00), Service Reference (070-7962-00).

**11A34V**
High Bandwidth Video Amplifier ..... **$5,400**
**Includes:** User Reference (070-8178-00), Service Reference (070-8179-00).

**WARRANTY-PLUS SERVICE OPTIONS**

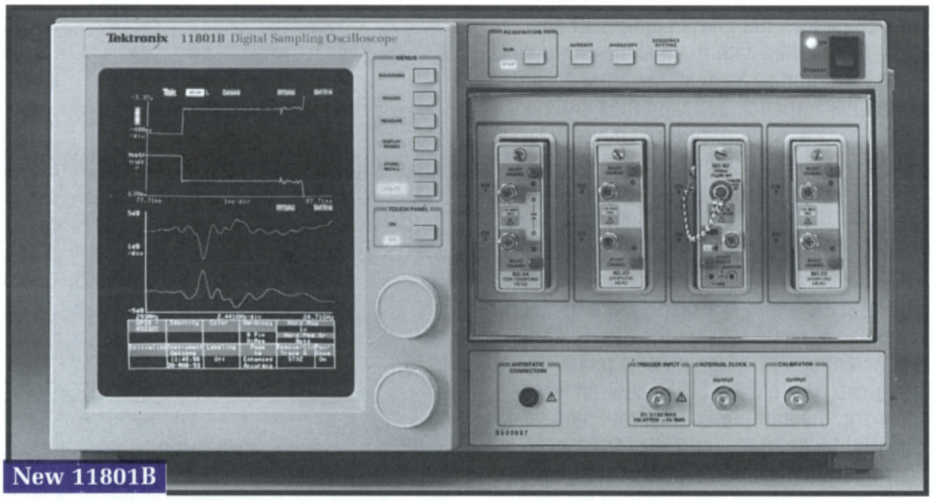
**Opt. M7 –** Calibration Service
11T5H ..... **+$125**
11A34V ..... **+$215**

**Opt. M9 –** Repair Protection
11T5H ..... **+$265**
11A34V ..... **+$410**

**PROBES**
See Probe Section on page 424 for complete descriptions and full line of probes and accessories.

# Digital Sampling Oscilloscope






New 11801B

## 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 4 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 | 2.5 GHz high impedance (100 kΩ/0.475 pF) dual-channel probe sampler |
| SD-20 | 20 GHz single-channel loop-through 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 |

### 11801B FEATURES

- DC to 50 GHz Bandwidth
- 7 ps risetime
- 8 Channels, expandable to 136 (w/SM-11)
- 10 fs Sampling Interval (0.01 ps)
- Modular Architecture
- 200 kS/s Sample Rate
- Dual Time Base
- Non-volatile Waveform and Setting Storage
- FFT
- Predefined Telecom Masks (Opt. 1T)
- TDR
- Automatic Measurements:
  - Jitter/ Noise, Statistical, Histograms, Mask Testing, Pulse w/statistics
- Programmable for ATE Applications
- Color Display

### BENEFITS

- Comprehensive Waveform Processing

### APPLICATIONS

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

*High resolution capable of viewing very fast digital signals.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The 11801B Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# 11801B Digital Sampling Oscilloscope

### 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-232C 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 of 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 (Option 1T, Predefined Telecom Masks). This option, 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).

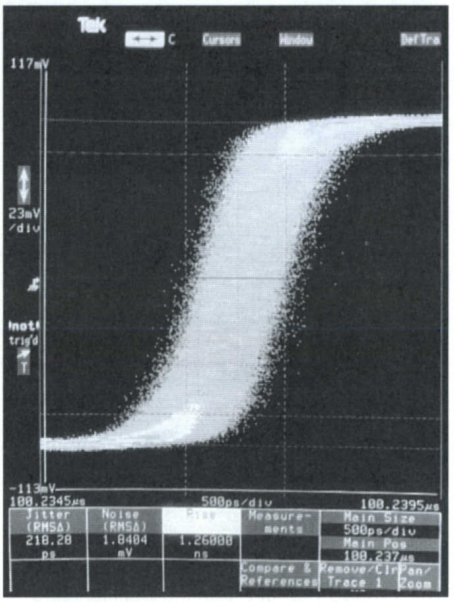



*Figure 1. Direct and automatic jitter, noise and risetime measurement using the statistical measurement mode.*

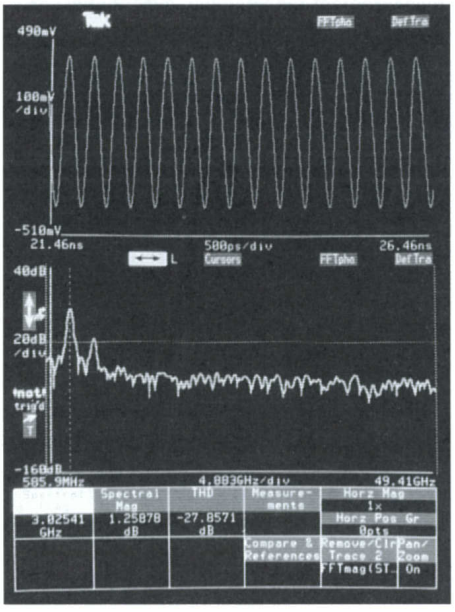



*Figure 2. FFT display and measurements in the 11801B offer additional analysis power to the engineer or scientist.*

# Digital Sampling Oscilloscope



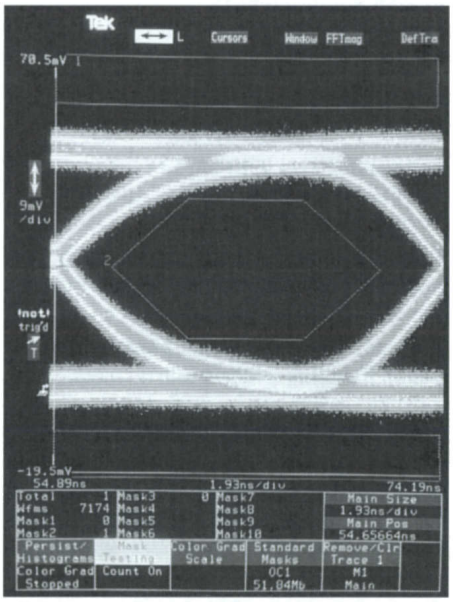



*Figure 3. Predefined Telecom masks make verifying digital stream conformance simple.*

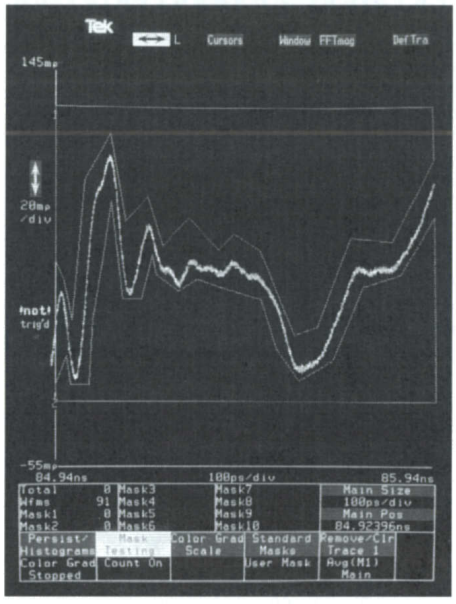



*Figure 4. TDR go/no-go impedance measurement suing masks.*

### 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 Ω.

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 Ω 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. Also, as with differential TDR, Tektronix' system is the only system offering true differential TDT. 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 NONVOLATILE 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-232C 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.*

## • ACCESSORY •

### AK02

- Provides adaptability to most signal sources for 50 Ω termination.
- Includes 50 Ω attenuators, 50 Ω cables, gender adapters.

*For complete information on all Accessory products, see page 424.*

# 11801B Digital Sampling Oscilloscope

## Characteristics

**VERTICAL SYSTEM**

**Rise Time/Bandwidth –** Determined by the sampling head used.*1

**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 –** 1ps/div to 5 ms/div, settable to 1-2-5 sequence or in 1 ps increments.

**Time Base Accuracy –** 8 ps +0.01% of time interval +0.001% of position.

**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 maximum of 8 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**

**Trigger Bandwidth –** 3 GHz.

**Trigger Sensitivity –**
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 –** ±1.0 V (±10 V with 10X trigger attenuator activated).

**Trigger Input Range –** ±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*3, rise, fall, spectral magnitude, spectral frequency, THD, SNR, frequency, period, prop delay, cross, width, phase, duty cycle, jitter*3, 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 Risetime –** 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 in. 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, sub-part 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 has external trigger only; requires 23 ns pretrigger or DL 11 Delay Lines to view trigger point (45.5 ns with Option 1M).*

**3 Available only in statistical measurement mode.*

# Digital Sampling Oscilloscope





## ORDERING INFORMATION

**11801B**
Digital Sampling Oscilloscope ..... **$27,500**
**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.

**Option 1R** – Rackmount ..... **+$250**
**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. ..... **+$1,000**

**Opt. 1T** – Predefined Telecom Masks. AutoMask offers 38 standards-defined masks in memory for instant recall. ..... **+$1,495**

**SM-11**
Multi-Channel Unit Accepts 16 heads ..... **$24,500**
**Includes:** Installation/User Manual.(070-7048-01)

**DL-11**
Delay Line ..... **$4,200**
**Includes:** Delay Line Instruction Sheet (070-7051-01)

**INTERNATIONAL POWER PLUG OPTIONS**
**Option A1** – Universal Euro 220 V, 50 Hz ..... **NC**
**Option A2** – United Kingdom 240 V, 50 Hz ..... **NC**
**Option A3** – Australian 240 V, 50 Hz ..... **NC**
**Option A1** – North American 240 V, 60 Hz ..... **NC**
**Option A1** – Switzerland 220 V, 50 Hz ..... **NC**
See Customer Information Section for additional information.

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M7** – Calibration Service ..... **+$505**
**Opt. M9** – Repair Protection ..... **+$615**

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

**PROBES**
**50 Ω Divider (Z0) Probe** – 9 GHz. Order P6150 ..... **$995**
**Active Probes** (requires 1103 power supply) – 10X, DC – 1 GHz, ≥10 MΩ input impedance, 1.9 pF. Order P6204 ..... **$1,550**
10X, DC – 4 GHz, ≥100 kΩ input impedance, 0.4 pF. Order P6217 ..... **$3,495**
1103 Power Supply ..... **$600**
**Current Probe** – (requires BNC to SMA Adapter)
DC – 50 MHz, 0-20 A (DC + peak AC). Order AM503S ..... **$2,745**
DC – 15 MHz, 0-100 A (DC + peak AC). Order AM503S Opt. 03. ..... **$3,395**
25 kHz-1 GHz, max current of 0.5 A RMS. Order CT-1 ..... **$295**
**Optical-to-Electrical Converters** – (See page 96)
DC – 6.4 GHz, 1000-1700 nm. Order SD42 ..... **$3,995**
DC – 1 GHz, 1100-1700 nm. Order P6703A*1 ..... *2
DC – 700 MHz, 450-1050 nm. Order P6701A*1 ..... *2
DC – 300 MHz, 1000-1700 nm, High Gain. Order P6713*1 ..... *2
DC – 250 MHz, 450-1050 nm, High Gain. Order P6711*1 ..... *2

*1 *See page 283 for complete selection information.*

*2 *Contact your local Tektronix representative for price and ordering information.*

**CALIBRATION STEP GENERATOR**
**U.S.** – Order 067-1338-00 ..... **$7, 750**
**Includes:** Instruction sheet; SMA to female; short-circuit termination.
**Universal European** – (240 V, 50 Hz). Order 067-1338-01 ..... **$7,750**
**UK** – (240 V, 50 Hz) Order 067-1338-02 ..... **$7,750**
**Australia** – (240 V, 50 Hz). Order 067-1338-03 ..... **$7,750**
**Switzerland** – (240 V, 50 Hz). Order 067-1338-05 ..... **$7,750**
**Japan** – (100 V, 50-60 Hz). Order 067-1338-06 ..... **$7,750**

**ADDITIONAL ACCESSORIES**
**Cart** – Order K465 ..... **$795**
**Power Strip** – Four Outlet, 6 ft., Noise/Surge Suppression. Order 131-5342-01 ..... **$45**
**SMA Accessory Kit** – 2 each 2X and 5X attenuators; 2 each SMA Terminations, Male Short Circuit, Female Short Circuit, Male 50 Ω, Female 50 Ω, 2 each 50 Ω Signal Cables (2 ns), 2 each 500 ps Semi-Rigid Cable, 2 each Male-to-Male adapters, 2 each SMA Male-to-BNC Female, 2 each Female-to-Female, 1 each 50 Ω Power Divider, 1 each Combination Wrench (.312, 6 point). Order 020-1693-00 ..... **$2,605**
**3.5 mm Accessory Kit** – 1 each 50 Ω Reference Air Line, 1 each Male-to-Male Adapter, 1 each Female-to-Female Adapter, 1 each 26.5 GHz 50 Ω Terminator (Male), 1 each 26.5 GHz 50 Ω Terminator (Female), 1 each 26.5 GHz Short Circuit (Male), 1 each 26.5 GHz Short Circuit (Female), 2 each 50 Ω Terminators (6 dB 26.5 GHz, 2.9 mm), 2 each 50 Ω Terminators (20 dB 26.5 GHz, 2.9 mm), 1 each Power Divider (26.5 GHz, 2.9 mm), 2 each Signal blews (2 ns, Male-to-Male), 2 each Signal Cables (500 ps, Male-to-Male, 2.9 mm semi-rigid), 1 each Torque Wrench, 1 each Combination Wrench (0.312, 6 point), 1 each Combination Wrench (0.281, 6 point).Order 020-1692-00 ..... **$8,365**
**2X Attenuator** – SMA Male-to-Female. Order 015-1001-00 ... **$225**
**5X Attenuator** – SMA Male-to-Female. Order 015-1002-00 ... **$210**
**Power Divider** – Order 015-1014-00 ..... **$315**
**Blank Sampling Head** – Order 200-3395-00 ..... **$1.05**
**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 ..... **$1,285**
**DC Block (Coupling Capacitor)** – Order 015-1013-00 ..... **$380**
**Slip-On Connector** – Order 015-0553-00 ..... **$46**
**Connector Savers** – (SMA) Order 015-0549-00 ..... **$185**
(APC) Order 015-0552-00 ..... **$280**
**DL-11 Service Manual** – Order 070-7050-00 ..... **$25**
**SM-11 Service Manual** – Order 070-7049-00 ..... **$165**

**CABLES AND EXTENDERS**
**Sampling Head Extender Cable** –
1 M. Order 012-1220-00 ..... **$850**
2 M. Order 012-1221-00 ..... **$935**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The 11801B Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Interconnect Parameter Analyzer



*Tektronix IPA 310 bridges the gap between measurement and simulation for high-accuracy interconnect characterization and modeling.*

**IPA 310 FEATURES**

- Automatic SPICE Model Generation and Verification
- Direct Measurement of L, C, Z, t
- Enhanced TDR Resolution Using Z-Profile Algorithm
- Lumped, Distributed, and Coupled Model Extraction
- Multi-Channel and Differential TDR
- Model Verification at Risetime of Interest
- Supports Industry Standard Simulators

**BENEFITS**

- Simulate/Predict System Performance Early in the Design-Process
- Improved Simulation Accuracy
- Predict Crosstalk, Reflections, and Ground-Bounce Using models Generated by the IPA 310

**APPLICATIONS**

- Extraction and Verification of IC Package SPICE Models
- DUT Load Board Characterization and Modeling
- Design and Modeling of Connectors, Sockets and Backplanes
- MCM and Circuit Board Trace Modeling

**TYPICAL USERS**

- High-Speed IC Designers and System Designers
- MCM Designers and Process Engineers
- Signal Integrity Engineers

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99




## IPA 310 Interconnect Parameter Analyzer

The IPA 310 Interconnect Parameter Analyzer is the first system to offer a complete, turnkey solution for modeling IC interconnects. With a combination of superior hardware and software capabilities, the IPA 310 supports the measurement, model creation, simulation, and verification of interconnects–all in the familiar time domain.

## The IPA Methodology

The IPA methodology involves using a high-bandwidth, high accuracy acquisition instrument (the 11801B equipped with TDR) to extract a reflection profile of the interconnect. Through special processing algorithms, one of a number of different model types can then be extracted. By automatically creating a simulation environment that represents the measurement environment, the simulated and measured results can be directly compared. This comparison *step* accomplishes the important *step* of model verification. This closed-loop process results in high confidence in the accuracy of the model. The interconnect model can then be combined with active circuitry to predict performance at the package or system level.

**MEASUREMENT**

The first step in the process of extracting a SPICE model involves using Time Domain Reflectometry (TDR) to get a reflection profile of the interconnect. The 11801B Digital Sampling Oscilloscope is an integral part of the IPA system. Combined with the SD-24 dual channel TDR/sampling head, the IPA 310 has unsurpassed TDR performance. The fast 35 ps reflected risetime (typically 28 ps) of

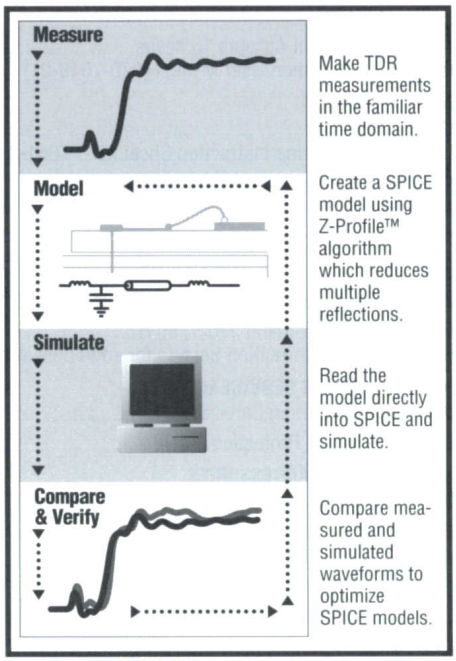



*Figure 1. The IPA 310 integrates measurement and simulation domains into a single, turnkey system*

the SD-24 ensures the highest resolution and accuracy. The IPA Nexus and high quality cables provided with the system ensure signal fidelity at the DUT interface.

The 11801B is used to provide the fast risetime stimulus and to capture the reflection profile of the IC package or other interconnect. This reflection profile, along with the open circuit or short circuit reflection at the DUT interface is transferred to the IPA software, residing on the PC.

# Interconnect Parameter Analyzer





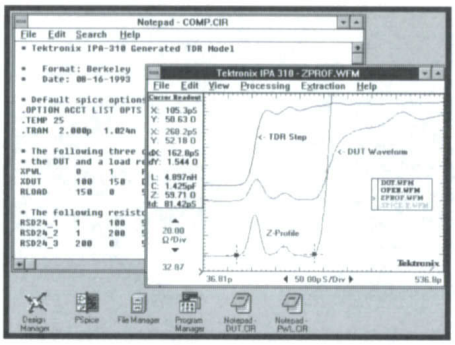



*Figure 2. Create and verify SPICE simulation models of IC packages and interconnect used in high-speed systems.*

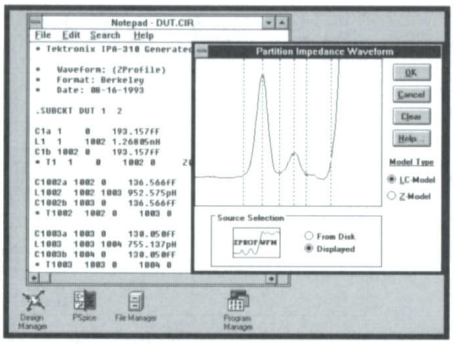



*Figure 3. The IPA 310 automatically creates SPICE models from a user defined segmentation of the Z-Profile waveform.*

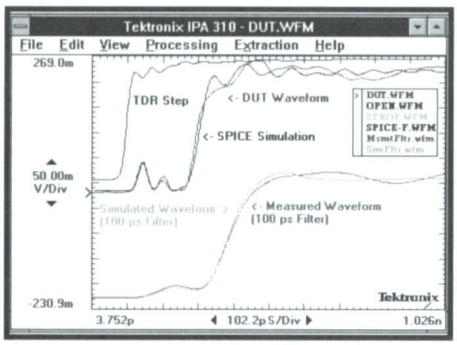



*Figure 4. Verify models by comparing simulated and measured waveforms. Filter the measured and simulated waveforms to verify the model at a user specified signal risetime.*

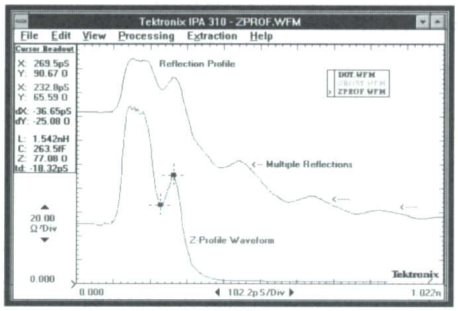



*Figure 5. Z-Profile reduces the effects of multiple reflections. The resulting waveform is scaled directly in ohms, not rho. This allows for inductance, capacitance, and impedance to be measured over any portion of the waveform.*

## MODELING

Using special algorithms built in to the IPA software, a number of different model types can be extracted. The Z-Profile algorithm is used to reduce the effects of multiple reflections inside the interconnect structure that degrade resolution and make it difficult to extract model parameters. The result of using Z-Profile is a true impedance profile, scaled in ohms. Cursors can then be used to extract inductance, capacitance, average impedance, and time delay over any section of the waveform. In addition, a SPICE model consisting of LC lumped elements or transmission line segments can be automatically extracted and written to disk as a standard, Berkeley compatible SPICE file. Other models such as lumped coupled, coupled transmission lines, and lossy elements can also be extracted.

## SIMULATION

Once an interconnect model has been created from the measured data, the model must be simulated in order to proceed to the verification process. Because the models created with the IPA 310 are standard Berkeley SPICE subcircuits, virtually any SPICE simulator can use them. The IPA 310 automatically generates the necessary simulation support files to create a simulation environment that represents the measurement environment. The IPA 310 automatically generates a SPICE Piece-Wise Linear voltage source to model the incident TDR waveform to act as the simulation stimulus. A Berkeley-compatible composite SPICE file combines the model of the TDR step with the interconnect model. By using PSpice resident on the PC, the composite SPICE file can be run very quickly The resulting waveform can then be imported into the IPA for verification.

## VERIFICATION: THE KEY TO ACCURATE SIMULATION

For the first time, you can directly overlay measured and simulated responses to instantly verify the accuracy of interconnect models. Optimization involves the simple process of adjusting parameters or modifying the model and re-simulating. By filtering the measured and simulated waveforms the model performance can be evaluated at the risetime of interest. Users can add models of active circuitry to predict the real performance of devices including the effects of interconnect.

Direct model verification through comparison with measured results means greater confidence in the design of high-speed systems, ICs, and interconnect. With more accurate simulation you can expect to shorten your time to market by eliminating design turns, reduce the cost and improve the quality of your designs through a better understanding of noise and timing margins.

## The Z-Profile™ Advantage

The IPA 310's proprietary Z-Profile algorithm overcomes two major limitations of traditional TDR measurements. First, traditional TDR returns data scaled in units of rho–the reflection coefficient. Extraction model parameters, such as inductance and capacitance, from data scaled in rho requires additional calculations to first scale the data in ohms.

Calculating ohms from the reflection coefficient is relatively simple and is accurate for a response with only one significant reflection. However, for a DUT with two or more discontinuities, multiple reflections and re-reflections between the discontinuities make the TDR results very difficult to interpret. In addition, calculating impedance directly from rho is no longer valid. To accurately measure impedance in the presence of multiple reflections requires special processing.

The Z-Profile algorithm minimizes the effects of multiple reflections and provides results 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 310 also provides cursors with direct readout of inductance, capacitance and impedance. The end result is faster model development and more accurate models, verified with actual measurements.

# Interconnect Parameter Analyzer



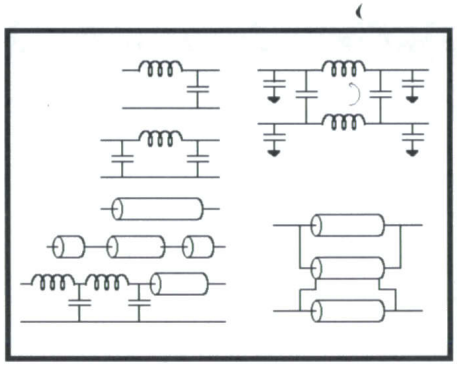


*Figure 6. The IPA supports a variety of model types that can be used with any SPICE simulator.*

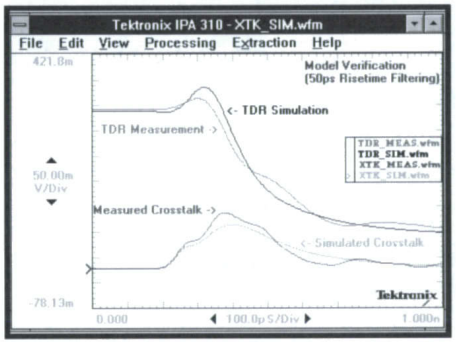



*Figure 7. The IPA 310 can create coupled models to predict crosstalk. These models can be verified by comparing the simulated and measured waveforms.*

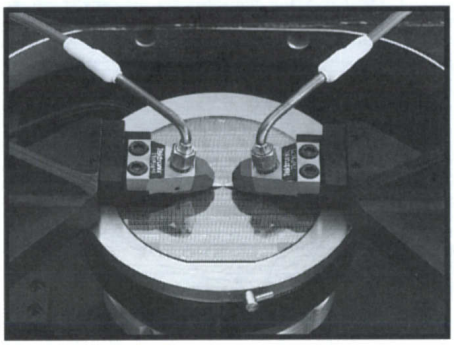


*Figure 9. Characterize MCMs, hybrids, and wafers using the TMP 9000 microwave probes.*

## Coupled Model Extraction

When coupling exists between nearby conductors, crosstalk is a concern. The IPA 310 can create a coupled model that allows the designer to simulate crosstalk. This is accomplished by using both channels of the SD-24 TDR/Sampling head to launch a step down one conductor while monitoring another for crosstalk. The IPA 310 can then extract the self inductance, mutual inductance, total capacitance and mutual capacitance for the two conductors. The coupled model can be verified by comparing the simulated and measured crosstalk and the simulated and measured TDR responses. Once again, filtering can be used to verify the model at the risetime of interest.

## Reliable, Repeatable DUT Connection

The IPA 310 comes standard with a precision, multi-line interface called the IPA Nexus, making the IPA 310 a complete, turnkey system for modeling and verifying high-speed interconnect. The Nexus accommodates established high-speed IC packages, including pin-grid arrays quad flat packs, SOICs and other popular packages.

The IPA Nexus supports up to 12 signal lines and pin spacing ranging from 100 to 15 mils. Its careful design creates a high-performance environment that ensures outstanding signal integrity. Quality cabling, accessories and options add flexibility to the IPA 310's fixture.

For newer technologies that require microwave probing, such as Multichip Modules, the IPA 310 supports a probe station and Tektronix TMP 9000 microwave probes.

Included with the IPA 310 is an interconnect accessory kit containing two high-quality SMA cables, 50 Ω terminators, shorts, cable wrench, and a torque wrench.

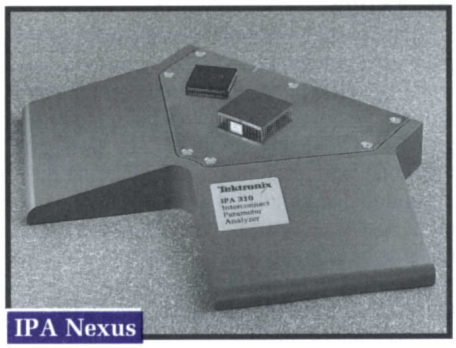



*Figure 8. The IPA Nexus is a precision multi-line interface to standard IC packages.*

## A Complete Solution

The IPA 310 is the first complete time-domain solution for creating and verifying SPICE models of interconnect. These models, combined with active circuit models can be used to predict system level performance early in the design process, reducing design turns and improving product quality.

## IPA 310 Capabilities

### MODEL TYPES

- Models built from multiple LC segments
- Distributed models consisting of multiple transmission line segments
- Coupled LC models for simulating crosstalk
- Coupled transmission lines
- Automatic Piece-wise Linear voltage sources of waveforms
- Automatic generation of composite SPICE file

### PROCESSING CAPABILITIES

- Z-Profile for enhanced TDR resolution and true impedance profile
- Filtering to view measured and simulated response at user-specified risetime
- Waveform math includes integration, add, subtract, multiply, and divide on any two waveforms
- Calculation of self inductance, mutual inductance, total capacitance, and mutual capacitance
- 11801B Digital Sampling Oscilloscope provides many additional waveform math functions
- 11801B includes the powerful 11000 series measurement system including statistical database, statistical measurements, mask testing, timing, voltage, and area/energy measurements.

### HIGH-SPEED INTERFACE TO DEVICE

- IPA Nexus for interfacing to PGA, QFP, SOIC, LCC, CC and DIP package styles
- Support for probe station and Tektronix TMP 9000 microwave probes
- Direct connection to SMA interface for characterizing cables or connectors
- Interface to PCB interconnect using coaxial probes

### CURSOR CAPABILITIES

- Volts, time, delta-V and delta-t
- Inductance, capacitance, average impedance, point impedance, round trip and one-way time
- Single or double cursors
- Ability to lock cursors to waveform or float on waveform display
- Cursor types include vertical, horizontal, or cross-hair including dot or solid options

# Interconnect Parameter Analyzer





**USER INTERFACE**
- On-Line, context sensitive help
- Annotation labels for waveforms and comments
- Cut & paste of waveform display for use in other applications
- Microsoft Windows 3.1 environment
- User-definable waveform color
- User-selectable graticule options
- Waveform legend for selecting, viewing or hiding waveforms
- Auto-scale, zoom and lock-waveform-scaling options
- Ability to drag and overlay waveforms for comparing simulated and measured results

**FILE FORMATS**
- Waveform formats: Tektronix 11K or time-voltage
- Scope settings saved on disk in Tektronix 11K format
- PSpice ".out" format converted to IPA ".wfm" format
- Berkeley SPICE compatible net-lists
- IPA setups saved and recalled in ".ipa" ASCII format

**STORAGE CAPABILITIES**
- Save and load waveforms on disk
- Save and load 11801B scope settings on disk
- Save and load IPA software setups on disk

**PRINTER SUPPORT**
- Support for the Phaser 200e color printer provided with the system
- Any graphics printer with a Windows print driver installed

## Standard System Configuration

**INSTRUMENTATION AND FIXTURING**
- 11801B Digital Sampling Oscilloscope
- SD-24 Dual Channel TDR/Sampling Head
- IPA Nexus (High-Speed Fixture for PGA Packages)
- QFP-25 Quad Flat Pack Adapter (or substitute)
- Coaxial Adapter Kit. Includes: 2 ea. High-Quality SMA Cables; 2 ea.; 2 ea.
- Torque Wrench

**SYSTEM SOFTWARE**
- IPA 310 Interconnect Parameter Analyzer Software
- PSPICE Evaluation Software by MicroSim
- GPIB Driver Software
- Norton Utilities for the PC
- DOS 6.0 and Windows 3.1

**CONTROLLER AND PRINTER**
- Compaq Prolinea, 50 MHz 486 PC; 240 MB Hard Drive; 16 MB RAM; 5.25 in. & 3.5 in. Floppy; Mouse; Keyboard
- NEC 4FG SVGA Monitor
- Tektronix Phaser 200e Color Printer
- National Instruments GPIB Card

**OTHER**
- Sample IC Packages, Copper Tape
- GPIB Cable
- Printer Cable

**SYSTEM INTEGRATION AND INSTALLATION**
- System Integration by Tektronix Integration Center
- On-Site Installation and Product Verification

*PSpice® is a registered trademark of MicroSim Corporation.*

## ORDERING INFORMATION

**IPA 310**
Standard System ..... **$74,950**
**Includes:** All system components listed above plus IPA 310 User Manual, all standard 11801B manuals and accessories, Compaq Prolinea manuals, PSPICE manuals.
**Opt. 02** – Add NEC 5GL 17" Display ..... **+$1,600**
**Opt. 20** – Delete 11801B Sampling Oscilloscope ..... **–$20,000**
**Opt. 21** – Delete SD-24 TDR/Sampling Head ..... **–$3,500**
**Opt. 22** – Delete IPA Nexus Package Fixture ..... **–$8,000**
**Opt. 23** – Delete NEC 4GL Display ..... **–$950**
**Opt. 24** – Delete Tektronix System Console ..... **–$500**
**Opt. 30** – Substitute QFP4-25 for Standard QFP ..... **NC**
**Opt. 31** – Substitute QFP2-50 for Standard QFP ..... **NC**
**Opt. 32** – Substitute QFP4-50 for Standard QFP ..... **NC**
**Opt. 34** – Include all four QFP Adapters ..... **+$4,850**

**11801B OPTIONS**
**Opt. 1R** – Rackmount ..... **+$250**
**Opt. 1M** – Multichannel Conversion. Modifies 11801B to permit operation with up to four SM-11 Multichannel Units. ..... **+$1,000**

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. Q1** – Warranty-Plus 1 cal/PM W/1 year ..... **+$7,500**
**Opt. Q2** – Warranty-Plus 2 cal/PM W/2 year ..... **+$13,500**
**Opt. Q3** – Warranty-Plus 3 cal/PM W/3 year ..... **+$20,250**

**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1** – Universal European, 220V, 50 Hz ..... **NC**
**Opt. A2** – UK, 240V, 50 Hz ..... **NC**
**Opt. A3** – Australia, 240V, 60 Hz ..... **NC**
**Opt. A4** – North America, 240V, 60 Hz ..... **NC**
**Opt. A5** – Switzerland, 220V, 50 Hz ..... **NC**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

SD-14/-20
SD-22/-24
SD-26/-30
SD-32/-42
SD-46/-51

# Sampling Heads

## CSA 803A/11801B Series

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

**SD-14**

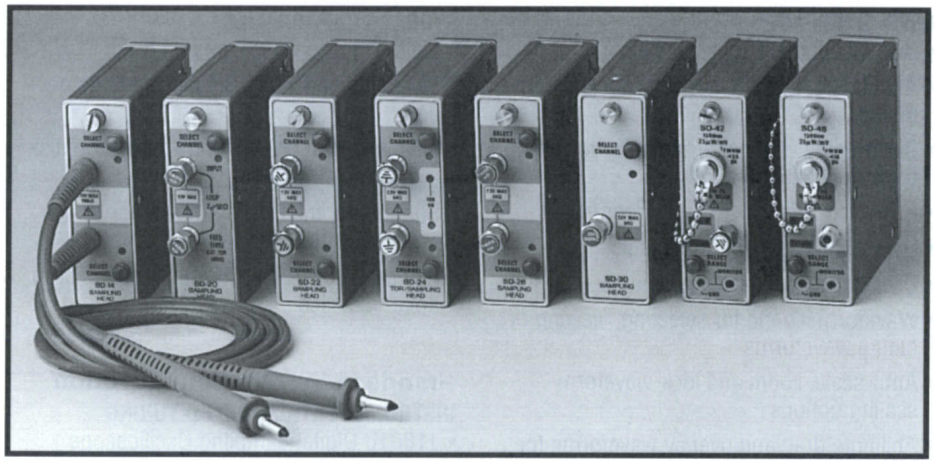
- 100 kΩ, 0.475 pF Typical
- 7 V p-p Dynamic Range
- 3 GHz Bandwidth
- ECL, CMOS and GaAs Device Characterization

**SD-20**

- Loopthrough Sampling Head
- Unterminated
- 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 0.475 pF capacitance results in very low loading of the device under test. The 7 volt 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 multichannel unit, it is possible to configure up to 136 channels of high impedance, high-bandwidth acquisition with measurement accuracy approaching 140 ps.

### 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.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Sampling Heads
## CSA 803A/11801B Series





### 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 risetime.

### 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.

### SD-42 Optical-to-Electrical Converter

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.

For more information on this product, see the Opto-Electronics Instruments section, of this catalog.

### SD-46 Optical-to-Electrical Converter

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.

For more information on this product, see the Opto-Electronics Instruments section, of this catalog.

### 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.

*Continued on next page.*

**SD-24**
- TDR/Sampling Head
- Dual-Channel, Differential TDR
- 20 GHz Bandwidth
- 35 ps Reflected Risetime
- Line Impedance & Crosstalk Characterization

**SD-26**
- 20 GHz Bandwidth
- Dual-Channel

**SD-30**
- 40 GHz Bandwidth
- Single-Channel
- High Bandwidth Communications and Microwave Applications

**SD-32**
- 50 GHz Bandwidth
- Single Channel

**SD-42**
- Optical-to-Electrical Converter
- DC to 6.4 GHz Optical Bandwidth
- 1000-1700 nm Wavelength Range

**SD-46**
- 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

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

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# SD-14/-20 SD-22/-24 SD-26/-30 SD-32/-42 SD-46/-51 Sampling Heads

## CSA 803A/11801B Series

### SAMPLING HEAD CHARACTERISTICS

| | Channels | Bandwidth | Risetime | Impedance | Noise | Applications (Typical) |
|---|---|---|---|---|---|---|
| SD-14 | 2 | 3 GHz | 140 ps | 100 kΩ/0.475 pF | 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: 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 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.

**Dynamic Range** – 1 V p-p within a ±1.6 V range for the SD-20, SD-22, SD-24, SD-30; 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: 50 Ω ±0.5 Ω. SD-14 is 100 kΩ and 0.475 pF. SD-20 is not terminated and not rated.

**Displayed Noise** –

| With unity dot response: Typical | Maximum | |
|---|---|---|
| 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 |
| **With smoothing:** | | |
| SD-20, SD-24, SD-26 | 550 µV | 350 µV |
| SD-22 | 400 µV | 180 µV |
| SD-30 | 1 mV | 700 µV |

**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 100).

**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 ±0.5 Ω.

**Aberrations (at ±250 mV amplitude)** – 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 (not SD-14/SD-20). 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
## CSA 803A/11801B Series

SD-32/-42 SD-46/-51 SD-14/-20 SD-22/-24 SD-26/-30



## ORDERING INFORMATION

**SD-14**
High Impedance Probe Sampler.....**$4,500**
**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.....**$4,400**
**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-22**
Low-Noise Sampling Head.....**$3,780**
**Includes:** Installation/User Reference (070-7226-01), Service Reference (070-7227-01), 2 SMA short-circuit terminations (015-1020-00).

**SD-24**
Dual TDR/Sampling Head.....**$5,250**
**Includes:** Installation/User Reference (070-7052-00), Service Reference (070-7053-00), SMA short-circuit terminations (015-1020-00).

**SD-26**
Dual Sampling Head.....**$3,780**
**Includes:** Installation/User Reference (070-7226-01), Service Reference (070-7227-01), 2 SMA short-circuit terminations (015-1020-00).

**SD-30**
Sampling Head.....**$9,450**
**Includes:** Installation/User Manual (070-7904-00); Service Manual (070-7905-00); 1 SMA short circuit termination (015-1020-00).

**SD-32**
Sampling Head.....**$12,500**
**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.....**$3,995**
See the Telecommunication Instruments section for complete information.

**SD-46**
Optical-to-Electrical Converter.....**$6,995**
See the Telecommunication Instruments section for complete information.

**SD-51**
Trigger Head.....**$3,500**
**Includes:** Installation/User Manual (070-7338-00), Service Reference (070-7339-00), 12 in. SMA male-to-male (174-1364-00).

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. Q2 –** Customer Site HW Service
SD-14.....**+$685**
SD-20.....**+$610**
SD-22.....**+$535**
SD-24.....**+$760**
SD-26.....**+$535**

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

**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.....**$995**
3.5 GHz, 1 pF/500 Ω, 10X 3 GHz, 1.1 pF/ 5000 Ω, 100X, 1.5 m. Order P6156 Opt. 25.....**$330**
Optional Tips: 1X, 10X, 20X, 100X, See page 457.
Requires SMA male-to-BNC female adapter when attached to SMA-type inputs. Order 015-0554-00.....**$47**
**Microwave Probes –** See pages 468 and 469 for full details.

**ADDITIONAL ACCESSORIES**
**SMA Accessory Kit –** 2 each 2X and 5X attenuators; 2 each SMA Terminations, Male Short Circuit, Female Short Circuit, Male 50 Ω, Female 50 Ω, 2 each 50 Ω Signal Cables (2 ns), 2 each 500 ps Semi-Rigid Cable, 2 each Male-to-Male adapters, 2 each SMA Male-to-BNC Female, 2 each Female-to-Female, 1 each 50 Ω Power Divider, 1 each Combination Wrench (.312, 6 point). Order 020-1693-00.....**$2,605**

**3.5 mm Accessory Kit –** 1 each 50 Ω Reference Air Line, 1 each Male-to-Male Adapter, 1 each Female-to-Female Adapter, 1 each 26.5 GHz 50 Ω Terminator (Male), 1 each 26.5 GHz 50 Ω Terminator (Female), 1 each 26.5 GHz Short Circuit (Male), 1 each 26.5 GHz Short Circuit (Female), 2 each 50 Ω Terminators (6 dB 26.5 GHz, 2.9 mm), 2 each 50 Ω Terminators (20 dB 26.5 GHz, 2.9 mm), 1 each Power Divider (26.5 GHz, 2.9 mm), 2 each Signal blews (2 ns, Male-to-Male), 2 each Signal Cables (500 ps, Male-to-Male, 2.9 mm semi-rigid), 1 each Torque Wrench, 1 each Combination Wrench (0.312, 6 point), 1 each Combination Wrench (0.281, 6 point). Order 020-1692-00.....**$8,365**

**2X Attenuator –** SMA Male-to-Female. Order 015-1001-00.....**$225**

**5X Attenuator –** SMA Male-to-Female. Order 015-1002-00.....**$210**

**75 Ω to 50 Ω Min Loss Attenuator –**
BNC, AC coupled. Order 011-0112-00.....**$105**

**Power Divider –** Order 015-1014-00.....**$315**

**Blank Sampling Head –** Order 200-3395-00.....**$1.05**

**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.....**$1,285**

**DC Block (Coupling Capacitor) –** BNC. Order 015-1013-00.....**$380**

**Slip-On Connector –** Order 015-0553-00.....**$46**

**Connector Savers –** (SMA) Order 015-0549-00.....**$185**
(APC) Order 015-0552-00.....**$280**

**CABLES AND EXTENDERS**
**Sampling Head Extender Cables –**
(1 m) Order 012-1220-00.....**$850**
(2 m) Order 012-1221-00.....**$935**

**Acquisition Extender –** Order 067-1324-00.....**$130**

**Acquisition System Extender –**Order 067-1323-00.....**$1,690**

**Card Cage Extender –** Order 067-1267-00.....**$1,360**

**Multi-Channel Kit –** For 11801A. Order 040-1267-01.....**$1,650**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# SM-11
# DL-11
# SIU 800

# Multi Channel Unit Delay Line

*Developed for use in applications such as TDR circuit board testing and cable testing.*

**SM-11**

- Multi-Channel TDR and Simultaneous Acquisition
- Up to 136 Acquisition Channels when Connected to the 11801B Digital Sampling Oscilloscope

**DL-11**

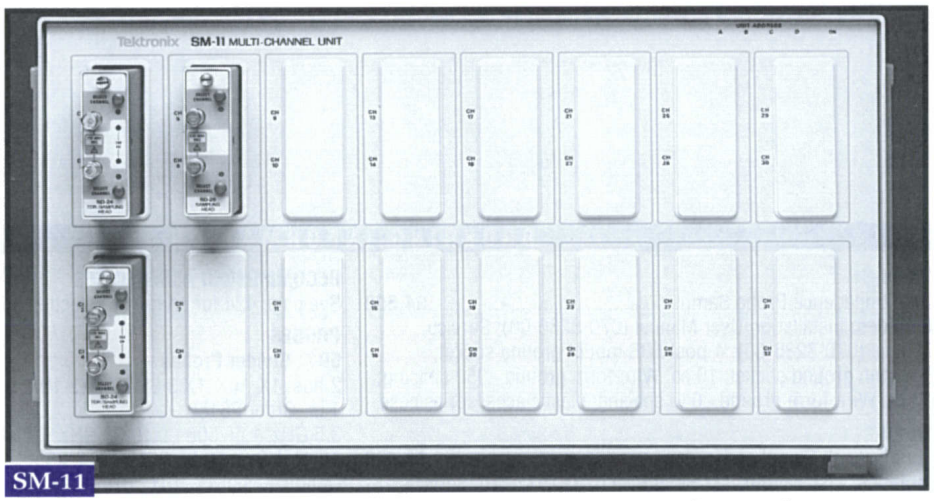
- 47.5 ns Compensated Dual Delay Line
- 5 GHz Bandwidth

**CALIBRATION STEP GENERATOR**

- 250 mV
- Verifies Specifications of SD-20, SD-22, SD-24, SD-26 Sampling Heads.

**SIU 800**

- <40 ps Reflected Risetime when used with SD-24
- <80 mp Reflection Coefficient




SM-11

*The SM-11 Multi-Channel Unit can accept up to 16 SD-Series Sampling Heads.*

## SM-11 Multi-Channel Unit

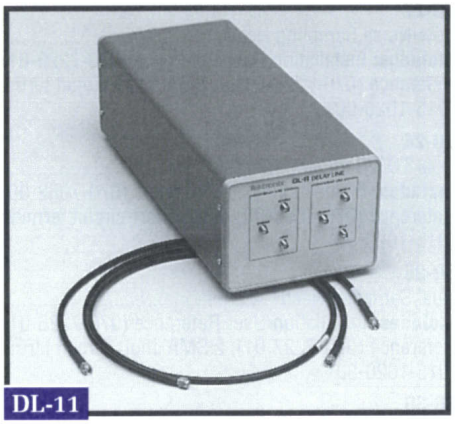
The SM-11 Multi-Channel Units expand the 11801B Digital Sampling Oscilloscope to 136 channels. Each SM-11 accepts up to 16 of the SD-Series Sampling Heads; an 11801B mainframe, with Option 1M added, is capable of driving up to four SM-11 Units. The entire system can then be driven through a single GPIB 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 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

## 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 |

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# 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-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 1.5 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 risetime 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

**SM-11**
Multi-Channel Unit ..... **$24,500**
**Includes:** Installation/User Manual (070-7048-00), Service Reference (070-7049-00), Power Cord, U.S., 120 V (161-0066-00).
**Opt. 1R** – Rackmount. ..... **+$250**

**INTERNATIONAL POWER PLUG OPTION**
**Opt. A1** – Universal Euro: 220 V, 50 Hz ..... **NC**
**Opt. A2** – United Kingdom: 240 V, 50 Hz ..... **NC**
**Opt. A3** – Australian: 240 V, 50 Hz ..... **NC**
**Opt. A4** – North American: 240 V, 60 Hz ..... **NC**
**Opt. A5** – Switzerland: 220 V, 50 Hz ..... **NC**
See Customer Information Section for additional description.

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. Q0** – Installation Service SM11 ..... **+$95**
**Opt. Q2** – Customer Site HW Service SM11 ..... **+$750**
Service Section for additional information.

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

**PROBES**
**50 Ω Divider –**
10X, DC to 9 GHz. Order P6150 ..... **$995**
3.5 GHz, 1 pF/500 Ω, 10X, 3 GHz, 1.1 pF/ 5000 Ω, 100X, 1.5 m. Order P6156 Opt. 25 ..... **$265**
Requires SMA male-to-BNC female adapter when attached to SMA-type inputs. Order 015-0554-00. ..... **$47**

**ADDITIONAL ACCESSORIES**
**SMA Accessory Kit** – 2 each 2X and 5X attenuators; 2 each SMA Terminations, Male Short Circuit, Female Short Circuit, Male 50 Ω, Female 50 Ω, 2 each 50 Ω Signal Cables (2 ns), 2 each 500 ps Semi-Rigid Cable, 2 each Male-to-Male adapters, 2 each SMA Male-to-BNC Female, 2 each Female-to-Female, 1 each 50 Ω Power Divider, 1 each Combination Wrench (.312, 6 point). Order 020-1693-00 ..... **$2,605**

**3.5 mm Accessory Kit** – 1 each 50 Ω Reference Air Line, 1 each Male-to-Male Adapter, 1 each Female-to-Female Adapter, 1 each 26.5 GHz 50 Ω Terminator (Male), 1 each 26.5 GHz 50 Ω Terminator (Female), 1 each 26.5 GHz Short Circuit (Male), 1 each 26.5 GHz Short Circuit (Female), 2 each 50 Ω Terminators (6 dB 26.5 GHz, 2.9 mm), 2 each 50 Ω Terminators (20 dB 26.5 GHz, 2.9 mm), 1 each Power Divider (26.5 GHz, 2.9 mm), 2 each Signal blews (2 ns, Male-to-Male), 2 each Signal Cables (500 ps, Male-to-Male, 2.9 mm semi-rigid), 1 each Torque Wrench, 1 each Combination Wrench (0.312, 6 point), 1 each Combination Wrench (0.281, 6 point). Order 020-1692-00 ..... **$8,365**

**2X Attenuator** – SMA Male-to-Female. Order 015-1001-00 ..... **$225**
**5X Attenuator** – SMA Male-to-Female. Order 015-1002-00 ..... **$210**
**Power Divider** – Order 015-1014-00 ..... **$315**
**Blank Sampling Head** – Order 200-3395-00 ..... **$1.05**
**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 ..... **$1,285**
**DC Block (Coupling Capacitor)** – Order 015-1013-00 ..... **$380**
**Slip-On Connector** – Order 015-0553-00 ..... **$46**
**Connector Savers** – (SMA) Order 015-0549-00 ..... **$185**
(APC) Order 015-0552-00 ..... **$280**

**CABLES AND EXTENDERS**
**Sampling Head Extender Cables**
(1 m) Order 012-1220-00 ..... **$850**
(2 m) Order 012-1221-00 ..... **$935**
**Acquisition Extender** – Order 067-1324-00 ..... **$130**
**Acquisition System Extender** – Order 067-1323-00 ..... **$1,690**
**Card Cage Extender** – Order 067-1267-00 ..... **$1,360**

**DL-11**
Delay Line ..... **$4,200**
**Includes:** Installation/User Manual (070-7050-00), Instruction sheet (070-7051-00), 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 ..... **$7,750**
**Includes:** Instruction sheet; SMA female, short-circuit termination.
**Universal Euro** – 220 V, 50 Hz – Order 067-1338-01 ..... **$7,750**
**United Kingdom** – 240 V, 50 Hz – Order 067-1338-02 ..... **$7,750**
**Australia** – 240 V, 50 Hz – Order 067-1338-03 ..... **$7,750**
**Switzerland** – 240 V, 50 Hz – Order 067-1338-05 ..... **$7,750**
**Japan** – 100 V, 50-60 Hz – Order 067-1338-06 ..... **$7,750**

**SIU 800**
Static Isolation Unit ..... **$1,650**
**Includes:** 12 VDC power supply, two SMA, Male-to-Female adapters, foot switch, two 50 Ω terminators, and an instruction/performance verification manual.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Digital Storage + Analog Real Time Oscilloscopes

## How To Choose The Right Portable Scope For Your Measurement Needs.

The Tektronix 2200 Series digital plus analog scopes span a performance range from 20 MHz to 100 MHz.

To choose the right scope, first characterize your signal and decide if you need full-featured advanced performance or economical standard performance. An advanced 100 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 | 150 MHz | 100 MS/s | 1K | 8-Bits | 2 | GPIB | Dual | 104 |
| 2440 | 300 MHz | 500 MS/s | 1K | 8-Bits | 2 | GPIB | Dual | 104 |
| 2232 | 100 MHz | 100 MS/s | 1K to 4K points | 8-Bits | 2 | GPIB & RS-232 Opt. | Dual | 105 |
| 2221A | 100 MHz | 100 MS/s | 1K to 4K points | 8-Bits | 2 | GPIB & RS-232 Opt. | Single | 105 |
| 2212 | 60 MHz*1 (Analog) | 20 MS/s | 4K points | 8-Bits | 2 | GPIB & RS-232 Opt. | Single | 110 |
| 2201 | 20 MHz*1 (Analog) | 10 MS/s | 2K points | 8-Bits | 2 | RS-232 hardcopy | Single | 112 |
| 2214 | 20 MHz*1 (Analog) | 16 MS/s | 16K Points | 8-Bits | 4 | RS-232 Hardcopy | Single | 108 |

*[1] Digital storage bandwidth limited by maximum sample rate.*

CONTENTS


**2400 SERIES**

2430A 150 MHz .....104
2440 300 MHz .....104

**2200 SERIES**

2212 60 MHz .....110
2201 20 MHz .....112
2232 100 MHz .....105
2221A 100 MHz .....105
2214 20 MHz .....108
2200 Software.....114

**ACCESSORIES**

Probes .....425
SMD Probes/Adapters.....450
Probe and Instrument Accessories .....492
Plotter/Printer .....496
Cameras.....499
Instrumentation Carts .....504

TDS 420
TDS 520A

2430A
2440

# Digitizing Oscilloscopes

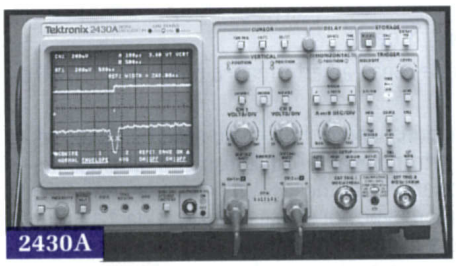
## 2430A/2440 Replacements

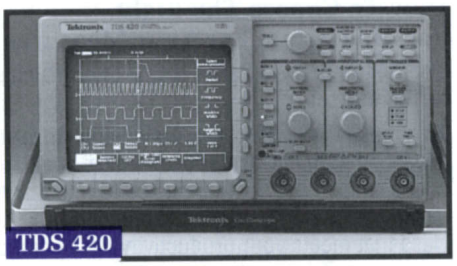
### Note to our Valued 2430A and 2440 DSO customers:

The 2430A and 2400 DSOs have served their markets very well, and are now being 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 *Price!*

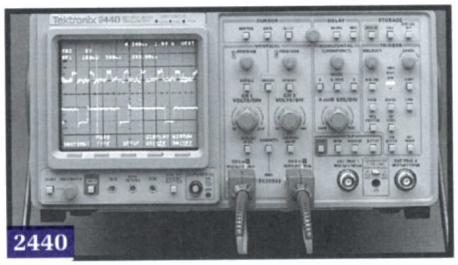
The summary table below highlights the key performance differences between the TDS family and 2400 series DSOs. We at Tektronix are proud to continuously deliver superior value to our customers.

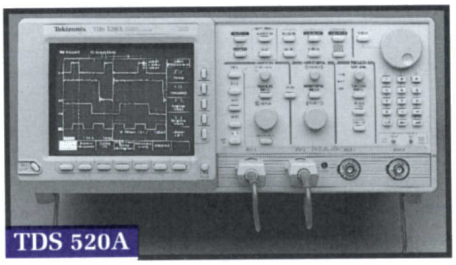
Please contact us for any assistance you require in making your Digitizing Oscilloscope selection. In U.S., call toll free: 1-800-835-9433, Ext. 2400 or contact your nearest Tektronix representative. Please refer to the pages in the back of the catalog for Tektronix contacts in your region.




| | 2430A | → | TDS 420 |
|---|---|---|---|
| Bandwidth | 150 MHz | | 150 MHz |
| Sample Rate | 100 MS/sec | | 100 MS/sec |
| 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 | 1K | | 15K (60K Optional) |
| Update Rate | 30 Hz | | 200 Hz |
| I/O Transfer | GPIB only | | GPIB, RS-232, Centronics |
| Roll Mode | Yes | | Yes + Triggered Roll |
| Horizontal Range | 5 ns-5 seconds | | 1 ns-20 seconds |
| Display Size | 5 in. CRT Size | | 7 in. CRT Size |
| User Interface | Normal | | Graphical User Interface |
| Advanced Math | None | | FFT, Differentiate, Integrate |
| Printer Pack | None | | Optional |
| Price | **$9,695** | | **$5,995** |



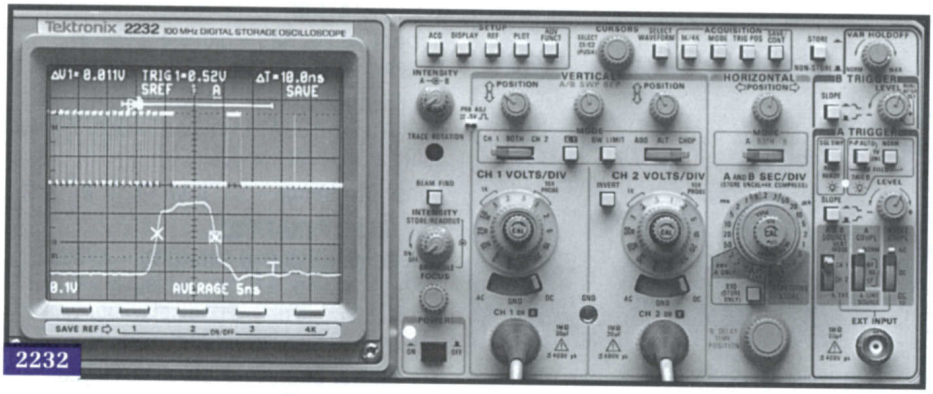




| | 2440 | → | TDS 520A |
|---|---|---|---|
| Bandwidth | 300 MHz | | 500 MHz |
| Sample Rate | 500 MS/sec | | 500 MS/sec |
| Channels | 2 Channels | | 2 + 2 Channels |
| Vertical Accuracy | 1.5% Vertical Accuracy | | 1% Vertical Accuracy |
| Single Shot BW | 200 MHz | | 200 MHz |
| Auto Measure | 21 Auto Measurements | | 25 Auto Measurements |
| Auto Setup | Yes | | Yes |
| Record Length | 1K Memory | | 15K (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-5 seconds | | 1 ns-20 seconds |
| Display Size | 5 in. CRT Size | | 7 in. CRT Size |
| User Interface | Normal | | Graphical User Interface |
| Advanced Math | None | | FFT, Differentiate, Integrate |
| Price | **$10,595** | | **$8,895** |

# Digital+Analog Oscilloscopes

## 100 MHz/100 MS/s






High-end performance, simple operation and affordable price. Any way you look at them, Tektronix' 2232/2221A oscilloscopes are hard to beat. These proven performers offer capabilities you won't find in comparable priced scopes, including: fast sampling, long record times, fault-finding glitch capture and familiar analog operation.

Capture and display random events as narrow as 10 ns in any application. Simply select Peak Detect sampling mode; the 2232 and 2221A maintain 100 MS/s sampling at any sweep speed, on both channels. These scopes are ideal for quickly isolating problems you might miss with another scope.

Extended waveform storage simplifies analysis, troubleshooting and documentation. You can capture either 10 divisions (1K record) or 40 divisions (4K record) of data in a single acquisition, then compress or expand the acquired signal on-screen for ease of analysis. Battery-backed waveform storage saves your acquisitions for up to three years.

On-screen cursors further simplify signal measurement by automatically calculating and displaying time and voltage differentials. The cursors are tied to a selected waveform and can be positioned off-screen for detailed timing analysis.

Make single-shot acquisitions easily–simply set the desired trigger voltage with the aid of trigger-level readouts. The 2232 and 2221A also make triggering easier with multiple trigger modes, including high and low frequency reflect filtering and variable hold-off.

Interested in computerizing your lab application? Consider our popular WaveSaver software package. When equipped with optional RS-232C interface, WaveSaver provides a simple, stand-alone solution for transferring waveforms to and from the 2232/2221A and your PC.

Enjoy dual time bases and an additional 26K memory with the 2232 oscilloscope. The 2232 provides dual time base capability which enables you to quickly zoom in on any portion of a waveform and acquire a full record of information – at up to 500ps sample resolution.

Once stored, you can expand, compress, and reposition any displayed waveform vertically and horizontally for precise analysis or comparison.

What's more, the 2232 comes with 26K of extended, battery-backed memory, enabling you to store up to 26 waveform acquisitions.

**2232/2221A**

- Analog + Digital Storage Operation
- 100 MHz Bandwidth (store and nonstore)
- 2221A: Single Time Base
- 2232: Dual Time Base
- 100 MS/s Digital Sampling Rate
- 10 ns Glitch Capture, Any Sweep Speed
- Selectable 1K or 4K Record Length
- 3-year Battery-Backed Storage for a Single 4K or Three 1K Acquisitions
- 26K Extended Memory for the 2232
- Time and Voltage Waveform Cursors
- Trigger-Level Readout
- Point-Selectable Pre/Post Triggering
- GPIB or RS-232C Communications Options
- 8.2 kg/18 lb.
- 3-Year Standard Warranty
- UL Listed, CSA and VDE Certified
- Two 10X Probes Included

*The Tek 2221A and 2232 100 MHz, 100 MS/s oscilloscopes feature 10 ns glitch capture at any sweep speed offering versatile performance at its affordable best.*

TD

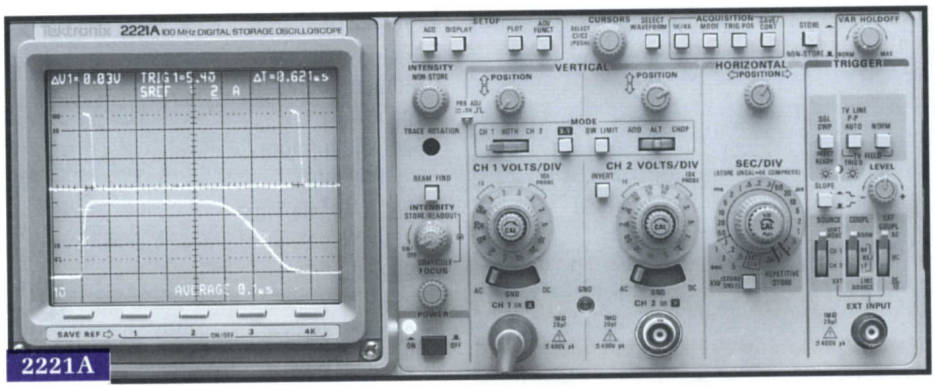
Product available through an Authorized Tektronix Distributor (listed on pages 570-571) 2232 also available through TekDirect. Call 1-800-426-2200.

GPIB IEEE-488 The 2200 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

2232
2221A

# Digital+Analog Oscilloscopes

## 100 MHz 100 MS/s




### Characteristics

**DIGITAL STORAGE SYSTEM**

**Sample Rate –** 100 MS/s per channel. Effective sample rates up to 2 GS/s in repetitive storage mode (0.5 µs/div and faster in single-channel mode, 0.2 µs/div and faster dual-channel).

**Resolution –** Vertical: 8-Bits (25 levels per division), up to 12-Bits in average mode. Horizontal: 10-Bits (100 points per division), 9-Bits per channel in dual channel mode.

**Record Length –** 4K or 1K selectable. 2K or 512 per channel in dual channel mode.

**Pre/Post Trigger –** 1/8, 1/2, or 7/8 trigger position selectable, point-selectable via menu.

**Acquisition Modes –** Peak Detect (10 ns glitch capture at all available sweep speeds); Accumulated Peak Detect; Average (weight-selectable from 1/1 to 1/256 in a binary sequence); and Sample.

**Save Reference Memory –** One 4K or three 1K acquisitions. Battery-backed memory stores waveforms for up to 3 years.

**2232 Additional –** 26K of extended memory (store up to 26 waveform sets).

**VERTICAL SYSTEM (2 IDENTICAL CHANNELS)**

**Bandwidth (–3 dB) and Rise Time –** 100 MHz and 3.5 ns (0°C to +35°C); 80 MHz and 4.4 ns (2 mV/div or +35°C to +50°C).

**Deflection Factor and Accuracy –** 2 mV/div to 5 V/div ±2% (+15°C to +35°C); ±3% (0°C to +50°C).

**Vertical Operating Modes –** CH 1, CH 2, CH 2 INVERT, ADD, ALT, CHOP (500 kHz), and XY.

**CMRR –** At least 10:1 at 50 MHz.

**Input R and C –** 1 MΩ, 20 pF.

**Max Input Voltage –** 400 V (dc + peak ac), 800 V p-p.

**Channel Isolation –** 100:1 at 50 MHz.

**HORIZONTAL SYSTEM**

**Sweep Speeds –** A sweep: 0.5 s/div to 0.05 µs/div, extended to 5 ns/div with X10 magnification. 5 s/div to 0.05 µs/div in store mode.

**2232 Additional –** B Sweep: 50 µs/div to 0.05 µs/div.

**Accuracy –** Nonstore Mode: X1: ±2%; X10: ±3% (+15°C to +35°C). X1: ±3%; X10: ±4% (0°C to +50°C). Store Mode: ±0.1% over full 10.24 divisions.

**Horizontal Operating Modes –** 2232: Nonstore Mode: A, ALT (A intensified by B and B), B. Store Mode: A, A intensified by B, B, 4K COMPRESS. 2221A: 4K COMPRESS in store mode.

**Delay Jitter –** 5000:1. (2232)

**Delay Time Accuracy –** ±1% (+15°C to +35°C); ±2% (0°C to +50°C).

**TRIGGER SYSTEM**

**Trigger Sensitivity (A and B) –** Internal: 0.35 div at 10 MHz, 1.5 div at 100 MHz. External: 40 mV at 10 MHz, 150 mV at 100 MHz. (A trigger only on 2232.)

**Trigger Operating Modes –** A-Mode: P-P AUTO (also for TV LINE), NORM, TV FIELD, SGL SWP.

**2232 Additional –** B-Mode: Runs-After-Delay, Triggered-After-Delay.

**Trigger Source –** A Trigger: VERT MODE, CH 1, CH 2, LINE, EXT.

**2232 Additional –** B Trigger: VERT MODE, CH 1, CH 2.

**Trigger Coupling –** With Internal Source: AC with P-P AUTO, TV LINE, or TV FIELD mode; DC with NORM or SGL SWP mode. With external source: AC, DC, or DC/10. With either source: HF REJECT (attenuates above 40 kHz), LF REJECT (attenuates below 40 kHz).

**Variable Holdoff –** At least 10:1.

**X-Y OPERATION**

**Deflection Factors –** Same as vertical system.

**Bandwidth –** X-Axis: 2.5 MHz in nonstore mode, up to 100 MHz in store mode. Y-Axis: same as vertical system.

**Phase Difference –** ±3° from DC to 150 kHz.

**ADVANCED FUNCTIONS**

**Cursor Function and Accuracy –** ΔVolts: ±3% of reading. ΔTime: ±1 display interval (5 s/div to 1 µs/div); ±[2 display intervals +500 ps] (0.5 µs/div to 0.05 µs/div).

**X-Y Plotter Output –** Plots all displayed waveforms, CRT readout, and graticule (selectable).

**External Clock Input –** DC to 1 kHz (roll mode), DC to 100 kHz (record mode).

**ANSI/IEEE-488 GPIB Interface (Opt. 10) –** Function Subsets Implemented: SH1, AH1, T5, L3, SR1, RL2, PP0, DC1, DT0, C0, E2. Plotter Devices: HPGL, Epson FX-Series, HP ThinkJet. Data Transfer Rate: approximately 1 KB.

**EIA Std RS-232C Interface (Opt. 12) –** Baud Rate: 50 to 2400 for interactive use, up to 4800 for driving plotters. Plotter Devices: HPGL, Epson FX-Series, HP ThinkJet. Connectors: DCE (female), DTE (male).

**CRT SYSTEM**

**Display –** 8 cm x 10 cm, 14 kV nominal voltage.

**Controls –** A INTENSITY, TRACE ROTATION, BEAM FIND, FOCUS, STORAGE/READOUT INTENSITY, GRATICULE ILLUMINATION.

**2232 Additional –** B INTENSITY.

**Z-Axis –** 5 V causes noticeable modulation. Usable to 20 MHz.

**POWER REQUIREMENTS**

**Line Voltage Range –** 90 VAC to 250 VAC.

**Line Frequency –** 48 Hz to 440 Hz.

**Max. Power Consumption –** 85 W (150).

**ENVIRONMENTAL/SAFETY CHARACTERISTICS**

Instrument meets in part, the environmental requirements of MIL-T-28800D or C for Type III, Class 3, Style D or C equipment described as below.

**Ambient Temperature –** Operating: 0°C to +50°C. Nonoperating: –40°C to +71°C.

**Humidity –** 95%, five cycles (120 hours) referenced to MIL-T-28800D, paragraph 4.5.5.1.2.2.

**Altitude –** Operating: to 4,500 m (13,716 ft.). Max. operating temperature decreases 1°C for every 303 m (1,000 ft.) above 1,515 m (5,000 ft.). Nonoperating: to 15,240 m (50,000 ft.).

# Digital+ Analog Oscilloscopes

## 100 MHz 100 MS/s



**EMC –** Meets Class B requirements per VDE 0871-B for radiated and conducted emissions and FCC requirements.

**Vibration –** Operating: 15 minutes along each of the three major axes. 0.015 inch p-p displacement 10 Hz to 55 Hz to 10 Hz in one-minute cycles. Holds for 10 minutes at 55 Hz (2.4 g at 55 Hz).

**Shock –** Operating: 30 g, 1/2 sine, 11 ms duration, 3 shocks per axis along each major axis. Total of 18 shocks.

**Safety –** UL listed 1244, Certified to CSA C22.2 No. 231-M39.

### PHYSICAL CHARACTERISTICS

| Dimensions | mm | in. |
|---|---|---|
| Width w/handle | 360 | 14.2 |
| Height | 137 | 5.4 |
| Depth w/o front cover | 440 | 17.3 |
| **Weight** | **kg** | **lb.** |
| Net | 8.2 | 18 |

### • ACCESSORY •

**AM503S**

- Simultaneous AC/DC broadband current measurement system.
- DC to 50 MHz with A6302 probe.
- DC to 15 MHz with A6303 probe.

*For complete selection information on all Accessory products, see page 424.*

### ORDERING INFORMATION

**2221A**
100 MHz Single Time Base Analog Plus Digital Storage Oscilloscope ..... TD **$4,695**

**Includes:** Two 10X Voltage Probes (P6109B); Operator's Manual (2221A: 070-8156-00; 2232: 070-7066-00); User's Reference Guide (2221A: 070-8158-00; 2232: 070-7068-00); Front Panel Cover (200-2520-00); Accessory Pouch (016-0677-02); Power Cord; 3-year warranty.

**2232**
100 MHz Dual Time Base Analog Plus Digital Storage Oscilloscope ..... TD **$5,595**

**Includes:** Two 10X Voltage Probes (P6109B); Operator's Manual (2221A: 070-8156-00; 2232: 070-7066-00); User's Reference Guide (2221A: 070-8158-00; 2232: 070-7068-00); Front Panel Cover (200-2520-00); Accessory Pouch (016-0677-02); Power Cord; 3-year warranty.

**INSTRUMENT OPTIONS**
**Opt. 3R –** Rackmount kit ..... **+$425**
**Opt. 10 –** GPIB Interface ..... TD **+$400**
**Opt. 12 –** RS-232C Interface (includes cable) ..... TD **+$400**

**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1 –** Universal Euro (020-0859-00) ..... **NC**
**Opt. A2 –** UK (020-0860-00) ..... **NC**
**Opt. A3 –** Australian (020-0861-00) ..... **NC**
**Opt. A4 –** North American (020-0862-00) ..... **NC**
**Opt. A5 –** Switzerland (020-0863-00) ..... **NC**

**WARRANTY-PLUS SERVICE PLANS**
**Opt. M2 –** Repair Protection
2232 ..... **+$250**
2221A ..... **+$240**
**Opt. M8 –** Calibration Service
2232 ..... **+$250**
2221A ..... **+$240**
**Service Manual –** 2221A. Order 070-8157-01 ..... **$145**
2232. Order 070-7067-01 ..... **$145**
**2232 F10 –** GPIB Field Upgrade Kit (For 2221A also) ..... **$400**
**2232 F12 –** RS-232C Field Upgrade Kit (For 2221A also) ..... **$400**

**RECOMMENDED ACCESSORIES**
See page 424 for complete description.

**PROBES**
**Passive Voltage –**
10 MHz/100 MHz, 1X/10X, switchable, with readout. Order P6129B ..... **$100**
100 MHz, 10X, ruggedized, with readout. Order P6109B ..... **$80**
15 MHz, 1X, modular without readout. Order P6101B ..... **$65**
**Current –** 20 Amp max, DC to 50 MHz, w/A6302 current probe. Order AM503S ..... **$2,745**
100 Amp max, DC to 15 MHz, w/ A6303 current probe. Order AM503S Opt. 03 ..... **$3,240**
**High Voltage –** 1.5 kV 100X, 120 MHz with readout. Order P6009 ..... **$270**
40 kV 1000X, 75 MHz with readout. Order P6015A Opt. 1R ..... **$1005**
**Specialty –** 100 MHz, 1X/10X differential probe, FET. Order P6046 ..... **$2,295**
**Logic Probe –** 16 channel word recognizer/Trigger-TTL. Order P6408 ..... **$500**
**Digital Timing Demodulator –** Order TVC501 ..... **$2,495**
**CART –** Order K212 ..... **$395**

**CAMERAS**
**Low-Cost –** With graticule illum. No flash required on camera. Order C-9 Opt. 20 ..... **$630**

**PLOTTER/PRINTER**
**GPIB –** Order HC100 Opt. 01 ..... **$1,260**

**CABLES**
**GPIB Cable, 2m –** 012-0991-00 ..... **$195**
**RS-232C Cable, 12 ft. (straight through)–** 012-0911-00 ..... **$100**
**RS-232C Cable, 9 ft. (null modem) –** 012-1285-00 ..... **$50**
**Carrying Strap –** Order 346-0199-00 ..... **$28**
**Transit Carrying Case –** Order 016-0792-01 ..... **$455**
**Front Panel Cover –** Order 200-2520-00 ..... **$17**
**Accessory Pouch –** Order 016-0677-02 ..... **$50**
**Viewing Hoods –** Collapsible. Order 016-0592-00 ..... **$20**
Binocular. Order 016-0566-00 ..... **$30**
Polarized. Order 016-0180-00 ..... **$100**
**CRT Shields –** Blue. Order 337-2775-00 ..... **$7.00**
Clear. Order 337-2775-01 ..... **$2.90**
**Rackmount Kit –** 016-0833-02 ..... **$425**
**Quick Start Training –** 020-1812-04 ..... **$280**

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571) 2232 also available through TekDirect. Call 1-800-426-2200.

GPIB IEEE-488 The 2200 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Digital+Analog Oscilloscopes

## 20 MHz Analog, 16 MS/s, 4 Channels

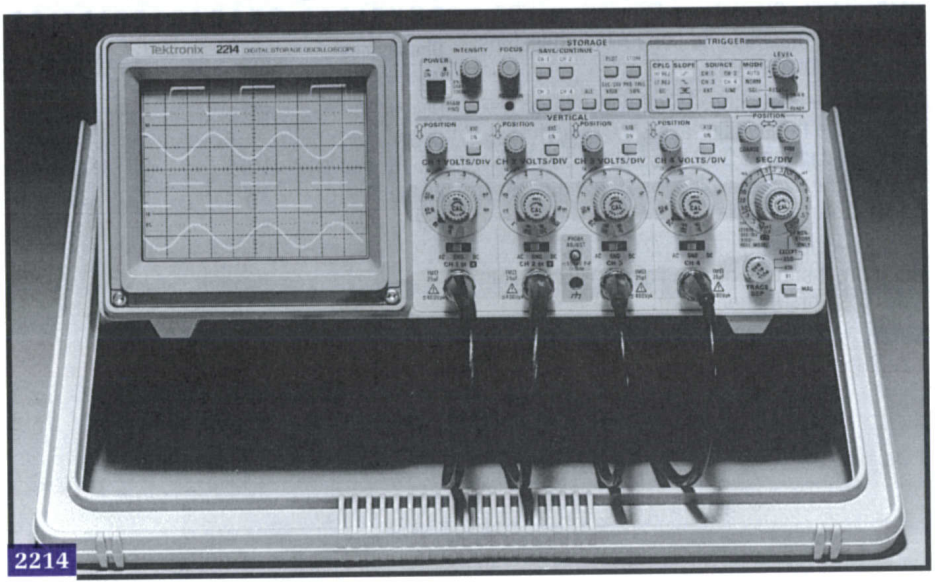
*Four channel DSO with 16K record length for physical signal investigation.*

**2214**

- 20 MHz Bandwidth In Non-Storage
- 16 MS/s per Channel Maximum Concurrent Sampling Rate (Quad Digitizers)
- 16K per Channel Record Length
- 8-Bit Vertical Resolution
- 500 µV/div Vertical Sensitivity
- Full Attenuation on All Channels
- Dual-Differential Measurement Capability (Add/Invert)
- Continuously Variable Timebase in Store and Non-Store Modes
- Roll Display Mode for Slow Events
- Chart-Record Mode
- Graticule Illumination
- RS-232C Interface
- External Clock Input
- 7.9 kg/17.4 lb.
- 3-Year Warranty
- UL Listed, CSA Certified
- Optional External 12 VDC Operation

**APPLICATIONS**

- Physical Signal Investigation




### 2214 Four-Channel Analog/Digital Oscilloscope

Like the rest of Tektronix 2200 Series digital scope family, it combines familiar analog operation with powerful digital capabilities to give you multi-channel data acquisition.

The 2214 uses four digitizers to acquire and display 16K of waveform data per channel. To view that data in greater detail, waveforms may be horizontally expanded up to 50 times. In addition, 500 µV/div vertical sensitivity makes low-level or noisy signals easier to view.

Enhanced triggering capabilities. The 2214 has all the versatility you need to trigger on troublesome real-world signals. Unique triggering features, such as bi-slope triggering, high and low-frequency reject filters and trigger level output make stable triggering easy.

Variable horizontal timebase calibration. Even in store mode, the timebase is continually variable, allowing you to view just the number of events (or machine cycles) you require.

No-hassle documentation. You can output 2214 waveforms directly to HPGL plotters such as Tektronix' four-color HC100. Or for low cost hardcopy use any Epson-compatible dot matrix printer.

For added flexibility, use GRABBER software (included) to transfer waveforms to your PC. Files may be archived, printed or exported for analysis.

### Characteristics

**DIGITAL STORAGE SYSTEM**

**Sample Rate –** 16 MS/s per channel (quad digitizers).

**Resolution –** Vertical: 8-Bits (25 levels per division). Horizontal: 14-Bits (1600 points per division).

**Record Length –** 16K per channel.

**Pre/Post Trigger –** 0%, 50%.

**Acquisition Mode –** SAMPLE, ROLL.

**Save/Continue Memory –** Freeze waveform record on any or all channels (16K/CH) Non-Volatile.

**VERTICAL SYSTEM (4 IDENTICAL CHANNELS)**

**Analog Bandwidth (-3 dB) and Rise Time –** 20 MHz and 17.5 ns (0°C to 40°C).

**Deflection Factor and Accuracy –** 5 mV/div to 5 V/div ±3%. 500 µV/div to .5 V/div ±3%, limited to 1 MHz with X10 vertical Mag.

**Vertical Operating Modes –** CH1, CH2, CH3, CH4, CH1 INVERT, CH3 INVERT, ADD CH1 + CH2, ADD CH3 + CH4, X10 Vertical Mag.

**CMRR –** At least 50:1 at 100 kHz.

**Input R and C –** 1 MΩ, 25 pF.

**Max Input Voltage –** 400 V (dc + peak ac) 800 V p-p.

**Channel Isolation –** 100:1 at 5 MHz.

**HORIZONTAL SYSTEM**

**Sweep Speeds –** 0.5 s/div to 0.1 ms/div, extended to 10 ns/div with X10 Mag. 0.1 ms/div to 0.5 s/div in store mode, extended to 50 s/div with X100 ROLL mode.

TD

Product available through an Authorized Tektronix Distributor (listed on pages 570-571).

# Digital+Analog Oscilloscopes

## 20 MHz Analog, 16 MS/s, 4 Channels

**Accuracy –** Store and Nonstore Modes: X1 ±3%, X10 ±4%, X50 ±7% (+15°C to +35°C); X1 ±4%, X10 ±5%, X50 ±8% (0°C to +40°C).

**Horizontal Operating Modes –** X1, X10, X50, X-Y, ROLL. Continuously variable timebase up to 1 ms/div in store mode.

**TRIGGER SYSTEM**

**Trigger Sensitivity –** Internal: 0.4 div at 5 MHz, 1.5 div at 20 MHz. External: 50 mV p-p at 5 MHz, 250 mV p-p at 20 MHz.

**Trigger Operating Modes –** P-P AUTO, NORM, SGL SWP.

**Trigger Source –** CH1, CH2, CH3, CH4, LINE, EXT.

**Trigger Coupling –** DC, HF REJECT (attenuates above 30 kHz), LF REJECT (attenuates below 30 kHz).

**X-Y OPERATION (NON-STORE)**

**Deflection Factors –** Same as vertical system.

**Bandwidth –** X-Axis: 2 MHz, Y-Axis: same as vertical system.

**Phase Difference –** Non-store Mode: ±3° from DC to 50 kHz.

**ADVANCED FUNCTIONS**

**Trigger Level Output Control –** Selects the amplitude point on the trigger signal that produces triggering. A side panel BNC connector provides the interface for the trigger level.

**External Clock Input –** DC – 8 MHz. ROLL Mode: DC – 16 kHz.

**Hardcopy Interface (RS-232C) –** Plots all 16K records; ROLL mode output for continuous printout of data. Baud rate: 300, 1200, 4800, 9600. Plotter devices: HP-GL, Epson FX-series. Connector: 9-Pin DTE (male).

**CRT SYSTEM**

**Display –** 8 cm x 10 cm, 12.6 kV nominal acceleration voltage. (CRT Readout not available).

**Controls –** INTENSITY, TRACE ROTATION, BEAM FIND, FOCUS.

**POWER REQUIREMENTS**

**Line Voltage Range –** Low: 95 Vac to 128 Vac. High: 185 Vac to 250 Vac.

**Line Frequency –** 48 Hz to 440 Hz.

**Maximum Power Consumption –** 85 W (95 VA).

**ENVIRONMENTAL CHARACTERISTICS**

**Ambient Temperature –** Operating: 0°C to +40°C. Nonoperating:–55°C to +75°C.

**Humidity –** 95%, five cycles (120 hours) referenced to MIL-T-28800C, paragraph 4.5.5.1.2.2, type III, Class 5 instruments.

**Altitude –** Operating: to 4,500 m (15,000 ft.). Nonoperating: to 15,000 m (50,000 ft.).

**EMC –** Meets Class B requirements per VDE 0871 for radiated and conducted emissions and FCC section 15, subpart J, class A requirements.

**Vibration –** Operating: 15 minutes along each of 3 major axes. 0.015 in. p-p displacement 10 Hz to 55 Hz to 10 Hz in one-minute cycles. Hold for 10 minutes at 55 Hz (2.4g at 55 Hz).

**Shock –** Operating: 30 g, 1/2 sine, 11 ms duration, 3 shocks per axis along each major axis. Total of 18 shocks.

**Safety –** UL 1244 listed, CSA certification.

**PHYSICAL CHARACTERISTICS**

| Dimensions | mm | in. |
|---|---|---|
| Width w/handle | 380 | 15.0 |
| Height | 137 | 5.4 |
| Depth w/o front cover | 438 | 17.2 |
| **Weight** | **kg** | **lb.** |
| Net | 7.9 | 17.4 |

**• ACCESSORY •**

### Direct Access to SMD Package

**P6561AS**

- SMD Package Support.
  - 50 mil
  - 25 mil JEDEC
  - 0.65 mm and 0.5 mm EIAJ Packages
- Low mass probe body and cable system.
- DC to 200 MHz bandwidth <11 pF/10 MΩ loading 10X attenuation.

*For complete selection information on all Accessory products, see page 424.*

**ORDERING INFORMATION**

**2214**
20 MHz Digital Plus Analog Oscilloscope ..... TD **$4,195**
**Includes:** Two 10X Voltage Probes (P6103B); Operator's Manual (070-7781-00); 9-Pin to 25-Pin RS-232 Interface Cable (012-1197-00); Grabber II Software; Power Cord; 3 Year Warranty

**Opt. 02 –** Accessory Pouch and Front Cover Panel ..... **+$60**
**Opt. 07 –** 12 VDC Input Inverter ..... **+$445**
**Opt. 3R –** Rackmount Kit ..... **+$330**
**Opt. 22 –** Two P6103B 10X Probes ..... **+$110**
**Opt. 23 –** Two P6119B 1X/10X Probes ..... **+$170**

**INTERNATIONAL POWER PLUG OPTIONS**

**Opt. A1 –** Universal Euro 220 V, 50 Hz. Order 020-0859-00 ..... **NC**
**Opt. A2 –** United Kingdom 240 V, 50 Hz. Order 020-0860-00 ..... **NC**
**Opt. A3 –** Australian 240 V, 50 Hz. Order 020-0861-00 ..... **NC**
**Opt. A4 –** North American 240 V, 60 Hz. Order 020-0862-00 ..... **NC**
**Opt. A5 –** Switzerland 220 V, 50 Hz. Order 020-0863-00 ..... **NC**

See General Customer Information Section for additional description.

**WARRANTY-PLUS SERVICE OPTIONS**

**Opt. M2 –** Repair Protection ..... **+$240**
**Opt. M8 –** Calibration Service ..... **+$240**

**RECOMMENDED ACCESSORIES**

See page 424 for complete selection information.

**PASSIVE PROBES**

1X. Order P6101B ..... **$65**
10X. Order P6103B ..... **$55**
1X/10X. Switchable. Order P6119B ..... **$85**
**CART –** Order K212 ..... **$395**
**CAMERA –** Low Cost Camera. Order C9 Opt. 20 ..... **$630**

**ADDITIONAL ACCESSORIES**

**Service Manual –** Order 070-7783-00 ..... **$130**
**Rackmount Kit –** Order 016-0819-03 ..... **$330**
**Front Panel Cover –** Order 200-3397-00 ..... **$10**
**Accessory Pouch –** Order 016-0677-02 ..... **$50**
**Carrying Case –** Order 016-0792-01 ..... **$455**
**Carrying Strap –** Order 346-0199-00 ..... **$28**
**RS-232C Cable –** Order 012-1197-00 ..... **$46**

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571).

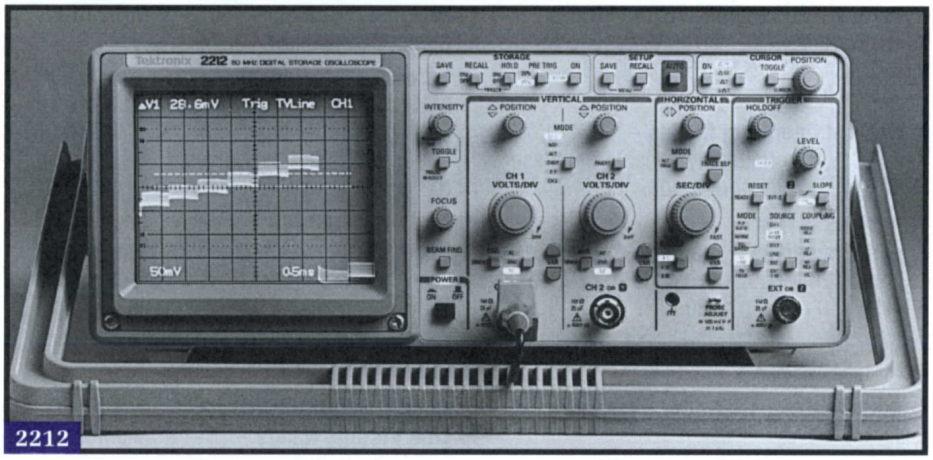
# Digital+Analog Oscilloscopes

## Programmable, 60 MHz Analog, 20 MS/s

*The 2212 offers a dual channel analog plus digital storage oscilloscope, with CRT readout, on-screen cursors, X-Y store and non-store operation, and a hardcopy parallel interface, at an affordable price.*

**2212**

- 60 MHz Analog Bandwidth
- 20 MS/s per Channel Sample Rate
- Auto Setup
- Fully Programmable With Optional GPIB and/or RS-232C Options
- 4K Record Length per Channel; 128K per Channel Option
- TV Line Select and Backporch Clamp Option
- Cursor Measurements
- CRT Readout Including Trigger Level
- CE Conforms to applicable standards with the EMC directive 89/336/EEC
- UL Listed, CSA Certified, meets IEC-1010-1
- 3-year Warranty Standard




*Combines analog and digital capability with full programmability, push button hardcopy, and low price.*

### 2212 Programmable Analog + Digital Oscilloscope

A familiar, convenient front panel layout and auto setup feature, enables fast, accurate measurements. With the push of a button, the scope switches between conventional analog and digital storage operation.

The front panel setup can be saved in a non-volatile memory. Also, two waveforms can be saved and recalled at any time when power is on.

Several on-screen readouts help you keep track of the settings for various functions, such as vertical and horizontal scale factors and trigger level.

On-screen cursors are provided to be helpful in making voltage, time and frequency measurements on the displayed waveform.

The horizontal alternate magnifier feature allows you to display the magnified and the unmagnified sweep alternately.

The parallel printer interface permits you to download acquired waveforms to a Centronics compatible printer/plotter for further analysis.

Optional to the 2212 oscilloscope are a GPIB and an RS-232C interface that allow full computer control. These optional features make the 2212 ideal for making automated measurements in a production or research environment that calls for repetitive data collection.

**TYPICAL APPLICATIONS INCLUDE:**

- Electronic product service
- Electro-mechanical research
- Production testing
- Process control
- Bio-physical application
- Audio applications

### Characteristics

**DIGITAL STORAGE SYSTEM**

**Sample Rate –** 20 Ms/s max per channel.

**Record Length –** 4K per channel standard, 128K optional.

**Pre/Post Trigger –** 25% or 75%.

**Acquisition Mode –** Sample.

**Save Reference Memory –** One acquisition (4K/CH).

**VERTICAL SYSTEM (2 Identical Channels)**

**Analog Bandwidth (-3dB, and (+5°C to +35°C)) –** 5 mV/div to 5 V/div: ≥60 MHz; 2 mV/div: ≥10 MHz and ≤15 MHz.

**Resolution (Store) –** –8-Bits (25 levels per division).

**Deflection Factor and Accuracy –** 2 mV/div to 5 V/div, ±3%.

**Vertical Operating Modes –** CH 1, CH 2, CH 2 Invert, ADD, ALT, CHOP, X-Y.

**Input Impedance –** 1 MΩ in parallel with ±25 pF.

**Maximum Input Voltage –** 400 V (DC + peak AC). 800 V p-p.

**Channel Isolation –** ≥100:1 at 10 MHz.

**HORIZONTAL SYSTEM**

**Sweep Speeds –** Non-store: 0.5 s/div to 50 ns/div. Store: 50 s/div to 20 µs/div.

**Resolution (Store) –** 400 points per div. Accuracy–X1: ±3%; X10: ±4%; X50: ±5% (all +15°C to +35°C).

**Horizontal Modes –** X1, X10, X50, X-Y (store and non-store), Alternate Magnifier.

**Roll Mode –** 0.1 s/div to 50 s/div in store mode.

TD

Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.

GPIB IEEE-488

The 2200 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Digital+Analog Oscilloscopes

## Programmable, 60 MHz Analog, 20 MS/s

**TRIGGER SYSTEM**

**Trigger Sensitivity –** 0.35 div. from DC to 5 MHz, increasing to 1.2 div. at 60 MHz. External: 40 mV p-p from DC to 5 MHz, increasing to 150 mV at 60 MHz.

**Trigger Modes –** Peak-Peak AUTO, NORM, Single Sweep, TV LINE, TV FIELD.

**Video Trigger Option –** Sensitivity is 1 division – signal display. Maximum lines per frame = > 1,200; Maximum line frequency = > 50 kHz; Clamp range = 50 div.; Clamp accuracy = better than 0.4 div.

**Trigger Source –** CH 1, VERT MODE, CH 2, LINE, EXT, EXT:10. (Z-Axis input shared with Ext Trigger input.)

**Trigger Coupling –** NOISE REJ, AC, LF REJ (-3 dB at 30 KHZ and lower), HF REJ (-3 dB at 30 kHz and higher), DC.

**Variable Holdoff –** ≥8:1.

**X-Y OPERATION**

**Deflection Factors –** Same as vertical system.

**Accuracy (Nonstorage) –** X-Axis: ±5%; Y-Axis: Same as vertical system.

**Accuracy (Storage) –** Same as digital storage vertical system.

**Bandwidth –** X-Axis: ≥2 MHz; Y-Axis: Same as vertical system.

**Phase Difference –** ≤3° from DC to 150 kHz.

**CURSOR FUNCTION AND ACCURACY**

**ΔVolts –** ±3% of reading.

**ΔTime (non-store) –** ±4% of reading in X1; ±5% of reading in X10; ±6% of reading in X50 (all +15°C to +35°C).

**ΔTime (store) –** ±0.4% of reading in X1; ±0.5% of reading in X10; ±0.6% of reading in X50 (all + 15°C to +35°C).

**External Clock –** DC to 10 MHz.

**HARDCOPY INTERFACE**

Plots all 4K records, readout and graticule (selectable in the MENU).

**Driver –** HPGL, EPSON.

**User test –** Selectable in the MENU.

**Connector Type –** 25-Pin D-type female connector.

**CRT SYSTEM**

**Display –** 8 x 10 cm Internal Graticule.

**Controls –** Display/Readout INTENSITY, TRACE/READOUT Switch, FOCUS, BEAM FIND.

**Z-AXIS –** 5 V causes noticeable modulation, useable to 5 MHz. (Z-Axis input shared with Ext Trigger input.)

**POWER REQUIREMENTS**

**Line Voltage Range –** 95 VAC to 128 VAC, or 190 VAC to 250 VAC (depends on line voltage setting).

**Line Frequency –** 48 Hz to 440 Hz.

**Max. Power Consumption –** 85 Watts (95 VA).

**ENVIRONMENTAL CHARACTERISTICS**

**Ambient Temperature –** Operating: +0°C to +40°C. Nonoperating – 55°C to +75°C. Relative Humidity – Max. 95%.

**Altitude –** Operating: To 4570 m. Nonoperating – To 15240 m.

**EMC –** Meets council directive 89/336/EEC.

**EMI –** Meets requirements per EN50081-1, VDE 871-B, FCC part 18, EN60555-2.

**EMS –** Meets requirements per EN50082-1, IEC 801-2,3,4.

**Safety –** UL listed, Certified CSA C22.2 No. 231-M89, meets requirements per IEC 1010-1.

**PHYSICAL CHARACTERISTICS**

| Dimensions | mm | in. |
|---|---|---|
| Height | 138 | 5.4 |
| Width | 380 | 15.0 |
| Depth (without cover) | 445 | 17.5 |
| **Weight** | **kg** | **lb.** |
| Net | 7.5 | 16.5 |

## ORDERING INFORMATION

**2212**
DSO + ART Oscilloscope ..... TD **$2,695**
**Includes:** Two 10X Voltage Probes (P6109B), Power Cord, Fuse, User Manual (070-8438-00), Reference (070-8592-00), Flat Washer, Loop Clamp.

**Opt. 5 Video Trigger –** Line count selectable by line number, Field selectable (odd, even), Backporch Clamp on CH 2, PAL, NTSC, SECAM and custom video compatible ..... **+$495**

**Opt. 1M –** 128K record length ..... **+$650**

**Opt. 3R –** Rackmount Kit (016-1204-00) ..... **$285**

**Opt. 10 –** GPIB Communication interface (complies with IEEE 488.2 1987) w/Grabber 2212 s/w ..... TD **+$300**

**Opt. 12 –** RS-232C Serial Communication Interface (conforms to EIA Standard RS-232C) w/Grabber 2212 s/w ..... TD **+$300**

**Opt. 23 –** Two P6129B 1X/10X Readout Passive Probes ..... **+$200**

**INTERNATIONAL POWER PLUG OPTIONS**

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

**Opt. A2 –** United Kingdom 240 V, 50 Hz ..... **NC**

**Opt. A3 –** Australian 240 V, 50 Hz ..... **NC**

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

**Opt. A5 –** Switzerland 220 V, 50 Hz ..... **NC**

**WARRANTY-PLUS SERVICE OPTIONS**

**Opt. M2 –** Repair Protection ..... **+$150**

**Opt. M8 –** Calibration Service ..... **+$150**

**SOFTWARE**

**DocuWave™ –** See page 64 ..... *1

*[1] Contact your Tektronix representative for price information*

**RECOMMENDED ACCESSORIES**

See page 424 for complete selection information.

**PROBES**

**Passive Voltage –**
10/100 MHz, 1X/10X ruggedized, with readout. Order P6129B ..... **$100**
100 MHz, 10X ruggedized, w/readout. Order P6109B ..... **$80**
15 MHz, 1X ruggedized. Order P6101B ..... **$65**

**Current –**
20 Amp max, DC to 50 MHz, w/A6302 current probe. Order AM503S ..... **$2,745**
100 Amp max, DC to 15 MHz, w/A6303 current probe. Order AM503S Opt. 03 ..... **$3,395**

**High Voltage –**
1.5 kV 100X, 120 MHz w/readout. Order P6009 ..... **$270**
40 kV 1000X, 75 MHz w/readout. Order P6015A Opt. 1R ..... **$1005**

**Digital Timing Demodulator –** Order TVC501 ..... **$2,495**

**CART –** Order K212 ..... **$395**

**Low-Cost Camera –** Order C-9 Opt. 20 ..... **$630**

**Printer –** Cannon BS-10EX Bubble Jet. Order HC220 ..... **$349**

**ADDITIONAL ACCESSORIES**

**2212 F10 –** GPIB Field Upgrade Kit ..... **$300**

**2212 F12 –** RS-232C Field Upgrade Kit ..... **$300**

**Rackmount Kit –** Order 016-1204-00 ..... **$285**

**Service Manual –** Order 070-8439–00 ..... **$120**

**Programmer Manual –** Order 070-8440–01 ..... **$85**

**Front Panel Cover –** Order 200-3397-00 ..... **$10**

**Accessory Pouch –** Order 016-0677-02 ..... **$50**

**Carrying Case –** Order 016-0792–01 ..... **$455**

**Cable –** PC to Centronics, 25-Pin. Order 012-1214-00 ..... **$55**

TD
Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.

GPIB IEEE-488
The 2200 Series complies-plies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Digital+Analog Oscilloscope

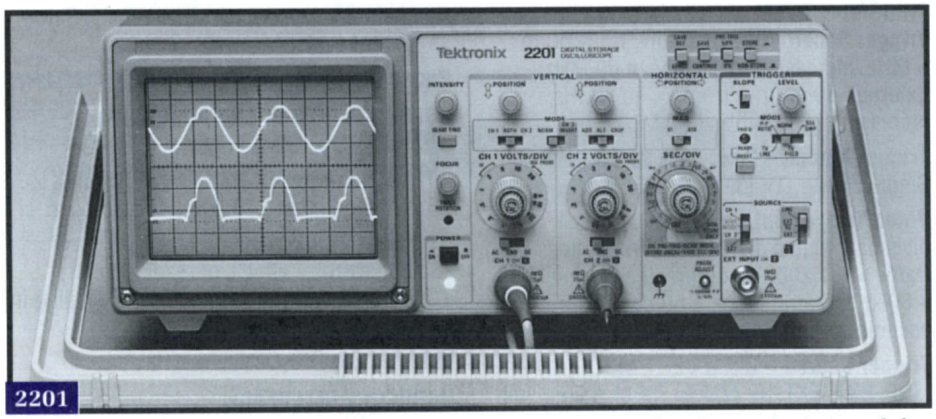
## 20 MHz Analog, 10 MS/s



*Here's digital storage and analog familiarity plus documentation at an affordable price.*

**2201**

- 20 MHz Analog Bandwidth
- 10 MS/s Per Channel Sampling
- 2K per Channel Record Length
- Hardcopy Interface Optional (RS-232C)




*The 2201 provides the power of digital storage, the familiarity of analog operation, and the affordability of Tektronix' lowest priced DSO.*

### 2201 Digital+Analog Oscilloscope

Tektronix brings you familiar analog operation, plus RS-232C hardcopy interface in a portable package. Now, with a 2201, you can have an inexpensive yet versatile oscilloscope with modern digital storage, without giving up the familiarity of analog operation.

The 2201 makes it easy to switch between conventional analog and digital storage operation. Just select storage or non-storage with the push of a button and the CRT switches between digital dot display and real-time mode.

**PREMIUM SPECIFICATIONS**

The 2201 provides 20 MHz analog bandwidth, two-channel sampling at 10 MS/s per channel, and a 2K record length per channel. Since the 2201 has dual digitizers, you don't sacrifice sampling speed or record length in two channel measurements.

A time base multiplier extends storage mode sweep speeds up to 50 s/div. Using the horizontal magnification, you can view delayed portions of the waveform similar to a dual time base oscilloscope. This allows analysis and documentation of slow or transient events found in physical measurement or electro-mechanical environments.

**PUSH BUTTON DOCUMENTATION**

The optional RS-232C hardcopy output serial interface provides hardcopy documentation with HPGL and EPSON compatible plotters and printers, simply by pressing a button.

**SOFTWARE**

Tektronix GRABBER II software lets you transfer waveform data to an IBM PC/XT/AT (or compatible) for display, mass storage, or evaluation. This software creates an HPGL plot file which can be archived, converted to other formats or printed for documentation.

Using a word processor which accepts HPGL files allows importing of stored waveforms to your documents. No complex communication protocols or cabling are required.

**POWERFUL FEATURES FOR THE NOVICE OR EXPERT**

In the digital storage mode, you can capture and display single-shot events and view low repetition rate signals without the usual flicker of an analog display. With digital pre-trigger you can view events that occurred before the trigger point, making it easy to identify trigger conditions.

These features make the 2201 the right instrument for a wide variety of applications. It is ideal for first-time users and seasoned operators.

### Characteristics

**DIGITAL STORAGE SYSTEM**

**Sample Rate –** 10 MS/s max. per channel.

**Resolution –** Vertical: 8-Bits (25 levels per division). Horizontal: 11-Bits (200 points per division).

**Record Length –** 2K per channel.

**Pre/Post Trigger –** 0% or 50% trigger position selectable.

**Acquisition Mode –** Sample.

**Save Reference Memory –** One acquisition.

**VERTICAL SYSTEM**
**(2 Identical Channels)**

**Analog Bandwidth (–3 dB) and Rise Time –** 20 MHz and 17.5 ns.

**Deflection Factor and Accuracy –** 5 mV/div to 5 V/div, ±3%.

**Vertical Operating Modes –** CH 1, CH 2, CH 2 INVERT, ADD, ALT, CHOP (500 kHz).

**CMRR –** At least 10:1 at 10 MHz.

**Input R and C –** 1 MΩ, 25 pF.

TD

Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.

GPIB IEEE-488 The 2200 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Digital+Analog Oscilloscope

## 20 MHz Analog, 10 MS/s



**Max Input Voltage** – 400 V (DC + peak AC), 800 V p-p.

**Channel Isolation** – 100:1 at 10 MHz.

**HORIZONTAL SYSTEM**

**Sweep Speeds** – 0.5 s/div to 0.05 µs/div, extended to 5 ns/div with X10 MAG. 0.5 s/div to 20 µs/div in store mode, extended to 50 s/div with X100 (store uncal).

**Accuracy** – X1: ±3%; X10: ±4%; X50: ±5% (all +15°C to + 35°C). X1: ±4%; X10: ±5%; X50: ±8% (all 0°C to + 40°C).

**Horizontal Operating Modes** – X-Y (non-store).

**TRIGGER SYSTEM**

**Trigger Sensitivity** – Internal: 0.35 div at 5 MHz, 1.0 div at 50 MHz. External: 40 mV at 5 MHz, 150 mV at 50 MHz.

**Trigger Operating Modes** – Peak-Peak AUTO (also TV LINE), NORM, TV FIELD, SGL SWP.

**Trigger Source** – VERT MODE, CH 1, CH 2, LINE, EXT, EXT/10.

**Trigger Coupling** – DC.

**X-Y OPERATION**

**Deflection Factors** – Same as vertical system.

**Bandwidth** – X-Axis: 2 MHz. Y-Axis: Same as vertical.

**Phase Difference** – ±3° from DC to 50 kHz.

**ADVANCED FUNCTIONS**

**Hardcopy Interface (RS-232C)** – Plots all displayed records (X1 MAG), CRT readout and graticule (selectable). Baud rate: 300 to 9600. Plotter Devices: HPGL, Epson FX-Series. Connector: 9-Pin DTE (male).

**Communication Software (Grabber 2)** – Comes with the instrument and transfers waveform data from the 2201 to an IBM PC/XT/AT (or compatible). Uses the RS-232C interface.

**CRT SYSTEM**

**Display** – 8 cm x 10 cm, 12.6 kV nominal voltage.

**Controls** – INTENSITY, TRACE ROTATION, BEAM FIND, FOCUS.

**Z-Axis** – 5 V causes modulation, usable to 5 MHz.

**POWER REQUIREMENTS**

**Line Voltage Range** – Low: 95 VAC to 128 VAC. High: 185 VAC to 250 VAC.

**Line Frequency** – 48 Hz to 440 Hz.

**Maximum Power Consumption** – 70 W (80 VA).

**ENVIRONMENTAL/SAFETY CHARACTERISTICS**

Instrument meets in part, the environmental requirements of MIL-T-28800D or C for Type III, Class 3, Style D or C equipment described as below.

**Ambient Temperature** – Operating: 0°C to +40°C. Nonoperating: –55°C to +75°C.

**Humidity** – Percent: 95% five cycles, (120 hours) Reference: MIL-T-28800D, paragraph 4.5.5.1.2.2.

**Altitude** – Operating: To 4,500 m (15,000 ft), maximum operating temp decreases 1°C per 300 m above 1500 m. Nonoperating: To 15,000 m (50,000 ft).

**EMC** – Meets Class B requirements per VDE 0871-B for radiated and conducted emissions and FCC requirements.

**Vibration** – Operating: 15 minutes along each of the 3 major axis. 10 Hz to 55 Hz in one minute cycles. Holds for 10 minutes at 55 Hz. Displ. (in p-p): 0.015.

**Shock** – Operating: 30 g, 1/2 sine, 11 ms duration, 3 shocks per axis along each major axis. Total of 18 shocks.

**Safety** – UL 1244 listed, Certified CSA C22.2 No. 231-M89.

### PHYSICAL CHARACTERISTICS

| Dimensions | mm | in. |
|---|---|---|
| Width (with handles) | 138 | 15.0 |
| Height | 380 | 5.4 |
| Depth (without cover) | 438 | 17.2 |
| **Weight** | **kg** | **lb.** |
| | 7.6 | 16.8 |

## ORDERING INFORMATION

**2201**
20 MHz Digital Plus Analog Oscilloscope ..... TD **$2,295**
**Includes:** Two 10X Voltage Probes (P6103B), Operators Manual (070-7190-00), Users Ref. Guide (070-7232-00), 3 Year Warranty, Power Cord.

**Opt. 02** – Pouch and Cover ..... **+$60**
**Opt. 12** – RS-232C ..... **+$300**
**Opt. 3R** – Rackmount Kit ..... **+$330**

**INTERNATIONAL POWER PLUG OPTIONS**

**Opt. A1** – Universal Euro 220 V, 50 Hz ..... **NC**
**Opt. A2** – United Kingdom 240 V, 50 Hz ..... **NC**
**Opt. A3** – Australian 240 V, 50 Hz ..... **NC**
**Opt. A4** – North American 240 V, 60 Hz ..... **NC**
**Opt. A5** – Switzerland 220 V, 50 Hz ..... **NC**

See General Customer Information Section for additional description.

**WARRANTY-PLUS SERVICE OPTIONS**

**Opt. M2** – Repair Protection ..... **+$135**
**Opt. M8** – Calibration Service ..... **+$135**

**RECOMMENDED ACCESSORIES**

See page 424 for complete selection information.

**PROBES**

**Passive Voltage** –
60 MHz, 10X, ruggedized, without readout. Order P6103B ..... **$55**
10 MHz/100 MHz, 1X/10X, switchable, without readout. Order P6119B ..... **$85**
15 MHz, 1X, modular without readout. Order P6101B ..... **$65**

**Current** – 20 Amp max, DC to 50 MHz, w/A6302 current probe. Order AM503S ..... **$2,745**
100 Amp max, DC to 15 MHz, w/ A6303 current probe. Order AM503S Opt. 03 ..... **$3,395**

**High Voltage** – 1.5 kV 100X, 120 MHz with readout. Order P6009 ..... **$270**
40 kV 1000X, 75 MHz with readout. Order P6015A Opt. 1R ..... **$1005**

**Specialty** – 100 MHz, 1X/10X differential probe, FET. Order P6046 ..... **$2,295**
Logic Probe, 16 channel word recognizer/Trigger-TTL. Order P6408 ..... **$500**

**Digital Timing Demodulator** – Order TVC501 ..... **$2,495**
**CART**– Order K212 ..... **$395**
**Camera Low-Cost** – Without graticule illum. Flash required on camera. Order C-9 Opt. 20 ..... **$630**

**PLOTTER/PRINTER**

**RS-232C** – Order HC100 Opt. 03 ..... **$1,145**

**ADDITIONAL ACCESSORIES**

**Carrying Strap** – Order 346-0199-00 ..... **$28**
**Transit Carrying Case** – Order 016-0792-01 ..... **$455**
**Front Panel Cover** – Order 200-3397-00 ..... **$10**
**Accessory Pouch** – Order 016-0677-02 ..... **$50**
**Rackmount Kit** – Order 016-0819-03 ..... **$330**
**Service Manuals** – Order 070-7189-00 ..... **$120**

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200

GPIB IEEE-488 The 2200 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Oscilloscope Interfacing & Software

*Tektronix offers the complete solution to your test and measurement needs, from hardware to software and accessories.*

*DocuWave™ links your Tektronix DSO to Desktop Publishing and Spreadsheet Analysis Tools.*

TD S41SAVE also available through an Authorized Tektronix Distributor (listed on pages 570-571)

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The 2200 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

**EXAMPLES OF SOFTWARE USAGE:**

- Printers and Plotters for Hardcopy Documentation
- Software for Instrument Control
- Software for Waveform Data Acquisition and Analysis

**WaveSaver TD (S41SAVE)**

- Waveform Transfer, Display, and Storage With 2232-Series Oscilloscopes, Utilizing Easy-to-Use Pop-Up Menus and Color EGA Graphics

**TeleServicing TD (S41TSS1)**

- Adds to WaveSaver the Ability for Remote Instrument Communication Over Modems, Includes Integrated Dialing Directory and Modem Control Software.

**DOCUWAVE™**

- Windows Friendly DOS Application
- Runs On Minimal PC Configuration
- Store and Load Waveforms and Instrument Settings
- Communications Options:
  - GPIB 488.2
  - RS-232
- Image File Formats:
  - BMP
  - EPS
  - TIFF
  - PCX
  - HPGL
- Data File Formats:
  - Comma Delimited
  - Tab Delimited
  - Lotus 123

Many of the 2200 Series instruments can be configured with a variety of interfaces to provide added functionality. These interfaces can provide a means to collect data into a computer, to control the oscilloscope with the computer, or to provide hardcopy output of the waveform data. In addition, through the use of specialized software, advanced functions (such as modem communications) are available.

**GPIB INTERFACE**

Several oscilloscopes can be configured with a GPIB interface. The 2212 is Tektronix' lowest-cost, fully programmable portable oscilloscope. With its optional GPIB interface (IEEE-488.2-1987 Standard), you can control all scope controls remotely. Waveform and measurement data can be transmitted to a personal computer for storage and analysis. Test routines can be developed with the help of development software from Tektronix that can quickly automate many repetitive test applications.

The 2232 and 2221A Digital Storage Oscilloscopes can also be ordered with a GPIB interface (Opt. 10). With the interface installed, you can transmit and receive waveform data from the scope to personal computers and other peripherals. Most front-panel settings and menu states can be queried and many functions controlled via the interface, for example, single-sweep trigger reset. In addition, the instruments can provide hardcopy output when connected directly to a compatible printer or plotter. Devices supported include HPGL digital plotters, such as the Tektronix HC100, or the HP ThinkJet printer.

**RS-232C INTERFACE**

All of the 2200-series DSO's can be ordered with an RS-232C serial interface. The 2232 and 2221A can be ordered with an RS-232C interface (Opt. 12) that provides all the functions described above for GPIB. The RS-232C interface has both DCE and DTE connectors, selectable with baud rate, parity, and line termination using switches located on the oscilloscope side panel. Hardcopy output is also available, and includes support for Epson FX-Series printers with a serial interface.

The 2201 can be ordered with Option 12 to include the interface. On the 2201, the interface is designed as a talker-only interface. Hardcopy output is available using a number of devices, including HPGL serial plotters and Epson-compatible (FX Series) serial printers. A special software program included with the 2201, called Grabber II, permits waveform transfer to a personal computer for long term storage or analysis.

**CENTRONICS INTERFACE**

The 2252 also comes equipped with a Centronics interface which provides hardcopy output for Epson FX-series printers. A push of the hardcopy button on the front panel causes all displayed wave-forms and measurements to be sent to the printer for documentation.

**INTEGRATED SOFTWARE PACKAGES**

To keep you focused on solving your problems, rather than software coding chores, Tektronix offers a variety of off-the-shelf software programs. Numerous packages are available for waveform acquisition, signal analysis, and instrument control. A partial listing is provided on this page as an example of solutions available.

## DocuWave™ Scope Data Management 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. Designed to be Windows friendly, 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 the GPIB or RS-232 interfaces
- Exports waveforms to be imported by analysis and spreadsheet programs
- Displays up to four waveforms with cursors and graphic zoom
- Sends waveforms back to the scope

To learn more about DocuWave, refer to page 64 in this catalog.

## ORDERING INFORMATION

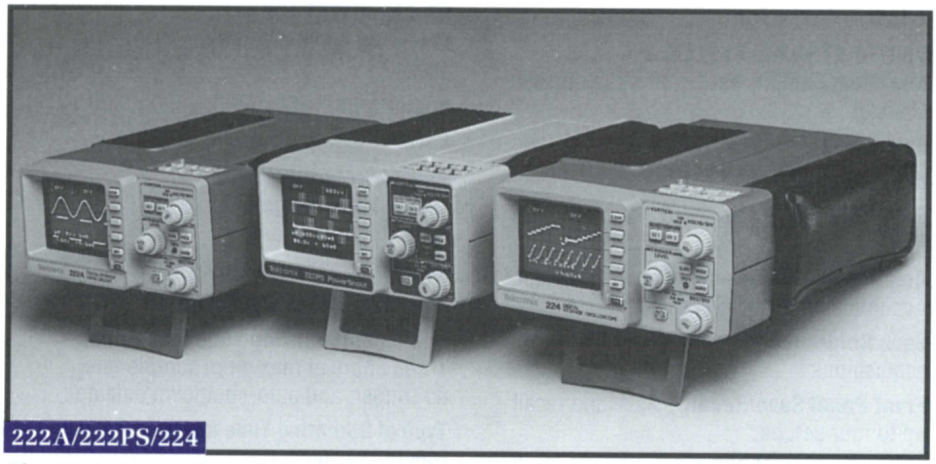
**S41SAVE**
WaveSaver Software ..... TD *1

**S41TSS1**
TeleServicing Software ..... TD *1

*1 Contact your Tektronix representative for price information.*

# Handheld, Battery Operated Digital Storage Oscilloscopes

**222A**
**222PS**
**224**




*The 222A, 224, and 222 PowerScout are the optimum scopes for industrial maintenance and field service. The 222 PowerScout and 224 offer an unprecedented safety margin to users making measurements on industrial power systems.*

## Battery-Operated Handheld Oscilloscopes

The 220 family of scopes provides unsurpassed power in the world of HandHeld oscilloscopes. The instruments are equipped with a 60 MHz bandwidth (224), (10 MHz 222A/222PS) 10 MS/s digitizing rate for each channel, RS-232C interface and full programmability in a size that goes anywhere. Battery operation eliminates the need for available power. The ability to charge and operate the scope from 12-28 VDC or 16-20 VAC makes the 220 family truly portable scopes on the go.

### UNMATCHED SAFETY

Because it is floatable to ±850 V per channel, the 224/222/PS PowerScout is designed to safely make measurements on industrial power systems. It is the first scope to be UL listed for measurements on line voltages to 600 VAC, and is specified to withstand peak surge voltages as high as 6 kV. The 222A is capable of safely measuring to ±400 V per channel or 800 V p-p.

### ISOLATED CHANNEL ARCHITECTURE

The 220 family channels are fully isolated from each other and the casing is double insulated ensuring ultimate operator safety.

### AUTOSETUP/SAVE/RECALL

The 220 family AutoSetup/Save/Recall features eliminate the need for unnecessary manipulation of the front panel. Just push the AutoSet button and the scope selects all the parameters for you. Save and recall those setups for repetitive situations at multiple sites and see the savings in time.

**222A/222PS/224**

- Isolated Channel™ Architecture
- Floatable to ±850 V/channel, (±400 V/channel 222A)
- 60 MHz BW 224, 10 MHz BW 222A, 222PS
- Digital Storage
- 100 ns Glitch Capture
- 6 kV Peak Surge Rating (222PS, 224)
- Exclusive Motor Trigger (222PS)
- Exclusive Video Line Trigger (224)
- Auto Trigger
- Save Reference Memory
- 10 MS/s Dual Digitizers
- Fully Programmable via RS-232
- Rugged Construction
- Battery Operation
- DC Operation
- 4.4 lb. Total Weight
- UL Listed, CSA Certified
- 3 Year Warranty
- Auto Setup/Save Setup/Recall
- Detachable X1/X10 Probes
- Ultra Portable

*Capture your measurements in out of the way places with these battery operated, compact, industrial service digital scopes.*

TD

Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200

222A
222PS
224

# Handheld, Battery Operated Digital Storage Oscilloscopes

### AUTOMOTIVE SERVICE SCOPE

A new option 1A is available for the 222A. It comes complete with a variety of automotive test leads and a self-study training package designed to give the technician the necessary knowledge to quickly learn the use of the 222A in diagnosing automotive electronic systems.

### WAVEFORM STORAGE

After you've acquired your waveform using AutoSetup, save it in one of four 512 pt. reference memories. Recall it to compare with known good signals and make any adjustments to the source necessary to bring the equipment on line.

### RS-232 AND THE 220 FAMILY

After saving your waveforms and setups, make a permanent record. Simply connect the scope to your PC and transfer them, using the optional CAT200 Software. Send them back to the scope when that same job is due again. In fact with CAT200 software, you can control the entire front panel from a remote location utilizing the RS-232C port, modems and a phone line.

### SOPHISTICATED PROCESSING IN A SMALL PACKAGE

The 220 Family offers features normally found only on full size portable scopes: Acquisition modes such as Envelope (Peak Detect) and Averaging; Pre/Mid/Post triggering capabilities; AutoSetup, Save/Setup/Recall; Save reference memories; XY operation; and RS-232C programmability. These features make the 220 family the ultimate service tool. The scopes come complete with a ballistic nylon carrying case that doubles as a neck strap for hands free operation.

### RUGGED DESIGN

The 220 Family is packaged in impact-resistant plastic, capable of withstanding 50 g's of force. (18 inch drop tested.) The scopes can operate in temperatures as low as –10°C and still be accurate. The batteries allow for a minimum of three hours of remote operation.

### INDUSTRY STANDARD WARRANTY

The 220 Family comes standard with a full three year warranty. Optional service warranties are also available to make the 220 family worry-free for the technician on the move, anywhere in the world.

## Characteristics

### DIGITAL STORAGE SYSTEM

**Maximum Sample Rate –** 10 MS/s on each channel.

**Resolution –** Vertical: 8-Bits, 25 levels/div.

**Record Length –** 512 bytes.

**Pre/Mid/Post-Trigger –** 1/8, 1/2, 7/8 of waveform.

**Acquisition Modes –** Normal, Peak Detect, Accumulated Peak, Averaging.

**Save Reference Memory –** Four 512 byte acquisitions.

**Front Panel Save/Recall –** Save and recall up to four setups.

**Motor Trigger (222PS only) –** Trigger on first pulse in bursts separated by at least 2.25 ms modulated output of a motor controller.

### VERTICAL SYSTEM

**Bandwidth –** Repetitive: 60 MHz. (224), 10 MHz (222A, 222PS) Single shot: 1 MHz.

**Rise Time –** 5.8 ns (224) 35 ns (222A, 222PS).

**Deflection Factor –** 222A: 5 mV/div to 50 V/div with P400; 222PS/224: 50 mV/div to 500 V/div with P850. (5 mV to 50 V/div with P400.

**DC Accuracy –** 4% (-15°C to +55°C).

**Operating Modes –** CH 1, CH 2, Invert.

**Input R & C –** 222A: 1 MΩ, 30 pF P400; 222PS/224: 10X probe P850, 10 MΩ, 4.5 pF.

**Maximum Safe Input Voltage –** 222A: 400 V (DC + peak AC), 800 V p-p @ 1 kHz or less; 222PS/224 with P850 probes: 600 VAC or 850 V (DC + peak AC) 6 kV peak surge.

**Channel Isolation –** >1000: 1 at 10 MHz.

### HORIZONTAL SYSTEM

**Sweep Speeds –** 50 ns/div to 20 s/div (X10 mode increases max sweep speed to 5 ns/div).

**Accuracy –** X1: ±2%; X10: ±5%.

### TRIGGER SYSTEM

**Sensitivity –** Internal: 0.5 div at 10 MHz. External: 250 mV at 10 MHz.

**Trigger Sources –** CH 1, CH 2 and External.

**Video Field and Line (NTSC, PAL STD) –** 0.5 V to 2 V p-p range (224 only).

### X-Y OPERATION

**Accuracy –** Same as Vertical System.

**Useful Bandwidth –** Same as Vertical System.

**Skew between CH 1 & CH 2 –** 5 ns.

### CRT SYSTEM

**Display –** 6 x 10 divisions (0.5 cm).

### RS-232 INTERFACE

**Maximum Applied Voltage –** 25 V (DC + peak AC).

**Baud Rates –** 300, 1200, 2400, 9600.

**Levels –** Compatible with RS-232C.

### POWER REQUIREMENTS

**Line Voltage Range –** 12 to 28 VDC, 16 to 20 VAC.

**Line Frequency –** 47 Hz to 400 Hz.

**Maximum Power Consumption –** 16 VA.

**Minimum Operating Time (batteries) –** Three hours at maximum sample rate, no trigger, and auto-shutdown defeated.

**Typical Operating Time (batteries) –** Four to six hours.

**Charging Time –** Three hours.

**Type –** Sealed lead acid.

**Discharge Protection –** Scope automatically shuts down when charge drops to 7.32 V.

### ENVIRONMENTAL

**Ambient Temperature –** Operating: –10°C to +55°C; Nonoperating: –51°C to +71°C.

**Altitude –** Operating: 4500 m (15,000 ft.). Nonoperating: 15,000 m (50,000 ft.).

**Humidity –** 95%, five cycles (120 hours). Referenced to MIL-T-28800D, for Type 3, Class III instruments.

**Vibration –** Operating and Nonoperating: 15 minutes along each of the 3 major axes, 0.06 cm (0.025 in.) p-p displacement (4 g's at 55 Hz), 10 to 55 to 10 Hz in 1-minute cycles. Held for 10 minutes at 55 Hz in each 3 major axes.

**Shock –** Operating and Nonoperating: 50 g's 1/2 sine,11 ms duration each direction along each major axis. Total of 18 shocks.

**Safety –** Double Insulated, Listed UL 1244, Certified to CAN/CSA-C22.2 No. 231-M89, Tektronix Self Certification to comply with IEC 348 recommendations.

**Emissions –** FCC A and VDE B.

**Display –** Update rate 30 Hz, Resolution 256 V x 512 H, Contrast 75:1, Brightness 30 Fl.

**Viewing Angle –** 160°

**Pixel Writespeed –** <1 ms.

**Record length –** 512 bytes.

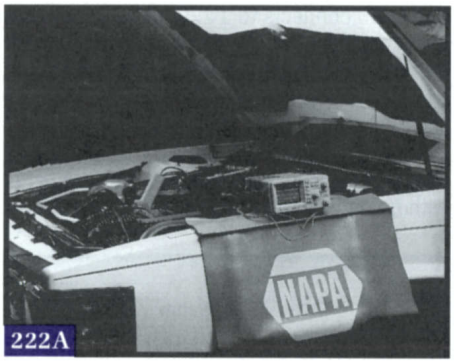
### PHYSICAL CHARACTERISTICS

| Dimensions | mm | in. |
|---|---|---|
| Width | 159 | 6.3 |
| Height | 86 | 3.4 |
| Depth | 252 | 9.9 |
| **Weight** | **kg** | **lb.** |
| Net, w/o accessories | 2.0 | 4.4 |
| Shipping | 3.2 | 7.0 |

# Handheld, Battery Operated Digital Storage Oscilloscopes








## 222A Option 1A

**AUTOMOTIVE DIAGNOSTICS PACKAGE**

The 222A is rapidly being adopted as a tool of choice for diagnosing the electronic systems and sensors used in today's automobiles. To improve productivity and convenience, Tektronix has packaged the 222A with an automotive test leadset, and a complete self-study training course. Just order Option 1A with the 222A and you will "jump start" your automotive diagnostic skills.

## ORDERING INFORMATION

**222A**
10 MHz Handheld DSO ..... TD **$2,550**
**Includes:** Operator Manual, Quick Ref. Guide,RS-232C Guide, AC adapter, Two P400 Replaceable Probes, Pouch, Feet, Probe Acc. Kit.

**Opt. 1A –** Automotive Diagnostic/Training Package .....**+$400**
**Includes:** Suitcase with room for 222A without pouch, Automotive Lead Set, Option 03 substitute P850 for P400 probes. Automotive self-study training course (packaged separately).

**222PS POWERSCOUT**
10 MHz Handheld DSO ..... TD **$2,950**
**Includes:** Operator Manual, Quick Ref. Guide, RS-232C Guide, AC adapter, Two P850 Replaceable Probes, Pouch, Feet, Probe Acc. Kit, Industrial Leadset.

**224**
60 MHz Handheld DSO ..... TD **$2,750**
**Includes:** Everything in 222PS, less Industrial Leadset.

**220 FAMILY OPTIONS**
**Opt. 02 –** Delete adapter .....**NC**
**Opt. 03 –** Substitute P850 Probes for P400 (222A only) .....**NC**
**Opt. 04 –** Add WP200 Serial Interface..... TD **+$295**
**Opt. 05 –** Add CAT200 Software ..... TD **+$395**
**Opt. 06 –** Add A620 Current Probe, 2000A pk, AC..... TD **+$350**

**OPERATION TAPE**
**NTSC –** Order 068-0344-04 .....**$60**
**PAL –** Order 068-0344-06 .....**$70**
**SECAM –** Order 068-0344-07 .....**$70**

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M2 –** Repair Protection
222A/222PS .....**+$178**
224 .....**+$250**
**Opt. M8 –** Calibration Service
222A/222PS .....**+$144**
224 .....**+$250**

**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1 –** Univ Euro 220 V, 50 Hz. NC .....**NC**
**Opt. A2 –** United Kingdom 220 V, 50 Hz. NC .....**NC**

**SOFTWARE**
**Virtual Instrument Software –** Order CAT 200 ..... TD **$395**

**RECOMMENDED ACCESSORIES**
See Accessory Section on page 424 for complete selection information.

**PROBES**
**Voltage–** 1X. Order P400 .....**$100**
10X. Order P850 .....**$100**
**Current –** Switch Selectable up to 1200 A, NEW. Order A620 .....**$350**
**External Trigger –** Order P6122 .....**$110**

**ADDITIONAL ACCESSORIES**
**External Battery Charger –** Order BAT200 ..... TD **$250**
**Battery/AC Adapter Pouch –** Order 016-0993-00.....**$18.75**
**Viewing Hood –** Order 016-1021-00 .....**$24**
**Ext Trig to Bnc Adapter –** Order 103-0090-00 .....**$15.50**
**US Power Adapter –** Order 120-1807-00 .....**$30**
**European Power Adapter –** Order 120-1826-00 .....**$37**
**UK Power Adapter –** Order 120-1827-00 .....**$42**
**Spare Battery –** Order 146-0075-00 .....**$100**
**RS-232 Cable –** Order 174-1453-00.....**$48**
**Cigarette Lighter Adapter –** Order 174-1734-00.....**$18.75**
**Intelligent Printer Interface –** Order WP200 .....**$295**
**Automotive Lead Set –** Order 020-2080-00..... TD **$295**
**X10 BNC Adapter –** Order 206-0445-00.....**$95**
**Industrial Lead Set –** Order 012-1392-00.....**$65**
**BNC Probe Head –** Order 206-0451-00 .....**$70**
**Automotive Self Study Training –** Order 650-3076-00.....**$350**

TD
Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200

# CAT200 A620

# Software Current Probe

*Control and collect waveform data from a remote location.*

**CAT200 VIRTUAL INSTRUMENT SOFTWARE FOR 222 SCOPE**

- Enables Remote Control of 222/ 222PS Digital Oscilloscope Via RS-232
- Simplifies Data Collections and Storage
- Easy to Use Graphical Interface
- Works With All Hayes-Compatible Modems
- No Programming Required

**TYPICAL APPLICATIONS**

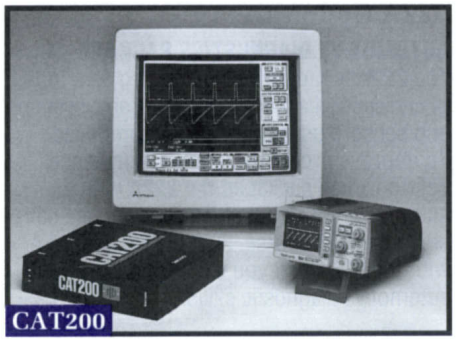
- Field Service
- Plant Maintenance
- Telecommunications
- Education

**A620 AC CURRENT PROBE FOR 220 FAMILY SCOPES**

- Display and Analyze Distorted Current Waveforms and Harmonics
- Three Switch-Selectable Ranges For Measurements Up to 1200 ARMS 2000 APeak
- Direct and Insulated Connection to 220 Family Scopes
- Display Sensitivity to 50 mA per Vertical Division (222A)
- Bandwidth to 50 kHz. Passive Filter Eliminates Ring on Rapid Rising Waveforms

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571)

CAT200 also available through TekDirect. Call 1-800-426-2200




## CAT200 Virtual Instrument Software for 222 Scope

CAT200 Virtual Instrument Software recreates the front panel of a Tektronix 222A, 222PS, or 224 digital storage oscilloscope on an IBM PC and PS/2 compatible computer monitor. The front panel is controlled using either the keyboard or a mouse. It has intuitive buttons and controls so the learning curve is short. When connected to a remote 220 Family Oscilloscope, the CAT200 package lets you control and collect waveform data from the scope to your computer.

Once in the computer, CAT200 automates voltage, time and frequency measurements with delta cursors. It simplifies documentation by providing hardcopy support. There is virtually unlimited waveform storage capacity where the data is stored in ASCII format or in a format compatible with the 222 driver for LabWindows®.

**SYSTEM REQUIREMENTS**

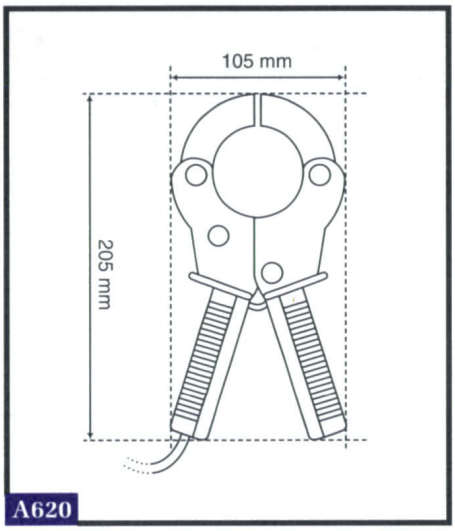
Requires IBM PC XT/AT or PS/2 compatible computer with at least 640 KB of memory, 1 floppy disk, EGA/VGA graphics adapter, MS-DOS 3.3 or above.

Hayes-compatible modem and/or Microsoft compatible mouse can be used for full utilization of the software features.

## A620 AC Current Probe for 220 Family Scopes

AC Current probe for industrial and power measurement applications. The A620 probe permits accurate display and measurement of currents with a 222A, 222PS or 224 handheld scope. RMS currents from 10 mA to 1000 A, 1 Hz to 50 kHz can be measured without breaking into the circuit.

The A620 connects to a 220 family scope using a proprietary insulated connector which enhances user safety over current probes with exposed metal connections. In addition each 220 scope uses Isolated Channel™ architecture to provide two fully isolated channels for safe, easy floating measurements with no danger to you or your equipment.




## Characteristics

**Switch Setting –** 100 mV/A, 10 mV/A, 1 mV/A.

**Frequency Range –3 dB Frequencies –** 5 Hz - 50 kHz, 1 Hz - 50 kHz, 1 Hz - 50 kHz (typ).

**Accuracy –** Between 50 Hz and 1 kHz: 5% ±10 mV.

**Maximum Input Current at 60 Hz –** 20 A pk, 200 A pk, 2000 A pk.

**Maximum Safe Voltage on Primary –** 650 VDC + AC pk (440 V RMS) between primary voltage and floating scope voltage.

**Colors –** Dark gray handles with red jaws.

**Cable Length –** 1.5 m (5 ft).

**Maximum allowable conductor size –** 54 mm (2.13 in.).

**PHYSICAL CHARACTERISTICS**

| Dimensions | mm | in. |
|---|---|---|
| Width | 105 | 4.1 |
| Length | 206 | 8.1 |
| Thickness | 48 | 1.6 |
| **Weight** | **kg** | **lb.** |
| Net | 0.65 | 1.43 |

## ORDERING INFORMATION

**CAT200**
**Includes:** Users manual, two 5.25 in. disks and one 3.5 in. disk ..... TD **$395**

**A620**
AC Current Probe ..... TD **$350**
**Includes:** Users Manual (070-8775-00)
**Note:** The A620 must be used with either a 222A, 222PS scope. The A620 is not compatible with the 222 non "A" version scope.

# Analog Oscilloscopes



### TAS 400 Series

The Tektronix TAS 400 Series Portable Analog Oscilloscopes are built on a new low cost platform. Modeled after the successful TDS Series, the TAS user interface simplifies scope operation. This new platform design significantly reduces parts count and provides a three times improvement in reliability over previous analog scopes.

### 2200 Series

The Tektronix 2200 Series Portable Analog Oscilloscopes offer a broad choice of performance, ranging from the basic 20 MHz 2205 to the feature packed, fully programmable 100 MHz 2252.

### 2400 Series

The Tektronix 2400 Series Portable Analog Oscilloscopes represent the most widely used and accepted 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.

All 2400 Series Oscilloscopes offer convenient and easy automatic setup and measurements, a broad range of functionality, and the depth of performance that set the standards for high-performance portable scopes.

**ANALOG OSCILLOSCOPES**

| Model | Bandwidth | Channels | Time Base | Cursors | Auto Setup | Computer Interfaces | Pages |
|---|---|---|---|---|---|---|---|
| TAS 400 | 100 to 200 MHz | 2 or 4 | dual | yes | yes | no | 120 |
| 2252<br>2247A | 100 MHz | 2+2 | dual | Smart<br>Smart | yes<br>yes | GPIB,<br>Centronics on 2252 only | 129 |
| 2205 | 20 and 40 MHz | 2 | single | no | no | no | 132 |
| 2467B<br>2467BHD<br>2465B<br>2445B | 200 to 400 MHz | 2+2 aux. | dual | yes | yes | GPIB Opt. | 124 |

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TAS 475 100 MHz ..... 120
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**2400 SERIES OSCILLOSCOPES**
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2467BHD 400 MHz HDTV ..... 124
2465B 400 MHz ..... 124
2445B 200 MHz ..... 124

**2200 SERIES OSCILLOSCOPES**
2252 100 MHz, Dual Time Base ..... 129
2247A 100 MHz, Dual Time Base ..... 129
2205 20 MHz/40 MHz ..... 132

**ACCESSORIES**
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Probe and Instrument Accessories ..... 492
Plotter/Printer ..... 496
Cameras ..... 499
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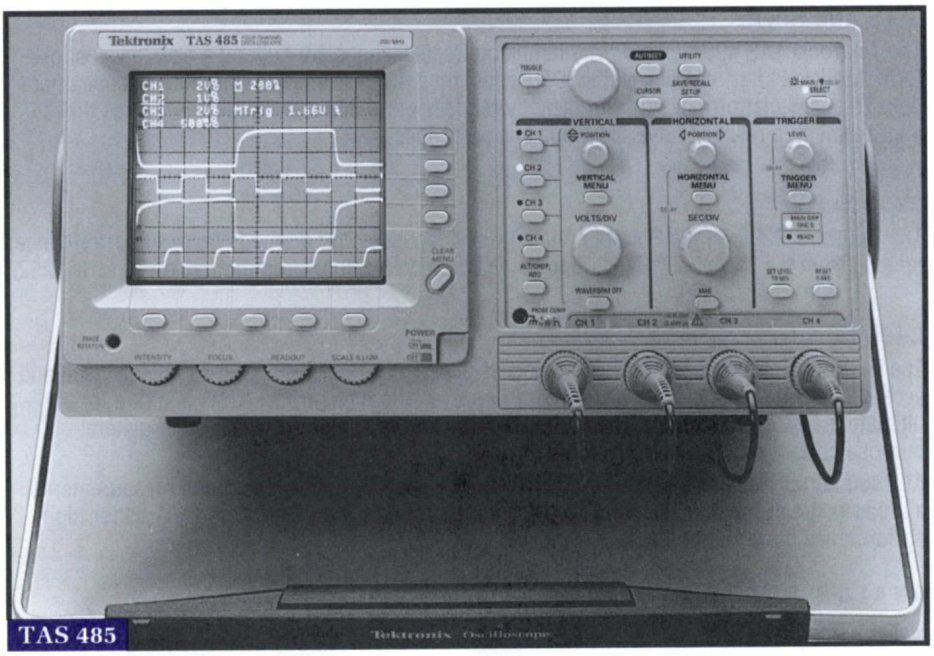
# TAS 465
# TAS 475
# TAS 485

# Analog Oscilloscopes
## 100 MHz to 200 MHz

*New level of power and reliability to general purpose scopes.*

**TAS 400 SERIES**

- Bandwidths of 100 MHz to 200 MHz
- Two or Four True Input Channels
- Auto Setup
- Store/Recall of Four Setups
- Video Triggering
- Dual Time Base
- Measurement Cursors
- Trigger Level Indicator
- Ground Reference Indicator
- Highly Integrated Design
- Three Year Free Replacement Warranty



TAS 485

### TAS 400 Series

By incorporating features from higher-end scopes, the low-cost Tektronix TAS 400 Series of scopes brings an advanced level of power and reliability to general purpose scopes. This family of instruments offers 2 or 4 input channels and 100 MHz to 200 MHz bandwidths.

**STREAMLINED INTERFACE**

Modeled after the brilliant TDS Series interface, the TAS interface simplifies scope operation without limiting the instrument's capabilities.

Important and frequently used functions, such as horizontal and vertical position, are controlled directly with buttons and knobs. Secondary functions are menu driven, eliminating the profusion of buttons found on most low-cost analog scopes.

For instance, to trigger on most signals, you simply press the SET LEVEL TO 50% button and the scope will set the trigger level to the midpoint of the signal. Because a trigger signal's level often changes, these scopes have Auto Level to retain the triggered signal. Adjusting the trigger level control indicates the trigger point on the screen.

**ADVANCED FEATURES**

The TAS 400 Series brings leading-edge innovation to low-cost analog scopes with a comprehensive set of features.

Auto Setup instantly delivers meaningful waveforms. Pressing the AUTOSET button automatically adjusts the horizontal, vertical, and triggering controls to display a stable signal.

Indispensable when trying to trigger and display unknown waveforms, Auto Setup also helps inexperienced users display useful waveforms quickly.

Cursors with readouts in the display greatly ease the task of measuring waveforms. Complete with menus, the cursors can measure frequency, delta time, delta volts, and absolute volts from the ground reference.

Save/Recall Setup stores up to four front-panel setups. With this feature you can save complex setups and recall them within seconds.

Comprehensive Video Triggering simplifies triggering on complex video waveforms. With line or field (odd, even, or both) composite video selections and positive or negative sync, you can cleanly trigger on any NTSC, PAL, or SECAM video signal. And the scopes' dual time bases let you zoom in on any portion of a waveform for closer examination.

The TAS 400 Series' Rugged Probes are the result of years of design innovation and customer feedback. These passive probes have a slim, pen-like design with a patented, one-piece, resilient rubber body.

Still comfortable to handle, the probes' sturdy construction protects their internal circuitry. The TAS 400 Series' probes can withstand extreme mechanical abuse while maintaining their superior measurement capability.

TD

Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200

# Analog Oscilloscopes

## 100 MHz to 200 MHz

**TAS 465**
**TAS 475**
**TAS 485**



**PERFORMANCE AND RELIABILITY WITH REDUCED MAINTENANCE**

A sophisticated hybrid circuit houses the entire acquisition system, including the vertical, horizontal, and trigger functions. Virtually a scope-on-a-chip, the hybrid gives TAS scopes more than three times the reliability of previous models. The hybrid, which is manufactured in-house at Tektronix, easily meets its specs over thousands of hours of use.

Another advantage of reduced circuitry with few connectors is a 50% improvement in mean-time-to-calibration. When calibration is necessary, there are fewer than fourteen manual adjustments.

**THREE-YEAR FREE REPLACEMENT WARRANTY**

These new designs are so reliable that if any TAS scope fails within the three year warranty period, Tektronix will replace it at no charge. While the TAS 400 Series was developed for the service, education, and electronic design fields, these are scopes that even a cost accountant can love.

### Characteristics

Except as noted, the following specifications are common to the TAS 400 Series.

**Bandwidth –** 100 MHz (TAS 465), 100 MHz (TAS 475), 200 MHz (TAS 485)

**Rise Time –** ≤ 3.5 ns (TAS 465), ≤ 3.5 ns (TAS 475), ≤ 1.8 ns (TAS 485).

**VERTICAL SYSTEM**

**Deflection Factor –** 2 mV/div to 5 V/div, continuously variable between V/div settings.

**Deflection Factor DC Accuracy –** ± 2.5%.

**Bandwidth Limit –** 20 MHz, independent channel control.

**Input Coupling –** AC, DC, GND.

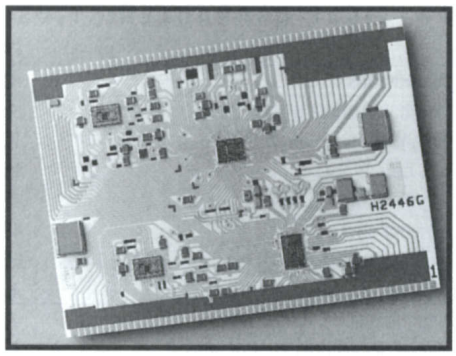
**Max Input Voltage –** ±400 V (DC + peak AC); derate at 20 dB/decade from 100 KHz to 13 V at 3 MHz.

**Input R and C –** 1 MΩ ± 1% in parallel with 20 pF ± 2.0 pF.

**Channel Isolation –** ≥ 50 dB at 10 MHz, ≥ 35 dB at 100 MHz. For 485: ≥ 32 dB at 200 MHz.

**Vertical Control (2 CH, 465) –** CH1; CH2; ADD CH1+CH2; INVERT either CH1 and/or CH2; ALTernate or CHOP between CH1 and CH2 for multiple channel displays.

**Vertical Control (4 CH, 475/485) –** CH1; CH2; CH3; CH4; ADD CH1+CH2; ADD CH3+CH4; INVERT any/all channels; ALTernate or CHOP between all channels.




*On the hybrid, two LSI bipolar ICs and two CMOS ICs house all of the vertical, horizontal, and trigger functions.*

**AC-Coupled Lower –3 dB Point –** ≤ 10 Hz with a 1X probe. The AC-coupled lower frequency limits are reduced by a factor of 10 when 10X passive probes are used.

**Common Mode Rejection Ratio –** ≥ 10:1 at 50 MHz.

**HORIZONTAL SYSTEM**

**Main Sweep Time Base Range –** 0.5 s/div to 20 ns/div (to 2 ns/div with X10 magnification). For 485: to 10 ns/div (to 1 ns/div with X10 magnification).

**Delayed Sweep Time Base Range –** 5 ms/div to 20 ns/div (to 2 ns/div with X10 magnification). For 485: to 10 ns/div (to 1 ns/div with X10 magnification).

**Time Base Accuracy –** ±2%, ±3% magnified.

**Delay Jitter –** 25,000 to 1 for sweep speeds slower than 1 ms/div. 10,000 to 1 for all other sweep speeds.

**TRIGGERING**

**Main Mode Selections –** AUTO LEVEL (with auto baseline), AUTO, NORMAL, TV LINE, TV FIELD (odd, even, or both), SGL SEQ.

**Delayed Mode Selections –** RUNS AFTER DELAY, TRIGGERABLE AFTER DELAY, and TV LINE (from MAIN source).

**Trigger Coupling –** DC, Noise Reject, HF Reject, LF Reject, and AC for both Main and Delayed.

**Lowest Frequency for Successful Operation of "Set Level to 50%" Function –** 50 Hz with 1 division internal, 100 mV EXT or 1 V EXT/10 SOURCE.

**Trigger Source (465) –** CH1, CH2, EXT, LINE, ADD, EXT/10.

**Trigger Source (475/485) –** CH1, CH2, CH3, CH4, LINE, ADD CH1 + CH2, ADD CH3 + CH4.

**Holdoff Control Range –** Increases Main sweep holdoff time by a factor of at least 10.

**External Trigger Input (465) –** 1 MΩ ± 2% in parallel with 20 pF ± 2.0 pF.

**Maximum Input Voltage –** ± 400 V (DC + peak AC); derate at 20 dB/decade from 100 KHz to 13 V at 3 MHz.

**TRIGGER SENSITIVITY**

**DC –** 0.3 division from DC to 25 MHz, increasing linearly to 1 div, at 150 MHz (465/475), 1.5 div at 250 MHz (485).

**Noise Reject –** 1.2 division from DC to 25 MHz, increasing linearly to 2.2 div, at 150 MHz (465/475), 3.5 div at 250 MHz (485); 0.5 div or less will not trigger.

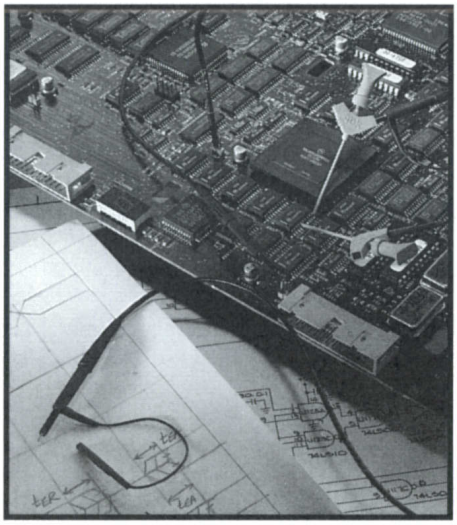
**HF REJ –** 0.3 division from DC to 10 kHz; attenuates signals above the upper –3 dB cutoff frequency of 50 kHz.

**LF REJ –** 0.3 division from 100 kHz to 25 MHz, increasing linearly to 1 div at 100 MHz (455), at 150 MHz (465/475), 1.5 div at 250 MHz (485); attenuates signals below the lower –3 dB cutoff frequency of 50 kHz.

**AC –** 0.3 division from 350 Hz to 25 MHz, increasing linearly to 1 div, at 150 MHz (465/475), 1.5 div at 250 MHz (485); attenuates signals below the lower –3 dB cutoff frequency of 160 Hz.

• A C C E S S O R Y •

### Direct access to SMD Packages



**P6561AS**

- SMD Package Support: 50 MIL, 25 MIL JEDEC, 0.65 mm and 0.5 mm EIAJ.
- DC to 200 MHz Bandwidth.
- <11 pF/10 MΩ Loading.
- 10X Attenuation.

*For complete information on all Accessory products see page 424.*

# TAS 465
# TAS 475
# TAS 485

# Analog Oscilloscopes
## 100 MHz to 200 MHz

**X-Y OPERATION**
**Sensitivity Range –** Same as Vertical Deflection System.

**X-Y Accuracy –** ± 4%.

**X-Axis Bandwidth –** DC to ≥ 3 MHz.

**Phase Difference Between X and Y –** ±3° DC to 150 kHz.

**CRT SYSTEM**
**Display –** 8 cm x 10 cm, 14 kV nominal voltage.

**Z-Axis Input –** Positive voltage decreases intensity; +2 V blanks maximum intensity trace usable to 20 MHz.

**Controls –** Sweep Intensity, Focus, Readout Intensity, Scale Illumination, Trace Rotation.

**PROBE COMPENSATOR OUTPUT**
**Output Voltage –** 0-5 V ± 10% into 1 MΩ load.

**Frequency –** 1 kHz ± 5%.

**Typical Rise Time –** ≤ 500 ns.

**Typical Aberrations –** ≤ ± 1% after the first 10 µs following the square wave transition.

**NONVOLATILE SETUP MEMORY**
**Number of Nonvolatile Setup Memories –** 4.

**Retention Time –** Typically 10 years.

**PHYSICAL CHARACTERISTICS**

| | TAS 400 Series | | Rackmount | |
|---|---|---|---|---|
| **Dimensions** | **mm** | **in.** | **mm** | **in.** |
| Width w/ handle | 362 | 14.3 | 483 | 19 |
| Height w/ feet, pouch | 191 | 7.5 | | |
| w/o pouch | 165 | 6.5 | 178 | 7 |
| Depth (stand alone) | 471 | 18.6 | 471 | 18.6 |
| w/ front cover | 490 | 19.3 | | |
| handle extended | 564 | 22.2 | 517 | 20.4 |
| **Weight** | **kg** | **lb.** | **kg** | **lb.** |
| Stand alone | 7.7 | 17 | *1 | |
| Net w/ accessories and pouch | 9.3 | 20.5 | 4.5 | 10*1 |
| Domestic Shipping | 13.6 | 30 | 15.4 | 33.9 |

*1 *Weight of conversion kit only. The rear support kit adds 7.3 kg/16 lb.*

**CURSORS**
**Cursor Functions –** ΔTime, 1/ΔTime, Absolute Volts, ΔVolts.

**Accuracy –**
ΔTime: ±2%, ±3% magnified of reading plus 0.1 Div; 1/ΔTime: Readouts calculated using; ΔTime.

Absolute Volts: –10°C to +30°C is ± (1% of reading + 2% of one vertical division + HF display errors + 0.5 mV + trace shift errors); +30°C to +55°C is ± (1% of reading + 2% of one vertical division + HF display errors + 4 mV + trace shift errors).

ΔVolts: ± (1.6% of reading + 2% of one vertical division + HF display errors).

**POWER REQUIREMENTS**
**Line Voltage Ranges –** 115 V: 90-132 VAC RMS. 230 V: 180-250 VAC RMS.

**Line Frequency –** 48 to 440 Hz.

**Maximum Power Consumption –** ≤ 85 W.

**MECHANICAL CHARACTERISTICS**
**Cooling Method –** Forced-air circulation with no air filter.

**ENVIRONMENTAL AND SAFETY**
The TAS Series scopes are designed to meet specific environmental conditions, as described in MIL-T-28800E for Type III, Class 3, Style D equipment, as specified below. Other environmental characteristics are available.

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

**Humidity –** Operating and nonoperating, up to 95% RH at or below +40°C; up to 75% RH from 41°C to 55°C.

**Altitude –** 15,000 ft/4572 m (operating); 40,000 ft/12192 m (nonoperating).

**Random Vibration –** 0.31 g's RMS (operating); 2.46 g's RMS (nonoperating), from 5 to 500 Hz, 10 minutes each axis.

**Electrostatic Discharge Susceptibility –** Up to 8 kV with no change to control settings or impairment of normal operation; up to 15 kV with no damage that prevents recovery of normal operation by the user.

**Safety –** UL 1244 Listed, Certified to CAN/CSA 22.2 No. 231 – M89.

**Emissions –** VFG 243, Category B; FCC Code, Part 15, Subpart B, Class A.

# Analog Oscilloscopes
## 100 MHz to 200 MHz








• A C C E S S O R Y •

### K212 Portable Instrument Cart

- Sturdy, mobile platform with two nylon safety straps.
- Tiltable top tray.
- Large wheel base for stability.
- Four outlet power strip; circuit breaker optional.

*For complete information on all Accessory products see page 424.*

## ORDERING INFORMATION

**TAS 465**
100 MHz Two Channel Oscilloscope ..... TD **$1,995**
**Includes:** Instruction Manual (070-8523-00); Basics Concept, XYZs of Analog and Digital Oscilloscopes (070-8690-00); Reference Guide (070-8522-00); Two 10X Voltage Probes (P6109B).

**TAS 475**
100 MHz Four Channel Oscilloscope..... TD **$2,395**
**Includes:** Instruction Manual (070-8688-00); Basics Concept, XYZs of Analog and Digital Oscilloscopes (070-8690-00); Reference Guide (070-88720-00); Two 10X Voltage Probes (P6109B).

**TAS 485**
200 MHz Four Channel Oscilloscope..... TD **$3,595**
**Includes:** Instruction Manual (070-8688-00); Basics Concept, XYZs of Analog and Digital Oscilloscopes (070-8690-00); Reference Guide (070-88720-00); Two 10X Voltage Probes (P6111B).

**TAS 400 SERIES OPTIONS**
**Opt. 02** – Pouch and Front Cover..... TD **+$60**
**Opt. 3R** – Rackmount Kit..... TD **+$400**
**Opt. 22** – Two each P6109B Probes (TAS 475)..... **+$160**
**Opt. 22** – Two each P6111B Probes (TAS 485)..... **+$260**
**Opt. 23** – Two each P6129B Probes (TAS 465/475) ..... **+$200**
**Opt. 9C** – Calibration Certification/Test Data ..... **+$125**
**Opt. M2** – Standard 3-year product warranty plus 2 additional years of repair services for a total of 5 years coverage.
TAS 465..... **+$150**
TAS 475..... **+$160**
TAS 485..... **+$210**
**Opt. M3** – Standard 3-year product warranty plus 4 years of calibration service and 2 years of repair services for a total of 5 years coverage.
TAS 465..... **+$285**
TAS 475..... **+$300**
TAS 485..... **+$400**
**Opt. M8** – Calibration Service
TAS 465..... **+$150**
TAS 475..... **+$160**
TAS 485..... **+$210**

**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1** – Universal Euro 220 V, 50 Hz. Order 00-000-00..... **NC**
**Opt. A2** – United Kingdom 240 V, 50 Hz. Order 00-000-00 ..... **NC**
**Opt. A3** – Australia 240 V, 50 Hz. Order 00-000-00 ..... **NC**
**Opt. A4** – North America 240 V, 60 Hz. Order 00-000-00 ..... **NC**
**Opt. A5** – Switzerland 220 V, 50 Hz. Order 00-000-00..... **NC**

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.
**Cart** – K212..... TD **$395**
**Camera** – C-9 Opt. 06 ..... TD **$630**
**Transit Case** – Order 016-0792-01 ..... **$455**
**Rackmount Kit** – Order 016-1166-00 ..... **$400**
**Accessory Pouch** – Order 016-1159-00..... **$50**
**Front Cover** – Order 200-3232-01..... **$10**

**PROBES**
**SMD**
**P6561AS** – 10X, 200 MHz probe set for ICs on 25 and 50 mil pitch Surface Mount Technology ..... **$350**
**Differential –**
**P6046** – 100 MHz, active differential, 6 ft. ..... TD **$2,295**
**High Voltage –**
**P6009** – 100X, 120 MHz, 1500 V, 2.5 pF/10 MΩ, 9 ft..... TD **$270**
**P6015A** – 1000X, 75 MHz, 20 kV, 3.0 pF/100 MΩ, 10 ft. ... TD **$950**
**General Purpose –**
**P6111B** – 10X, 200 MHz, 14.1 pF/10 MΩ, 2 m..... TD **$130**
**P6109B** – 10X, 100 MHz, 13.2 pF/10 MΩ, 2 m..... TD **$80**
**P6129B** – 1X-10X Switchable; 1X: 8 MHz, 124 pF/1 MΩ, 2 m.; 10X: 100 MHz, 16 pF/10 MΩ, 2 m. ..... **$100**
**P6101B** – 1X, 15 MHz ..... TD **$65**
**Logic –**
**P6408** – 20 MHz, 17-Bit, Word Recognizer/Logic Trigger.... TD **$500**
**Current –**
**P6022** – 935 Hz to 120 MHz, 6 A Peak..... TD **$595**
**P6021** – 120 Hz to 60 MHz, 15 A Peak..... TD **$550**
**AM503S** – DC to 50 MHz System, includes AM503A, and A6302 Current Probe..... **$2,745**
**Time Voltage Conversion –**
**TVC501** – Time-Interval to Voltage Converter ..... **$2,495**

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200

# 2467B 2467BHD 2465B 2445B Analog Oscilloscopes

## 200 MHz to 400 MHz

*Convenient and easy setup and measurements.*

**2445B/2465B**

- Four Channels
- Up to 400 MHz Bandwidth
- Up to 500 ps/div Timing Resolution
- Auto Setup
- Automatic Measurements
- Save and Recall Front-panel Setups
- Cursor Measurements
- 1% Timing Accuracy
- 3 Year Warranty

**2467B**

- Includes all the 2465B Functionality
- Bright Microchannel Plate Display (MCP)

**2467BHD**

- Includes All of the Above 2465B Functionality Plus a MCP Display
- Opt. 5H Tri-level Sync Triggering for HDTV Video Signals
- Opt. 06 Counter/ Timer/Trigger

**APPLICATIONS**

- Troubleshooting (2400B Series)
- Laser and Radar Pulses (2400B Series)
- Video Equipment Design (2467BHD)
- Disk Drive Testing (2467B)
- Advanced Imaging (2467BHD)
- Service (2400B Series)

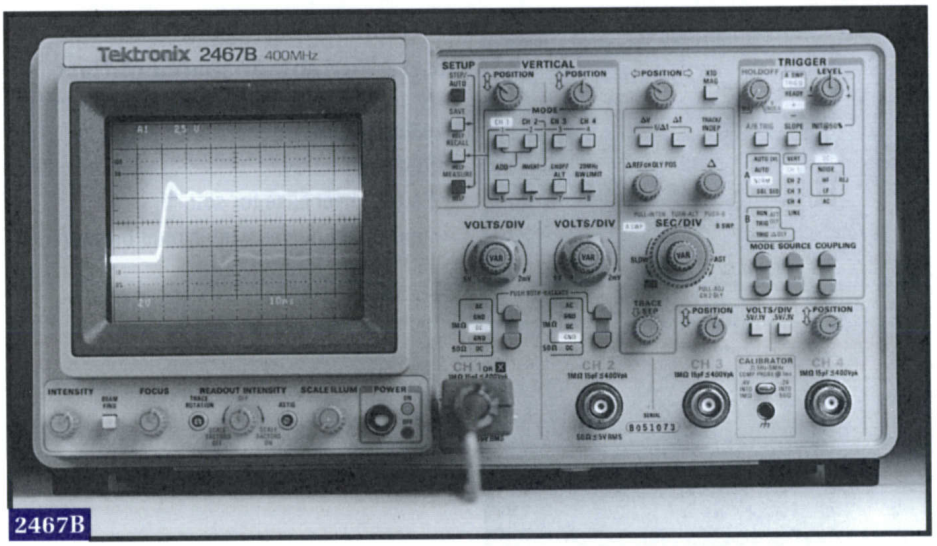
TD

The 2465B/2445B are available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.

2467B/2467BHD available through your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488

The 2467B, 2465B, and 2445B with Opt. 10, comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

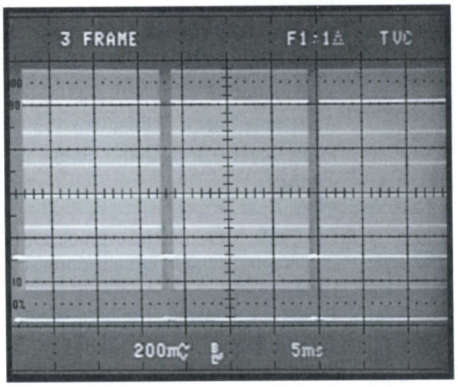



2467B

### Power of Analog

Recognizing that digital and analog scopes have different strengths, Tektronix designs and manufactures both analog and digitizing oscilloscopes so you can choose the right scope for your application and budget.

Although digital scopes feature many attractive capabilities, for a variety of applications analog scopes offer unique benefits that most digitizing scopes can't match.




### Grey Scaling and Persistence

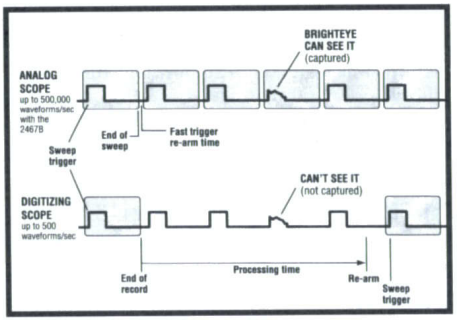
With an analog display, faster signals appear fainter than slower signals. Called grey scaling, this phenomenon gives important clues about relative frequencies when analyzing mixes or overlayed signals like video waveforms.

Or when an event only occurs occasionally in a repetitive signal, the anomaly will fade quicker and look dimmer than the rest of the waveform. This persistence effect reveals critical information when analyzing and debugging complex analog designs, such as switching power supplies.

### Real Time Display

The display on an analog scope responds instantly to changing signal conditions. Unlike digital scopes that need to acquire and process signal information before displaying, analog scopes simply attenuate or amplify the input signal directly onto the display.

As a result, analog scopes can trigger on many more waveforms per second than a digital scope. For instance, the 2467 BrightEye acquires up to 500,000 waveforms/sec. As a result, an analog scope updates its display so quickly that you literally see waveform behavior as it happens.




• A C C E S S O R Y •

### Powerful Waveform Analysis System

**DCS01 DIGITIZING CAMERA**

- Fast Transient Capture:
  - 100 GS/s, >400 MHz Single Shot w/2467
  - 250 GS/s, >1 GHz with 2465B/2445B

*For complete information on all Accessory products, see page 424.*

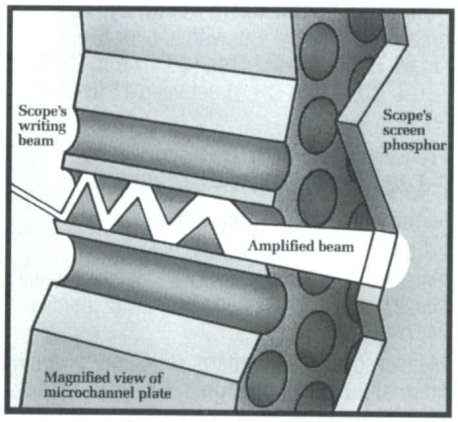
# Analog Oscilloscopes
## 200 MHz to 400 MHz

**2467B** **2465B**
**2467BHD** **2445B**



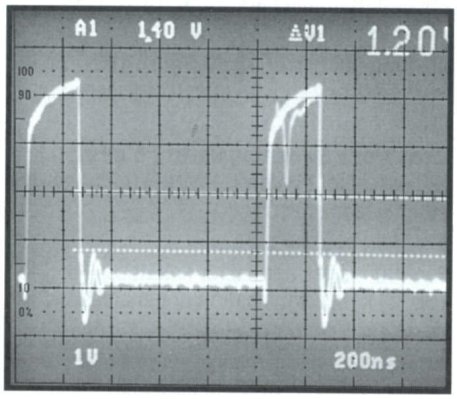
### BrightEye® Display

Sometimes grey scaling and persistence create such faint signals, you can have difficulty seeing them on ordinary scopes. In response to this problem, the 2467B BrightEye® includes a revolutionary new display, the microchannel plate (MCP), that can increase the intensity of a dim waveform up to a thousand times.

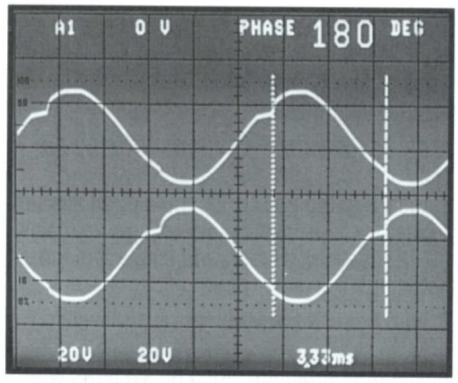



*Metastability in this flip-flop occurs only once in a million normal cycles, yet it is clearly visible due to the 2467B's high visible writing speed.*

This MCP technology makes it possible to see a single sweep even at 500 ps/div without a viewing hood. Even those difficult to find logic errors or metastability problems in a repetitive signal environment are easily seen.



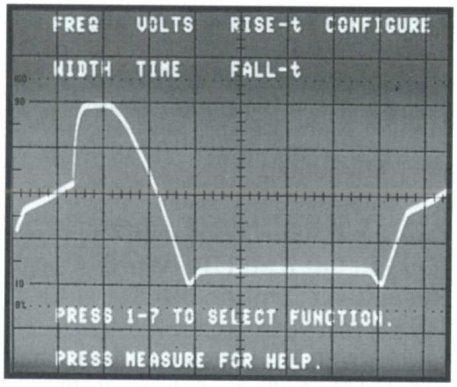

*Metastability in this flip-flop occurs only once in a million normal cycles, yet it is clearly visible due to the 2467B's high visible writing speed.*




*With the delta-time and voltage cursors, you can measure a waveform's parameters including phase.*

### Fully Independent Cursors

Fully independent delta-time and voltage cursors with readouts streamline display measurements.



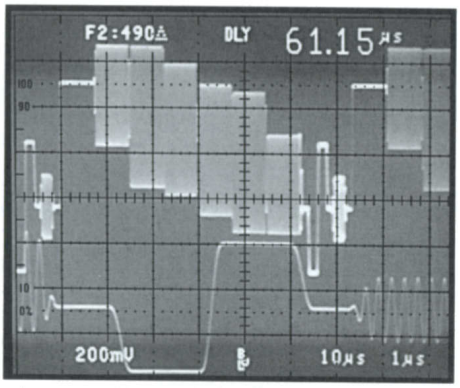

*Select from a variety of automatic measurement choices included with all the 2400B series scopes.*

### The Simplicity of Automated Control

2400B series automates several key functions so you can easily access the powerful capabilities of these scopes.

**STRAIGHTFORWARD SETUP**

To quickly locate and display undefined or complex signals, simply press AUTO SETUP. This function automatically triggers, scales and positions waveforms from any or all of the input channels.




*The 2467BHD automatically triggers on tri-level sync pulses used in high-definition video signals. Note: Line Count Readout Displays Field 2 – Line #490.*

**ADVANCED TRIGGERING**

With a complete selection of trigger modes, the 2400B series scopes can display any signal regardless of its complexity. The auto level function maintains a stable waveform display even as input signals change so you can view variable-voltage signals clearly without irritating jitter.

To noticeably improve the accuracy of timing measurements, press the INIT at 50% selection and the scope will maintain the trigger level at the input signal's 50% voltage level.

Choose AC or DC coupling and reject high or low frequencies or noise to clarify the waveform display.

### HDTV Analysis Made Easy

Built on the 2467B BrightEye platform, the 2467BHD applies the power of MCP technology to the acquisition of high-definition video signals.

The 400 MHz 2467BHD can automatically recognize tri-level sync pulses on any of the proposed HDTV standards, including 1250/50, 1125/60 and 1050/60 formats.

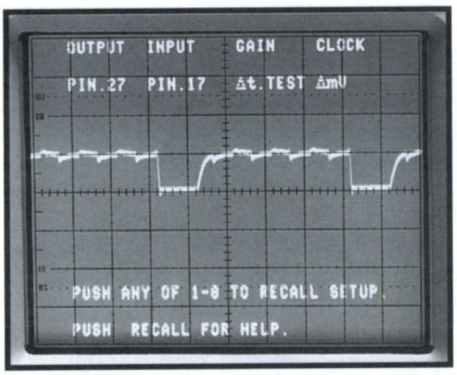
This scope, by including option 5H, clearly displays high-definition video signals with an unequalled frequency response flatness rating of ±2% over the first 30 MHz. To display signals even more clearly, you can significantly attenuate noise or clock frequency interference with the 50 MHz bandwidth limit selection.

A built-in counter/timer/trigger (Option 06) will help you make vital timing measurements as accurately as possible. And with its 500 ps/div sweep rate, the 2467BHD will capture and display a high-definition signal's fastest transients.

*Continued on next page.*

# 2467B 2467BHD 2465B 2445B Analog Oscilloscopes

## 200 MHz to 400 MHz




*Create measurement sequences using the front panel controls for semi-automated testing.*

### Streamlined Front-Panel Setups

Just press SAVE SETUP to save a front-panel setup instead of recreating it again and again. The scope instantly stores all front panel information, including intensity, cursor locations and control settings. And you label each setup with a descriptive name.

The 2400B series scopes will retain up to 30 front-panel setups in non-volatile memory until you decide to replace or delete them.

### Easy Automation

With built-in sequencing, you can develop a custom test series without writing a line of code. First save and label a series of front-panel setup, each representing a step in the test procedure. Then link the steps in any order you want.

To execute your custom test series, press STEP to sequence through the individual steps. This is extremely useful for manufacturing evaluation and device characterization. You'll appreciate the ease and efficiency of the 2400B series automatic sequencing.

### 2400B Series Options

The following options are not retrofittable on standard products after purchase.

**VIDEO WAVEFORM MEASUREMENT SYSTEM (OPTION 05)**
Tailors the 2445B, 2465B and 2467B for applications involving broadcast and cable television, graphics displays and raster-scan systems. It enables CRT readout of the line number of field selected for triggering, so the operator knows exactly what the display represents.

**Sync Separation:** Stable sync separation from sync-positive or sync-negative composite video on systems with 525 to 1280 lines, 50 Hz or 60 Hz, interlaced or noninterlaced.

**Trigger Modes:** Lines, FLD 1, FLD 2, ALT (FLD 1/FLD 2).

**Back Porch Clamp:** Within 1.0 div of the ground reference.

**HIGH-DEFINITION TELEVISION (OPTION 5H)**
Only available with the 2467B scope and standard in the 2467BHD, this option lets you trigger on tri-level sync pulses, automatically senses the HDTV standard being used and autosets itself accordingly.

**Stable Sync Separation:** From tri-level and bi-level sync-positive or sync-negative composite or component video on systems with 525 to 1280 lines per frame, 50 Hz or 60 Hz field rate, interlaced or non interlaced.

**HD Video Triggering Modes:** Lines, FLD 1, FLD 2, ALT (FLD 1/FLD 2), and the Active Video Mode.

**Standard TV Presets:** Lines, fields, frames, line select, active video, horizontal blanking, vertical blanking, pixel and TSG triggering.

**Bandwidth Limiter:** Reduces the upper –3 dB to 50 MHz.

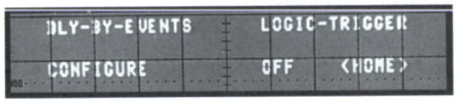
**Frequency Response (–3 dB 400 MHz)**
**Flatness:** ±1% for 50 kHz to 100 MHz, ±1%–2% for 10 MHz to 20 MHz, ±2% for 20 MHz to 30 MHz.

### Counter/Timer/Trigger (CTT) (Option 06) And CTT/Word Recognizer (Option 09)

These options feature a crystal-controlled timebase with 0.001% accuracy. Option 09 adds a word recognizer. Useful when probing TTL-compatible logic families, this 17-Bit word recognizer is operable up to 20 MHz with an external clock and up to 10 MHz with the internal clock.

These options also feature a 7-digit CRT readout display for Frequency (0.5 Hz to 150 MHz), Period (6.666667 ns to 2 s), Totalize (to 9,999,999) and Delay by Events triggering (up to 4,194,303).




### GPIB Interface (Option 10)

Functions implemented include SH1, AH1, T6, L3, SR1, RL1, CD1, E1, DT0, C0 and PP0.

### Characteristics

For more detailed specifications, contact any Tektronix Sales Office or authorized Tektronix distributor near you.

**VERTICAL SYSTEM**
**Deflection Factor:** 2 mV/div to 5 V/div, continuously variable between V/div settings (CH 1 and CH 2). 100 mV/div and 500 mV/div (CH 3 and CH 4).

**Deflection Factor Basic Accuracy:** ±2%, measured at any V/div with a 4- or 5-div signal, centered on screen (CH 1 and CH 2). ±10% (CH 3 and CH 4) between 15°C and 35°C.

**Frequency and Step Tr Response (–3 dB Bandwidth)/(Tr = 0.35/BW)**

| Instrument | BW/Rise Time |
|---|---|
| 2445B | 200 MHz/1.75 ns |
| 2465B/ 2467B/ 2467BHD | 400 MHz/0.875 ns (≥ 5 mV/div), and 350 MHz/1 ns (2 mV/div) |

Measured with a standard accessory probe or internal 50 Ω termination.

**Bandwidth Limiter:** Reduces upper –3 dB to 20 MHz for 2445B, 2465B and 2467B. Reduces upper –3 dB to 50 MHz for 2467BHD.

**Input Coupling and Max Voltage:** (1 MΩ) AC, DC, GND; Max input voltage: 400 V (DC + peak AC). (50 Ω) Max input voltage: 5 V RMS average for 1 sec, ±50 V peak.

**Input R and C:** 1 MΩ ±5% and 15 pF ±2 pF or 50 Ω (nominal).

**Channel Isolation:** ≥100:1 at 100 MHz, ≥50:1 at nominal bandwidth (CH 1, CH 2), ≥50:1 at 100 MHz (CH 3, CH 4).

**AC-Coupled Lower –3 dB Point:** 10 Hz or less. 1 Hz or less with standard accessory probe.

**Chop Mode Switching Rate:** 2.5 MHz ±0.2% (20 µs/div to 2 µs/div). 1 MHz ±0.2% for all other sweep speeds.

**A Sweep Timing Accuracy**
For 100 ms/div and faster settings, +15°C to +35°C, X10 magnification not enabled.

| Method | Accuracy |
|---|---|
| A Sweep | ±(0.7% of time interval +0.6% of full scale) |
| ΔT using cursors | ±(0.5% of time interval +0.3% of full scale) |
| ΔT using delay | ±(0.3% of time interval sweep +0.1% of full scale +200 ps) |
| Delay from A trig to B sweep | ±(0.3% of time interval +0.6% of full scale +0 to –25 ns) |

# Analog Oscilloscopes
## 200 MHz to 400 MHz

**2467B 2467BHD** | **2465B 2445B**



### HORIZONTAL SYSTEM

**Display Modes:** A (main sweep), A INTENsified, ALTernate, A INTEN with B (delayed sweep) and B. In X-Y mode, CH 1 provides X-axis (horizontal) deflection.

**A Sweep Time Base Range:** 2445B: 500 ms/div to 10 ns/div (to 1 ns/div with X10 magnification).

2465B/2467B/2467BHD: 500 ms/div to 5 ns/div (to 500 ps/div with X10 magnification).

**B Sweep Time Base Range:** 2445B: 50 ms/div to 10 ns/div (to 1 ns/div with X10 magnification).

2465B/2467B/2467BHD: 50 ms/div to 5 ns/div (to 500 ps/div with X10 magnification).

**Variable Timing Control:** Continuously variable and calibrated (add 2% of time interval timing accuracy) between SEC/DIV settings. Extends slowest A Sweep to 1.5 s/div. Change the A sweep's sec/div setting with the A display mode selected. Change the B sweep's sec/div with INTEN, ALT and B Modes selected. When VAR control is out of detent, the ΔT cursors measure RATIO (with 5 divisions being 100%) and 1/ΔT cursors measure PHASE (five divisions being 360°).

**Displayed CH 2 Signal Delay with Respect to CH 1:** Adjustable ±500 ps.

**Delay Jitter:** Within 0.004% (one part or less in 25,000) of maximum available delay plus 50 ps (2445B/2465B). Within 0.01% (one part or less in 10,000) of maximum available delay plus 100 ps (2467B/2467BHD).

### ACCURACY SPECIFICATIONS FOR AUTOMATIC MEASUREMENTS

(Excluding 2467BHD counter measurements—see Opt. 06 for specs.)

For +15°C to +35°C, specifications are based on noise less than 0.1% of a peak-to-peak input waveform.

**Period:** 0.5% + 500 ps + jitter error.

**Volts:** 5% +5 mV + (0.5 mV times probe attenuation) + signal aberrations + 1 LSD to 1 MHz (minimum width at peak amplitude ≤ 10 ns).

**Rise time, Fall time:** 5% + 3 ns (for transition times greater than 5 ns). These rise and fall times are based on measurements of 20% to 80%, extrapolated to 10% and 90% (pulse overshoot and pulse undershoot less than 5% of peak-to-peak signal).

**Time A-B (from % to %):** 0.5% + 3 ns (+ 0.5 ns if measuring from CH 1 to CH 2) + 5% of start event + 5% of stop event transition times.

**Time A-B (between two voltages):** 0.9% + 3 ns (+ 0.5 ns if measuring from CH 1 to CH 2) + 5% of start event + 5% of stop event transition.

**Pulse Width:** 0.9% + 1 ns + jitter error + 2X offset error (transition times less than 10% of measured interval).

### TRIGGERING

**A and B Trigger Coupling:** DC, Noise Reject, HF Reject, LF Reject, AC.

**Trigger Level Range:** ±18 times V/div setting for CH 1 and CH 2. ±9 times V/div setting for CH 3 and CH 4.

**Trigger Sensitivity to 50 MHz from CH 1 or CH 2:** 0.35 div DC coupled; ≤1.2 div noise reject coupled; 0.5 div from DC to 30 kHz HF reject coupled; 0.5 divs from 80 kHz LF reject coupled; 0.35 divs from 60 Hz AC coupled.

For above 50 MHz, DC, LF reject and AC coupling, the triggering signal requirement increases to 1.5 divs at 500 MHz (2465B/2467B/2467BHD) and at 250 MHz (2445B).

For noise reject coupling above 50 MHz, the triggering signal requirement increases to 4.5 divs at 500 MHz (2465B/2467B/2467BHD) and at 250 MHz (2445B).

**Triggering Sensitivity from CH 3 or CH 4:** One half the CH 1 or CH 2 requirements.

**LEVEL Control Range:** ±18 times the V/div setting for CH 1 or CH 2; ±9 times the V/div setting for CH 3 or CH 4.

**LEVEL Readout Basic Accuracy:** ±[3% of setting + 3% of p-p signal + 0.2 div + 0.5 mV + (0.5 mV times probe attenuation factor)] for CH 1 or CH 2; ±[3% of setting + 4% of p-p signal + 0.1 div + (0.5 mV times probe attenuation factor)] for CH 1 or CH 2.

Basic accuracies apply from +15°C to +35°C and are measured with triggering signals having transition times greater than 20 ns with 1 MΩ input, DC trigger coupling.

### X-Y OPERATION

**X-Axis Deflection Factor Range, Variable Range, and Accuracy:** Same as CH 1.

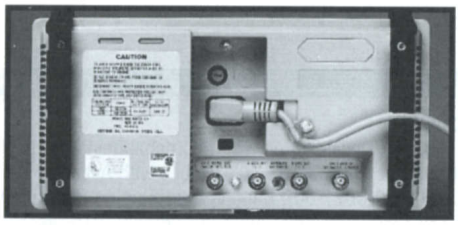
**X-Axis Bandwidth:** DC to 3 MHz.

**Phase Difference Between X and Y:** ≤1° from DC to 1 MHz. ≤3° from 1 MHz to 2 MHz.

### OTHER SIGNAL INPUTS AND OUTPUTS

**Inputs include:** Z-axis and AUTO/SETUP control.

**Outputs include:** CH 2 Signal Out, A Gate Out, B Gate Out and Calibrator/Probe Compensation output.



### DISPLAY

**Graticule Size:** 2445B/2465B: 80 mm x 100 mm 2467B/2467BHD: 68 mm x 85 mm.

**Standard Phosphor:** GH(P31).

**Cursors:** ΔVolts, ΔTime, 1/ΔTime, Ratio, Phase, and %.

### POWER REQUIREMENTS

**Line-Voltage Ranges:** 115 V: 90 to 132 VAC. 230 V: 180 to 250 AC.

**Line Frequency:** 48 to 440 Hz.

**Maximum Power Consumption:** 120 W (180 VA) for a fully optioned instrument.

### ENVIRONMENTAL AND SAFETY

The 2400B scopes meet the environmental conditions described in MIL-T-28800D for Type III, Class 3, Style D equipment as specified below. Other environmental specifications are available.

**Temperature:** –15°C to +55°C (operating); –62°C to +85°C (nonoperating).

**Humidity:** Operating and nonoperating, up to 95% RH at or below +40°C; to 75% RH from +41° to +50°C.

**Altitude:** 15,000 ft (op); 50,000 ft (non-op).

**Safety:** UL 1244 Listed, Certified to CSA C22.2 No. 231-M89.

### PHYSICAL CHARACTERISTICS

| | 2445B/ 2465B | 2467B/ 2467BHD | Rackmount[1] |
|---|---|---|---|
| **Dimensions** | **mm/in.** | **mm/in.** | **mm/in.** |
| Width w/handle | 338/13.3 | 338/13.3 | 483/19.0 |
| Height with feet & pouch | 190/7.5 | 190/7.5 | 178/7.0 |
| w/o pouch | 160/6.3 | 160/6.3 | |
| Depth with front cover | 434/17.1 | 472/18.6 | 419/16.5 |
| Handle extended | 508/20.0 | 533/21.0 | |
| **Weight** | **kg/lb.** | **kg/lb.** | **kg/lb.** |
| Net with accessories and pouch | 10.2/22.5 | 10.9/24.0 | 4.0/8.8 |
| w/o accessories & pouch | 9.3/20.5 | 9.7/21.3 | |
| Domestic Shipping | 12.8/28.2 | 14.6/32.1 | 6.3/13.8 |

*[1]Weight of conversion kit only. Rear support kit weight is an additional 6.3 kg/13.8 lb.*

*Continued on next page.*

# 2467B 2467BHD 2465B 2445B Analog Oscilloscopes

## 200 MHz to 400 MHz

## ORDERING INFORMATION

**2467B**
400 MHz Oscilloscope with Microchannel Plate Display....**$12,995**
**Includes:** Four P6137 10X Probes with Accessories fuse (159-0021-00); Banana Plug/Binding Post Adapter (134-0016-01); Snap Accessory Pouch (016-0692-01); Operators Manual (070-6861-01); Front cover (200-3199-01).

**2465B**
400 MHz Oscilloscope ..... TD **$6,995**

**2445B**
200 MHz Oscilloscope ..... TD **$5,744**
**Both Include:** Two P6137 10X Probes with Accessories Fuse (159-0021-00); Banana Plug/Binding Post Adapter (134-0016-01); Snap Accessory Pouch (016-0692-01); Operators Manual (070-6860-00); CRT Filter/Clear (378-0208-00); Front Cover (200-3199-01); Power Cord (161-0104-00).

**2467BHD** (Special Configuration for Video)
400 MHz HDTV Oscilloscope.....**$14,995**
**Includes:** same as 2467B plus: CCIR Graticule Filter (378-0270-01); NTSC Graticule Filter (378-0270-02); Polarized Viewing Hood (016-0180-00); Three 75 Ω Terminators (011-0055-00).
**Instrument Options are not retrofittable after purchase.**

**Opt. 05 –** Video Waveform Measurement System for bi-level sync formats. ..... TD **+$995**
**Opt. 5H –** High-Definition Television (2467B only) .....**+$1,595**
*Available also as the 2467BHD oscilloscope.*
**Opt. 06 –** Counter/Timer/Trigger. .....**+$1,295**
**Opt. 09 –** Counter/Timer/Trigger with Word Recognizer. ..... TD **+$1,995**
**Opt. 10 –** IEEE-488 GPIB Interface. ..... TD **+$995**
**Opt. 11 –** Rear panel probe power. For P6201 and P6202A. (Cannot be ordered with Opt. 09). .....**+$225**
**Opt. B1 –** Service Manual for standard 2465B and 2467B (070-6863-00) and for standard 2445B (070-6862-00). .....**+$120**
**Opt. B2 –** Service Manual for any of the above options, including the 2467BHD (070-6864-00). .....**+$120**
**Opt. 1R –** Instrument configured for rackmount. Includes slideout assemblies. .....**+405**
**Opt. 1T –** Transit Case (202-0302-00) with telescoping handle and retractable wheels. .....**+$570**
**Opt. 22 –** Two additional matching probes (P6137). (standard with 2467B and 2467BHD) .....**+$410**

**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1 –** Universal Euro, 220 V, 50 Hz. .....**NC**
**Opt. A2 –** United Kingdom, 240 V, 50 Hz. .....**NC**
**Opt. A3 –** Australian, 240 V, 50 Hz. .....**NC**
**Opt. A4 –** North American, 240 V, 60 Hz. .....**NC**
**Opt. A5 –** Swiss, 220 V, 50 Hz. .....**NC**
See General Customer Information Section for additional description.

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M2 –** Repair Protection
2467B .....**+$390**
2467BHD .....**+$450**
2465B .....**+$260**
2445B .....**+$220**

**Opt. M8 –** Calibration Service
2467B .....**+$390**
2467BHD .....**+$450**
2465B .....**+$260**
2445B .....**+$220**

**SOFTWARE**
Additional information in the Software section.
**EZ-TEST PC Test Development Software –** Requires GPIB-equipped instruments; used with Tektronix 2402A or IBM PC/XT/AT and compatibles (computer must also have GPIB). Order S45F030 .....**$995**

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

**PROBES**
**Passive (1 MΩ) –**
10X, 400 MHz, compact tip. Order P6137 .....**$205**
**Active –** 1X, 10X, 100X FET Probe, 900 MHz. Order P6201 .....**$1,550**
**Low Impedance (50 Ω) –** 10X Low Impedance, 3.5 GHz, 1X, 20X, 100X. Order P6156 Opt. 28 .....**$475**
**Current –** 50A MHz, 20A (DC + pk AC). Order AM 503S..... TD **$2,745**
15 MHz, 100A (DC + pk AC) Order AM 503S Opt. 03 .....**$3,395**
15A (p-p). Order P6021 .....**$550**
6A (p-p). Order P6022 .....**$595**
**High Voltage –** 120 MHz, 1500 V pk. Order P6009 .....**$270**
75 MHz, 40 kV pk. Order P6015A Opt. 1R .....**$1,005**
**Differential –** Order P6046 .....**$2,295**
**Digital Timing Demodulator –** Order TVC501 .....**$2,495**

**CARTS**
**Portable Instrument –** Order K212 ..... TD **$395**
**with Plotter Shelf –** Order K212 Opt. 22 .....**$540**

**CAMERAS**
**High Performance –** Order C-9 Opt. 20 ..... TD **$630**
**Digitizing –** Order DCS01 Opt. 2A .....**$6,925**

**ADDITIONAL ACCESSORIES**
**Optical to Electrical Converters –** 450-1050 nm, 700 MHz (requires 1103 Probe Power Supply). Order P6701A .....*1
450-1050 nm, 250 MHz, High Gain, (requires 1103 Probe Power Supply). Order P6711 .....*1
1000-1700 nm, 500 MHz (requires 1103 Probe Power Supply). Order P6703A .....*1
1100-1700 nm, 300 MHz, High Gain, (requires 1103 Probe Power Supply). Order P6713 .....*1
**Power Supply –** For up to two optical probes. Order 1103 .....**$600**
**Isolator –** Two independently-isolated channels, 20 MHz, 3000 VAC. Order A6902B Opt. 02 .....**$2,960**
**Ground Isolation Monitor –** Order A6901 .....**$1,800**
**SMT Interconnects –** See Pages 450-455 for complete line of attachment products.
**Carrying Cases –** Telescoping handle, retractable wheels. Order 202-0302-00 .....**$570**

**1 See page 283 for complete selection information.*

TD
The 2465B/2445B are available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.

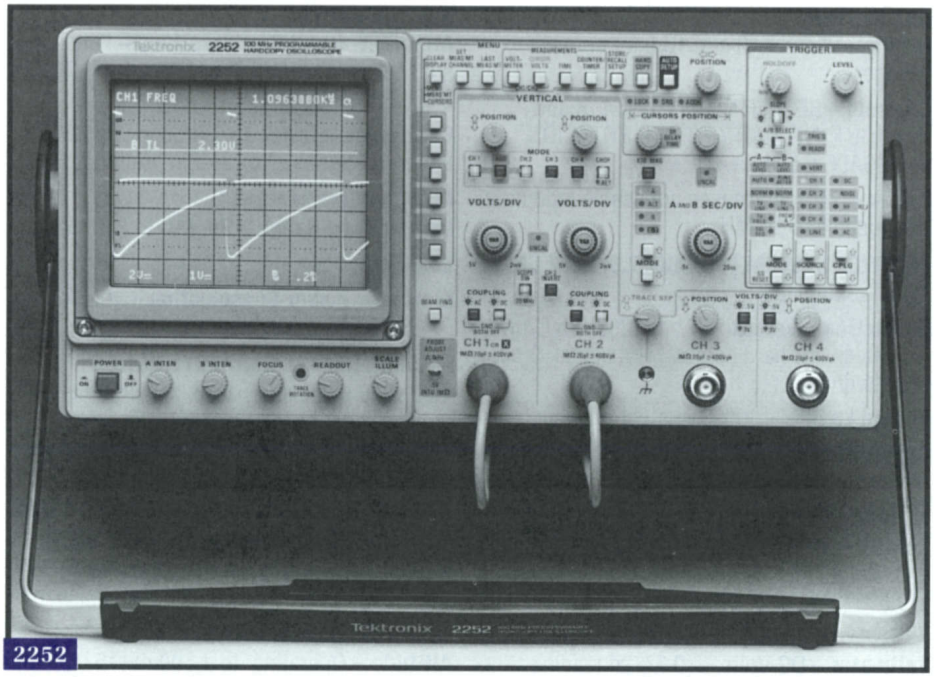
2467B/2467BHD available through your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488
The 2467B, 2465B, and 2445B with Opt. 10, comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Analog Oscilloscopes
## 100 MHz Counter/Timer Voltmeter

**2252**
**2247A**





2252

### 2252 and 2247A

The Tektronix 2252 and 2247A offer the most complete set of capabilities ever assembled in a low-cost analog scope. Combining an integrated counter/timer, digital voltmeter and built-in automation, each delivers the crystal-controlled accuracy, measurement power and productivity you demand.

You can measure frequency, period, rise/fall time, width and frequency ratio direct from the vertical inputs of the 2252 or 2247A. Make these measurements and many more with the push of a button. Gated time, frequency ratio and propagation delay time measurements are also made easily and automatically.

The voltmeter provides accurate measurements of + peak, – peak, peak-to-peak, DC and gated volts with convenient on-screen readout of values and operator prompts. The exclusive SmartCursor™ shows exactly where on the waveform an automatic measurement is being made. Delayed sweep cursors make possible highly accurate measurements on expanded waveforms.

Auto Setup of the front panel automatically adjusts vertical, horizontal, triggering and display controls to display a waveform – all at the press of a button! Or, simply use the store/recall of your specific front-panel setups: you can save up to 20 setups in the scope's memory for later recall. Sequences can also be set up for standard service routines.

For repetitive signals, enjoy the advantages of waveform digitizing and hardcopy documentation with the 2252 oscilloscope. Digitizing makes the 2252 even more powerful. Like hardcopy documentation at the push of a button via a Centronics interface to any Epson-compatible printer. Digitize repetitive waveforms using a unique sequential sampling technique, and then print the results for a permanent record.

Waveforms can also be sent via GPIB to a PC for display, analysis, and storage to disk. High vertical resolution and Tektronix' exclusive anti-aliasing peak detect process assure accurate signal analysis.

**2252/2247A**

- 100 MHz Bandwidth with 2 ns/div Time Base
- Four Independent Channels
- Auto Setup of Instrument Front Panel
- Store/Recall of 20 Front-Panel Setups
- Integrated 200 MHz Precision Counter/Timer
- Gated Counter Measurements
- Automatic Rise/Fall Time and Propagation Delay Time Measurements
- Delayed Sweep Cursors
- Initialized Time Cursors
- Automatic Phase Tracking
- Pre-set TV Trigger Slope
- Hands-off Voltmeter Measurements
- SmartCursor™ Track Voltmeter Measurements, Trigger Level, and Ground

2252 ONLY

- One-button Hardcopy Printout For Documentation, and GPIB Interface For PC Display, Analysis and Storage
- 3-year Warranty
- U.L. Listed, CSA and VDE Certified

*Automated measurements in a top-of-the-line, analog real time oscilloscope. Including the convenience of waveform digitizing and fully programmable GPIB control in the 2252.*

TD
Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200

GPIB IEEE-488
The 2252 complies with IEEE Standard 488.2-1988, and with Tektronix Standard Codes and Formats.

# 2252
# 2247A

# Analog Oscilloscopes
## 100 MHz Counter/Timer Voltmeter

### Characteristics

**VERTICAL SYSTEM (4 CHANNELS)**

**Bandwidth (–3 dB) and Rise Time –** 100 MHz and 3.5 ns (–10°C to +35°C); 90 MHz and 3.9 ns (2 mV/div or +35°C to +55°C). Bandwidth limit: 20 MHz.

**Deflection Factor and Accuracy –** CH 1&2: 2 mV/div to 5 V/div; CH 3&4: 0.1 V/div and 0.5 V/div; all at ±2% (±3% outside +15°C to +35°C). CH 1&2 variable at least 2.5:1.

**Vertical Operating Modes –** CH 1, 2, 3, 4, CH 2 INVERT, ADD, ALT, CHOP (625 kHz).

**CMRR –** At least 10:1 at 50 MHz.

**Input R and C –** 1 MΩ, 20 pF.

**Max Input Voltage –** 400 V (DC + peak AC) or 800 V p-p.

**Channel Isolation –** 50:1 at 100 MHz.

**HORIZONTAL SYSTEM**

**Sweep Speeds –** A Time Base: 0.5 s/div to 20 ns/div; B Time Base: 5 ms/div to 20 ns/div (X10 MAG to 2 ns/div A and B).

**Accuracy –** ±2%; Magnified ±3% (degrade by 1% outside +15°C to +35°C).

**Horizontal Operating Modes –** A, ALT, B, X-Y.

**Delay Jitter –** 20,000:1.

**Delay Time Accuracy –** ±0.5% +5% of one division +25 ns.

**TRIGGER SYSTEM**

**Trigger Sensitivity (A and B) –** DC: 0.35 div to 25 MHz, 1.0 div at 150 MHz. Noise Reject: 1.4 div to 25 MHz, 2.2 div at 100 MHz. HF Reject: attenuates above 70 kHz. LF Reject: attenuates below 50 kHz. AC: Same as DC, attenuates below 25 Hz. TV LINE, TV FIELD: 0.5 div of composite sync for stable display.

**Counter Sensitivity (A and B Trigger) –** 0.5 div at 10 MHz, 2.0 div at 100 MHz.

**Trigger Operating Modes –** A mode: AUTO LEVEL, AUTO, NORM, TV LINE, TV FIELD, SINGLE SEQ. B mode: RUNS AFTER DELAY, AUTO LEVEL, NORM, TV LINE (from A source).

**Trigger Source (A and B) –** VERT, CH 1, 2, 3, 4, LINE.

**Variable Holdoff –** At least 10:1.

**X-Y OPERATION**

**Deflection Factors –** Same as vertical system.

**X-Y Operating Modes –** X: CH 1; Y: CH 1, 2, 3, 4, and ADD.

**Bandwidth –** X-Axis: 3 MHz; Y-Axis same as vertical system.

**Phase Difference –** ±3° from DC to 50 kHz.

**CRT SYSTEM**

**Display –** 8 cm x 10 cm, 16.5 kV nominal voltage.

**Controls –** BEAM FIND, FOCUS, A, B and READOUT INTENSITY, TRACE ROTATION and SCALE ILLUMINATION.

**Z-Axis –** 3.8 volts causes noticeable modulation. Usable to 10 MHz.

**DIGITIZER SYSTEM (4 CHANNELS) 2252 ONLY**

**Type –** Sequential

**Resolution –** Vertical: 11 bits (256 levels/div) (25 pts/div for hard copies). Horizontal: 9 bits (50 pts/div).

**Record Length –** 500 points per channel.

**Usable Sweep Speeds –** 0.5 s to 20 ns/div (A Horizontal Mode only).

**ADVANCED FUNCTIONS**

**Cursors –** Time, 1/Time: ±(0.5% +2% of one div); Delta Time, 1/Delta Time, Delta Phase: ±(0.5% + 1% of one div); Volts: ±(0.5% + 2% of one vertical div).

**Voltmeter –** DC Volts: ±(0.5% of reading + 2% of one vertical div +250 µV); Plus or Minus Peak Volts and PK-PK Volts (25 Hz to 25 MHz): ±(2% of reading + 15% of one div + 1 mV). Channels 1 and 2.

**Counter/Timer –** Time Base and Accuracy: 200 MHz and 10 ppm (0.001%).

**Frequency –** 0.01 Hz to 100 MHz.

**Max resolution –** 0.00000001 Hz. Max accuracy same as base.

**Period –** 100 s to 5 ns.

**Max resolution –** 0.1 fs. Max accuracy same as time base.

**Width –** 100 s to 5 ns.

**Max resolution –** 1 ps. Max accuracy same as time base (±2 ns). Totalize: 0.00000001 to 99999999.

**Delta Time –** 0 to >±5 s. Max resolution: 1 ps. Max accuracy same as time base ±100 ps.

**1/Delta Time –** 0.2 Hz to 10 GHz.

**Rise/Fall –** 0 to 5 s. Max resolution: 1 ps. Max accuracy same as time base ±2 ns. Propagation Delay: 0 to 5 s. Max resolution: 1 ps. Max accuracy same as time base ±100 ps.

**External C/T Time Base Input –** 10.1 kΩ AC coupled. Sensitivity: 1 V p-p. Max input V: 35 V (DC + peak AC). Frequencies: 1, 5, and 10 MHz.

**2252 I/O PORTS**

**ANSI/IEEE-488.2 GPIB Interface –** Function subsets: SH1, AH1, T6, L4, SR1, RL1, DC1, DTO, PPO, E1 and CO.

**Centronics Interface –** Hardcopy Devices: Epson FX-Series (9 or 24-Pin printers).

**POWER REQUIREMENTS**

**Line Voltage Range –** 90 VAC to 250 VAC.

**Line Frequency –** 48 Hz to 445 Hz.

**Maximum Power Consumption –** 100 W (155 VA).

**ENVIRONMENTAL CHARACTERISTICS**

Instruments meet in part the environmental requirements of MIL-T-28800D or C for Type III, Class 3, Style D or C equipment as described below.

**Ambient Temperature –** Operating: –10°C to +55°C. Nonoperating: –51°C to +71°C.

**Humidity (Operating and Nonoperating) –** 95%, five cycles (120 hours). Reference: MIL-T-28800D, paragraph 4.5.5.1.2.2.

**Altitude –** Operating: to 4,500 m (15,000 ft.). Maximum operating temperature decreases 1°C/1,000 ft from 5,000 ft to 15,000 ft. Nonoperating: to 15,000 m (50,000 ft).

**EMC –** Meets class B requirements per VDE 0871-B for radiated and conducted emissions and FCC requirements.

**Vibration –** Operating: 15 minutes along each of the 3 major axes. 0.025 inch p-p displacement 10 Hz to 55 Hz to 10 Hz in one minute cycles. Holds for 10 minutes at 55 Hz (4 g at 55 Hz).

**Shock –** Operating: 30 g, 1/2 sine, 11 ms duration, 3 shocks per axis along each major axis. Total of 18 shocks.

**Safety –** UL 1244 listed, CSA certification.

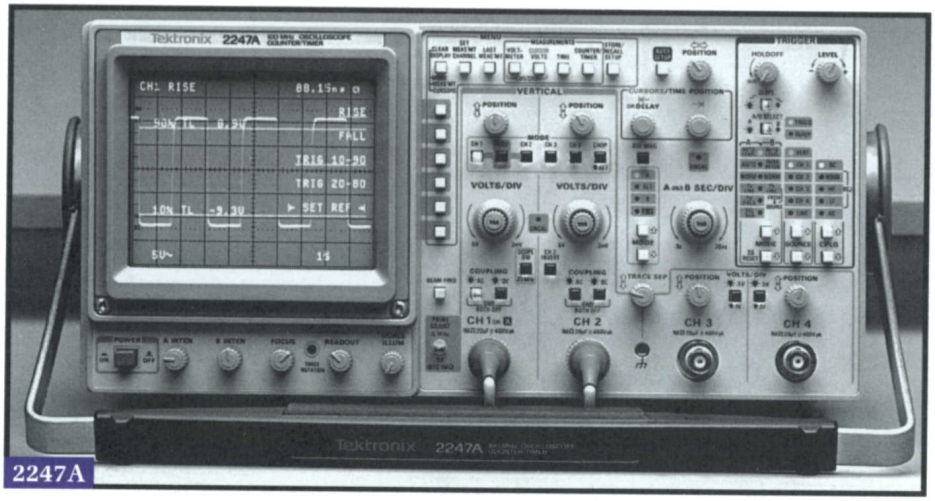
**PHYSICAL CHARACTERISTICS**

| Dimensions | mm | in. |
|---|---|---|
| Width (with handle) | 362 | 14.2 |
| Height | 164 | 6.4 |
| Depth (with front cover) | 445 | 17.5 |
| **Weight** | **kg** | **lb.** |
| Net (2252) | 8.73 | 17.9 |
| Net (2247A) | 7.9 | 17.3 |

# Analog Oscilloscopes
## 100 MHz Counter/Timer Voltmeter







2247A

## ORDERING INFORMATION

**2247A**
100 MHz Oscilloscope
with Counter/Timer and Voltmeter ..... TD **$3,695**

**Includes:** Two 10X Voltage probes (P6109B); Operators Manual, (2247A: 070-6373-00; 2252: 070-7837-00); Users Reference Guide (2247A: 070-6688-00; 2252: 070-7839-00); Power Cord.

**2252**
100 MHz Programmable Oscilloscope
with Hardcopy Output ..... TD **$4,195**

**Includes:** Two 10X Voltage probes (P6109B); Operators Manual, (2247A: 070-6373-00; 2252: 070-7837-00); Users Reference Guide (2247A: 070-6688-00; 2252: 070-7839-00); Power Cord.

### INSTRUMENT OPTIONS

**Opt. 1R –** Rackmounted Instrument ..... **+$400**
**Opt. 15 –** CH 2 and A Gate Outputs ..... TD **+$100**
**Opt. 02 –** Accessory Pouch and Cover ..... **+$60**
**Opt. 22 –** Add two P6109B probes ..... **+$160**

### INTERNATIONAL POWER PLUG OPTIONS

**Opt. A1 –** Universal Euro (020-0859-00) ..... **NC**
**Opt. A2 –** UK (020-0860-00) ..... **NC**
**Opt. A3 –** Australian (020-0861-00) ..... **NC**
**Opt. A4 –** North American (020-0862-00) ..... **NC**
**Opt. A5 –** Switzerland (020-0863-00) ..... **NC**

### WARRANTY-PLUS SERVICE PLANS

**Opt. M2 –** Repair Protection
2247A ..... **+$180**
2252 ..... **+$210**
**Opt. M8 –** Calibration Service
2247A ..... **+$180**
2252 ..... **+$210**

### RECOMMENDED ACCESSORIES

See page 424 for complete selection information.

### PROBES

**Passive Voltage –**
10 MHz/100 MHz, 1X/10X, switchable, with readout.
Order P6129B ..... **$100**
100 MHz, 10X, ruggedized, w/readout. Order P6109B ..... **$80**
15 MHz, 1X, modular w/o readout. Order P6101B ..... **$65**

**Current –**
20 Amp max, DC to 50 MHz, w/A6302 current probe.
Order AM503S ..... **$2,745**
100 Amp max, DC to 15 MHz, w/A6303 current probe
Order AM503S Opt. 03 ..... **$3,395**

**High Voltage –** 1.5 kV 100X, 120 MHz with readout.
Order P6009 ..... **$270**
40 kV 1000X, 75 MHz with readout. Order P6015A Opt. 1R ... **$1,005**

**Differential –** 100 MHz, 1X/10X differential probe, FET.
Order P6046 w/power ..... **$2,295**

**Logic Probe –** 16 channel word recognizer/Trigger-TTL
Order P6408 ..... **$500**

**Cable –** Centronics 2252 to printer (25 -Pin).
Order 012-1250-00 ..... **$55**

**CART –** Portable instrument. Order K212 ..... **$395**

**CAMERA –** Scopes with graticule illum.
No flash required on camera. Order C-9 Opt. 20 ..... **$630**

**Digital Timing Demodulator –** Order TVC501 ..... **$2,495**

### OPTIONAL ACCESSORIES

**Carrying Strap –** Order 346-0199-00 ..... **$28**
**Transit Carrying Strap –** Order 016-0792-01 ..... **$455**
**Rain Cover –** Order 016-0848-00 ..... **$28**
**2247A Service Manual –** Order 070-6367-00 ..... **$130**
**2252 Service Manual –** 070-7838-00 ..... **$130**
**Rackmount Kit –** Order 016-1166-00 ..... **$400**
**Front Panel Cover –** Order 200-3232-00 ..... **$10**
**Accessory Pouch –** Order 016-0857-00 ..... **$50**
**Quick Start Training** – Order 020-1864-04 (NTSC) ..... **$240**
**Opt. 15 Retrofit Kit –** Order 040-1301-02 ..... **$120**

**Viewing Hoods –**
Collapsible. Order 016-0592-00 ..... **$20**
Binocular. Order 016-0566-00 ..... **$30**
Polarized. Order 016-0180-00 ..... **$100**

**2252 ONLY:**
**GPIB Cable –** Order 012-0991-00 ..... **$195**
**Centronics Cable –** Order 012-1250-00 ..... **$55**
**2252 Programmer Manual –** Order 070-8378-00 ..... **$60**

TD
Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200

GPIB IEEE-488 The 2252 complies with IEEE Standard 488.2-1988, and with Tektronix Standard Codes and Formats.

# Analog Oscilloscope

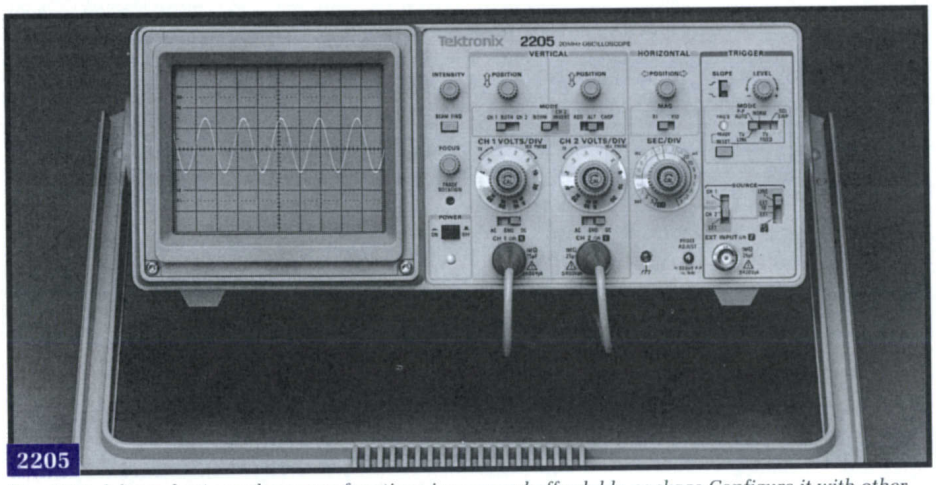
## 20 MHz and 40 MHz



*Everything you need for basic scope measurements.*

**2205**

- 40 MHz Bandwidth Option 40
- Peak-to-Peak Auto Triggering
- 0.3 div Trigger Sensitivity
- Front Panel Z-Axis Input
- 10 ns/div Max. Sweep Rate




*The 2205 delivers basic analog scope functions in a rugged affordable package Configure it with other low-cost Tektronix bench equipment, and you have the perfect combination for field applications, classroom labs, or production test.*

### 2205 Oscilloscope

**SOLID PERFORMANCE AND TEKTRONIX QUALITY**

The 20 MHz, two channel 2205 is the most basic of the 2200 Series analog scopes, yet it offers Tektronix quality and unexpected performance features. Engineered for ease of operation, versatility, and ruggedness, the 2205 provides solid performance and a price that's right for a variety of applications.

With its industrial quality construction and ability to operate under environmental extremes, the 2205 is an excellent choice for field applications, production testing, or classroom instruction.

**40 MHZ BANDWIDTH OPTION**

For added bandwidth and CRT brightness specify option 40. The 2205 bandwidth is increased to 40 MHz and the CRT brightness is increased via a 6 kV CRT accelerating potential.

**VALUE-ADDED FEATURES**

In the 2205, performance features add value, not expense. For example, standard features include 5 mV/div vertical sensitivity, a fast 10 ns/div horizontal display and a flexible trigger system. Peak-to-peak auto capabilities deliver virtually hands-free triggering. Also featured are TV line and field triggering and front-panel access to the Z-axis input.

**IDEAL FOR TEST SYSTEMS**

The 2205 can be configured with low-cost bench equipment available from Tektronix (see pages 395-408 for TM 250 products). These configurations are ideal for use in applications such as field service, production testing and classroom lab stations.

### Characteristics

**VERTICAL SYSTEM (2 IDENTICAL CHANNELS)**

**Bandwidth (–3 dB) and Rise Time –** 20 MHz and 17.5 ns (5°C to 35°C). 15 MHz and 23.3 ns (0°C to 40°C).

**2205 Option 40 Bandwidth (-3dB) and Rise Time –** 40 MHz and 8.75 ns (+5°C to +35°C). 35 MHz and 10 ns (0° to 40°C).

**Deflection Factor and Accuracy –** 5 mV/div to 5 V/div ±3%, (15°C to 35°C); ±5%, (0°C to 40°C).

**Vertical Operating Modes –** CH 1, CH 2, CH 2 IN-VERT, ADD, ALT, CHOP.

**CMRR –** At least 10:1 at 10 MHz.

**Input R and C –** 1 MΩ, 25 pF.

**Max Input Voltage –** 400 V (DC + peak AC), 800 V p-p.

**Channel Isolation –** 100:1 at 20 MHz.

**HORIZONTAL SYSTEM**

**Sweep Speeds –** 0.5 s/div to 0.1µs/div. (X10 MAG to 10 ns/div).

**Accuracy –** ±3%; Magnified ±4% (degrade by 1% outside 15°C to 35°C).

**Horizontal Operating Modes –** X1, X10, X-Y.

**TRIGGER SYSTEM**

**Trigger Sensitivity –** Internal: 0.30 div at 5 MHz, 1.0 div at 30 MHz. External: 40 mV at 5 MHz, 150 mV at 30 MHz (150 mV at 45 MHz for option 40).

**Trigger Operating Modes –** Peak-Peak AUTO, NORM, TV FIELD, TV LINE, SGL SWP.

**Trigger Source –** VERT MODE, CH 1, CH 2, LINE, EXT, EXT/10.

**Trigger Coupling –** AC, DC.

TD

Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200

# Analog Oscilloscope
## 20 MHz and 40 MHz





**X-Y OPERATION**

**Deflection Factors –** Same as vertical system.

**Bandwidth –** X-Axis: 2 MHz. Y-Axis: same as vertical system.

**Phase Difference –** ±3° from DC to 50 kHz.

**CRT SYSTEM**

**Display –** 8 cm x 10 cm, 1.8 kV nominal voltage (2205); 6 kV nominal voltage (Opt. 40).

**Controls –** INTENSITY, TRACE ROTATION, BEAM FIND, FOCUS.

**Z-Axis –** 5 V causes noticeable modulation. Useable to 5 MHz.

**POWER REQUIREMENTS**

**Line Voltage Range –** Low: 95 VAC to 128 VAC. High: 185 VAC to 250 VAC.

**Line Frequency –** 48 Hz to 440 Hz.

**Maximum Power Consumption –** 40 W (60 VA).

**ENVIRONMENTAL SPECIFICATIONS**

Instruments meet in part, the environmental requirements of MIL-T-28800D or C for Type III, Class 3, Style D or C equipment as described below.

**Ambient Temp –** Operating: 0°C to +40°C. Nonoperating: –55°C to +75°C.

**Humidity –** Percent: 95% five cycles, (120 hours) 90% +40C 4 hours. Reference: MIL-T-28800D, paragraph 4.5.5.1.2.2. Tektronix 062-2847-00, II.

**Altitude –** Operating: to 4,500 m (15,000 ft.), maximum operating temp decreases 1°C per 300 m above 1500 m. Nonoperating: to 15,000 m (50,000 ft.).

**EMC –** Meets Class B requirements per VDE 0871-B for radiated and conducted emissions and FCC requirements.

**Vibration –** Operating: 15 minutes along each of the 3 major axis, 10 Hz to 55 Hz to 10 Hz in one minute cycles. Hold for 10 minutes at 55 Hz. Displ. (in p-p): 0.015.

**Shock –** Operating: 30 g, 1/2 sine, 11 ms duration, 3 shocks per axis along each major axis. Total of 18 shocks.

**OTHER CHARACTERISTICS**

**Safety –** UL 1244 listed, Certified to CSA C22.2 No. 231-M89.

**Warranty –** 1 year; 3 years optional.

**PHYSICAL CHARACTERISTICS**

| Dimensions | mm | in. |
|---|---|---|
| Width (with handle) | 380 | 15.0 |
| Height | 137 | 5.4 |
| Depth (without front cover) | 440 | 17.3 |
| **Weight** | **kg** | **lb.** |
| Net | 6.7 | 14.8 |

## ORDERING INFORMATION

**2205**
20 MHz Oscilloscope ..... TD **$695**
**Includes:** Two 1X test leads (103-0275-00), Operators Manual (070-6717-00), 1 Year Warranty, Power Cord.

**Opt. 02 –** Pouch and Cover ..... **+$60**
**Opt. 3R –** Rackmount ..... **+$175**
**Opt. 23 –** Add two P6119B 1X/10X Probes ..... **+$170**
**Opt. 24 –** Add two P6103B 10X Probes ..... **+$110**
**Opt. 40 –** Increase Bandwidth to 40 MHz ..... **+$300**
**Includes:** Two P6103B 10X Probes.

**INTERNATIONAL POWER PLUG OPTIONS**

**Opt. A1 –** Universal Euro 220 V, 50 Hz. Order 020-0859-00 ..... **NC**
**Opt. A2 –** United Kingdom 240 V, 50 Hz. Order 020-0860-00 ..... **NC**
**Opt. A3 –** Australian 240 V, 50 Hz. Order 020-0861-00 ..... **NC**
**Opt. A4 –** North American 240 V, 50 Hz. Order 020-0862-00 ..... **NC**
**Opt. A5 –** Switzerland 220 V, 50 Hz. Order 020-0863-00 ..... **NC**
See Customer Information Section for additional description.

**WARRANTY-PLUS SERVICE OPTIONS**

Opt. M7 – Calibration Service ..... **+$35**
Opt. M9 – Repair Protection ..... **+$70**

**RECOMMENDED ACCESSORIES**

See Page 424 for complete selection information.

**PROBES**

**Passive Voltage –**
1X/10X, switchable, w/o readout. 10 MHz, 120 pF/1 MΩ, 2 m; 100 MHz, 15.3 pF/10 MΩ, 2 m. Order P6119B ..... **$85**
60 MHz, 10X, ruggedized, w/o readout. 13.2 pF/10 MΩ, 2 m. Order P6103B ..... **$55**
15 MHz, 1X, modular w/o readout. 54 pF/1 MΩ, 2 m. Order P6101B ..... **$65**

**Current –**
20 Amp max, DC to 50 MHz, w/A6302 current probe. Order AM503S ..... **$2,745**
100 Amp max, DC to 15 MHz, w/A6303 current probe. Order AM503S Opt. 03 ..... **$3,395**

**High Voltage –**
1.5 kV 100X, 120 MHz with readout. Order P6009 ..... **$270**
40 kV 1000X, 75 MHz with readout. Order P6015A Opt. 1R ..... **$1,005**

**Specialty –**
Logic probe, 16-channel word recognizer/Trigger-TTL Order P6408 ..... **$500**

**Cameras –** Order C-9 Opt. 20, Opt. 1F ..... **$755**
**Cart –** Portable instrument. Order K212 ..... **$395**

**ADDITIONAL ACCESSORIES**

**Service Manual –** Order 070-6716-00 ..... **$130**
**Rackmount Kit –** Order 016-0819-03 ..... **$330**
**Self-Study Package Video*1 –** Order 068-0289-XX ..... **$60**
**Carrying Strap –** Order 346-0199-00 ..... **$28**
**Transit Carrying Case –** Order 016-0792-01 ..... **$455**
**Front Panel Cover –** Order 200-3397-00 ..... **$10**
**Accessory Pouch –** Order 016-0677-02 ..... **$50**

**Viewing Hoods –**
Collapsible. Order 016-0592-00 ..... **$20**
Binocular. Order 016-0566-00 ..... **$30**
Polarized. Order 016-0180-00 ..... **$100**

**1 See the Educational Section, pages 409-412 for more information.*

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200

# Digitizers



### SCD Family

The SCD Family of Transient Waveform Digitizers provide the unique capability of high time and amplitude resolution single-shot capture of low nanosecond and picosecond events. This technology allows a large number of waveform data points even on the fastest events.

### RTD720A/RTD710A

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.

The RTD710A provides high resolution, accuracy, and speed. With four times the resolution of an 8-Bit digitizer and 60 dB of dynamic range, the RTD710A provides excellent resolution of fine signal details.

### 9503/9504

The 9503 or 9504 provide storage of long data records obtained from high speed analog-to-digital converter. In conjunction with the RTD710A Waveform Digitizer, they provide the fastest real time data logging capability for multiple, complex waveforms.

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**ACCESSORIES**

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# SCD 5000
# SCD 1000

# Transient Event Digitizers
## 1 GHz and 4.5 GHz Bandwidth

*High performance transient event capture.*

### SCD FAMILY

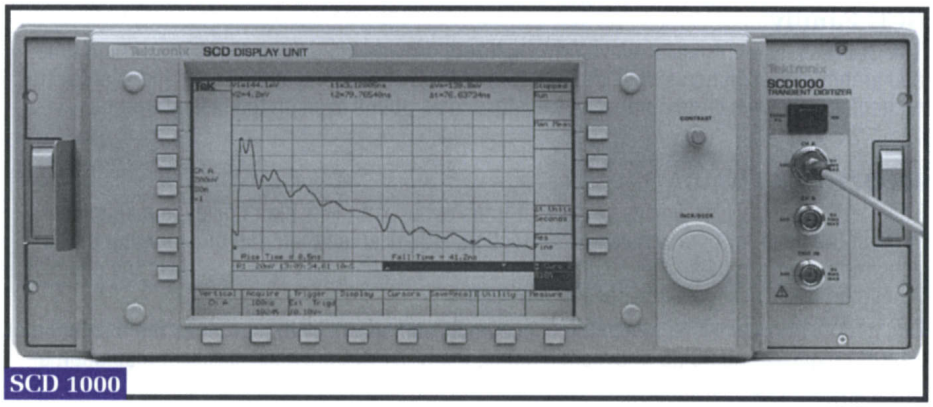
- High Single-Shot Sample Rate to 200 GS/s (5 psec/pt)
- High Analog Bandwidth

  4.5 GHz with SCD5000

  1.0 GHz with SCD1000
- 11-Bit Vertical Resolution (2048 levels of resolution)
- Variable Record Lengths 256, 512, 1024
- Display Unit for Easy Control, Viewing, and Measurements

### SCD FAMILY 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 & Lidar
- High Frequency Ultrasonics



SCD 1000

### SCD 5000/SCD 1000

The Tektronix SCD Family of 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 Family 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.

### STAND-ALONE SUPPORT

The SCD Family, while designed as a system product, has a feature set and capabilities to meet application requirements as a stand-alone 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 8 of the 21 measurements that are made can be displayed on the Display Unit (all 21 measurements plus additional information is 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
- 10 stored (and battery backed-up) instrument settings
- Rack mounting 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.

Another important system capability is the maintaining of the highest accuracy and signal fidelity. The SCD Family 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.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488

The SCD5000/SCD1000 complies with IEEE Standard 488.1 and Tektronix Standard Codes and Formats.

# Transient Event Digitizers

## 1 to 4.5 GHz Bandwidth

**SCD 5000**
**SCD 1000**



**HIGH FIDELITY WAVEFORM CAPTURE**
The SCD Family 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.

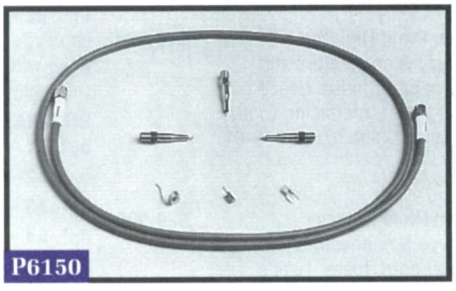
**Arming –** Internal or External. Triggers are not recognized until the unit is armed. External Arm is a BNC input that arms on a switch closure to ground (internal pull-up provided to 5 V).

**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. The SCD1000 provides two independent signal conditioning input channels that can be used as either or the other or added together.

| Parameter | SCD5000 | SCD5000 Opt. 01 | SCD1000 |
|---|---|---|---|
| Analog Bandwidth (–3 dB) | ≥4.5 GHz | ≥3.0 GHz | ≥1.0 GHz |
| Risetime (from Calculation) Tr = 0.35/Bandwidth | ≤80 picoseconds | ≤120 picoseconds | ≤350 picoseconds |
| Vertical Resolution Averaging | 11-Bits / 2048 levels Averaging to 14-Bits | 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 | 100 mV to 10 V Full Scale 1, 2, 5 Sequence |
| Offset Range | ±4 V | ±8 V | ±2.5 X Input Range |
| Input Impedance and Coupling | DC Coupled: 50 Ω | DC Coupled: 50 Ω | DC Coupled: 50 Ω AC Coupled: 50 Ω in series with ≈ 2.2 µF |
| **TRIGGERING** | | | |
| Sources | External | External or Internal | External or Internal (CHA or CHB) |
| Coupling | AC | AC | AC or DC |
| Slope | Positive or Negative | Positive or Negative | Positive or Negative |
| Range | ±0.5 V | ±0.5 V External ±1.0 V Internal | ±1.25 V External ±125% of Input Range Internal |
| Sensitivity (Sinewave) Internal | Not Applicable | 500 mV 20 KHz to 50 MHz 1.5 V 50 MHz to 500 MHz 3.5 V 500 MHz to 1 GHz | 5% of input range DC to 250 MHz 15% of input range 250 MHz to 1 GHz |
| 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 | 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 picosecond HAD (half duration amplitude) pulse | ≤150 mV with 500 picosecond HAD (half duration amplitude) pulse | ≤150 mV with 500 picosecond HAD (half duration amplitude) pulse |
| Pretrigger View Time | Not Applicable | ≥2 ns | ≥2 ns |




• ACCESSORY •

### Lowest Capacitive Loading Available

**P6150**

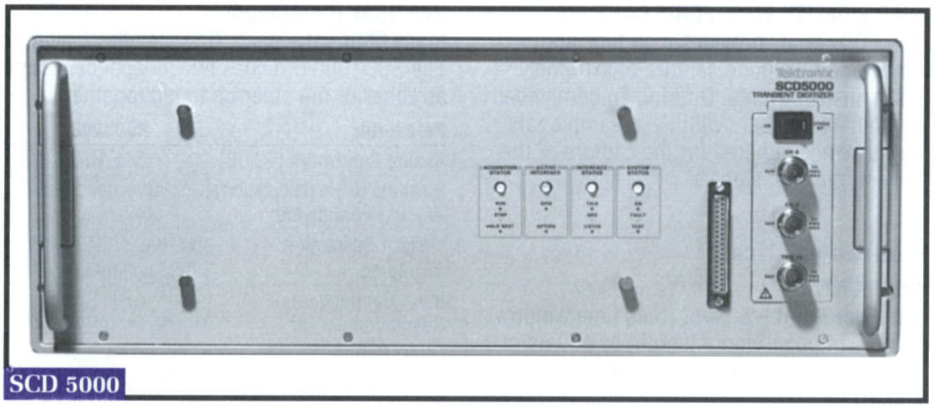
- <0.15 pF/500 Ω provides lowest circuit loading for 50 Ω circuitry.
- Extremely wide bandwidth (>9 GHz).
- Interchangeable attenuator tips (1X, 10X).
- Useful in high speed sampling TDR applications.
- SMA style connection.

*For complete information on all Accessory products, see page 424.*

# SCD 5000
# SCD 1000

# Transient Event Digitizers

## 1 GHz to 4.5 GHz Bandwidth



SCD 5000

**COMPUTER INTERFACES**

**GPIB - IEEE-488 –** Interface is standard for instrument control and waveform data transfer. Maximum transfer rate ≥500 KB/sec.

**Parallel Port –** As an (Opt. 2F) a waveform data output only 16-Bit wide parallel port is provided capable of two 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 & INSTRUMENT CONTROL**

**Display –** Provides for waveform viewing and instrument control. The waveform data display provides viewing of up to 4 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 VRMS or 180 to 250 VRMS.

**Power Consumption –** SCD5000 and SCD1000 fully optioned ≤300 Watts.

**Warranty –** The SCD1000 and SCD5000 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

## ORDERING INFORMATION

**SCD5000**
4.5 GHz Bandwidth Transient Event Digitizer.....**$46,900**
**Includes:** Instrument with type N connectors and detachable display with power cord; fuses; User's Manual (070-6960-01); Instrument Interfacing Guide (070-7315-01); Quick Reference Guide (070-7316-01); and rack mount kit.

**SCD1000**
1.0 GHz Bandwidth Transient Event Digitizer.....**$29,900**
**Includes:** Instrument with type N connectors and detachable display with power cord; fuses, User's Manual (070-6960-01); Instrument Interfacing Guide (070-7315-01); Quick Reference Guide (070-7316-01); and rack mount kit.

**Opt. 1P –** Increase waveform capture and transfer rate from one to ten 512 point waveforms per second.....**+$3,000**

**Opt. 2E –** Change Type N input connectors to SMA .....**+$250**

**Opt. 2F –** Parallel Waveform Data Output Port with Battery Back-up of Linear Array Data.....**+$3,500**

**Opt. 20 –** Delete Display Unit .....**–$2,000**

**Opt. 1E –** (SCD1000 ONLY) Change Type N input connectors to BNC with Tektronix SmartProbe Interface.....**+$900**

**Opt. 01 –** (SCD5000 ONLY) Add delay line with internal trigger pick-off .....**+$3,000**

**Opt. 9E –** (SCD5000 ONLY) 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 Options 01 and 2E) .....**+$1,000**

**INTERNATIONAL POWER PLUG OPTIONS**

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

**Opt. A2 –** United Kingdom 240 V, 50 Hz.....**NC**

**Opt. A3 –** Australian 240 V, 50 Hz.....**NC**

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

**Opt. A5 –** Switzerland 220 V, 50 Hz .....**NC**

**RECOMMENDED ACCESSORIES**

See page 424 for complete selection information.

**PROBES**

**Active –** 4 GHz, 0.4 pF/100 kΩ, 1 m. (Requires Opt. 1E or 1103 Power Supply). Order P6217.....**$3,495**

**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.....**$335**

**Spring Contact –** 9 GHz, 0.15 pF/500 Ω; SMA compatible. Order P6150 .....**$995**

**ADDITIONAL ACCESSORIES**

**Plotter –** Four color. Order HC100 with Opt. 01.....**$1,260**

**Video –** Order HC02A.....**$3,200**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

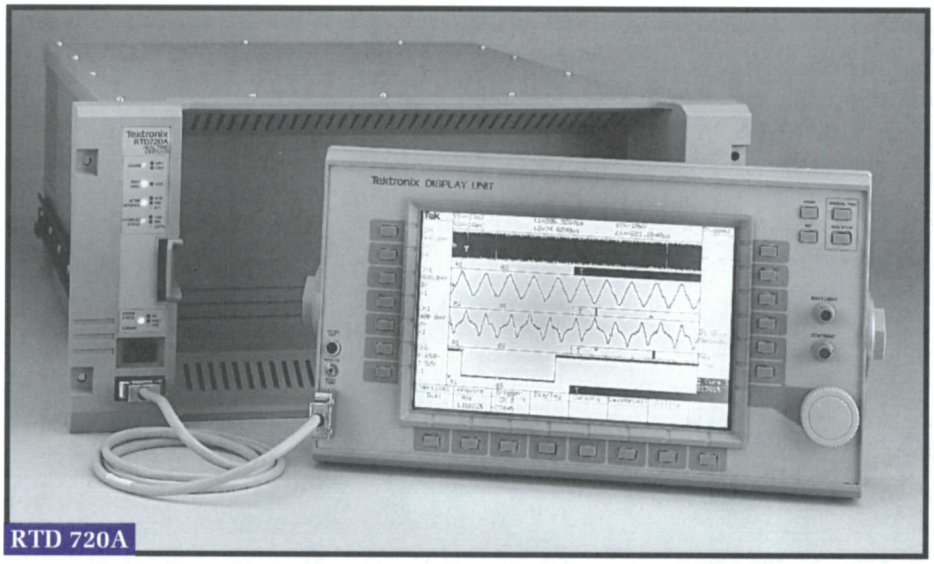
GPIB IEEE-488

The SCD5000/ SCD1000 Series of Digitizers complies with the IEEE Standard 488.1 and Tektronix Standard Codes and Formats.

# Transient Waveform Digitizer








RTD 720A

## 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 effecting 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 is 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 micro-seconds/point) for fine time resolution and accurate capture of the signals of interest. With up to four channels of acquisition (requires option 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 128K 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 512K of battery backed-up memory, 1 MB of 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 capture a sequence of up to 1024 events on each channel with only 5 µs re-arm time between events. 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 event 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.*

### RTD 720A 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 & Lidar
- High Frequency Ultrasonics

**Long Record Length Applications**

- Intelligence/ Electronic Warfare
- Spectroscopy (Time-of-Flight)
- Computer Mass Storage Device & Media Characterization

### FEATURES

- 2 GS/s Single Channel Mode
- 1 GS/s Dual Channel Mode
- 500 MS/s Four Channel Mode
- Long Waveform Memory-128K Standard
  - 512K Battery Backed-up Memory Opt.
  - 1 MB Mem. Opt.
  - 4 MB Mem. Opt.
- Intelligent Memory Usage
  - User Selection of Memory Size
  - Extremely Fast Multiple Event Capture
- 500 MHz Analog Bandwidth
- 8-Bit Vertical Res.
- Opt. Removable Display w/ Remote Operation Capability

*High fidelity capture of transient events.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The RTD 720A complies with the IEEE Standard 488.1, and with Tektronix Standard Codes and Formats.

## RTD 720A

# Transient Waveform Digitizer

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

Complementing 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.

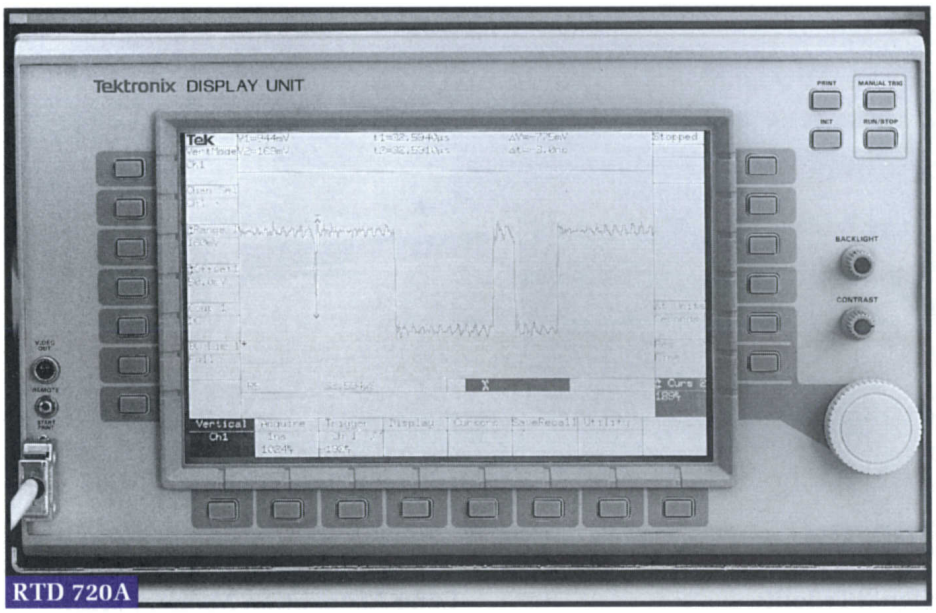
The digitizer's GPIB (IEEE-488) computer interface provides efficient instrument control and waveform data transfer. In burst mode (such as when transferring waveform data) the maximum transfer rate is ≥500 KB per second (dependent on the transfer speed capability of the computer). For even faster transfer 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



RTD 720A

- 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 the maintaining of the 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 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) requires Opt. 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).

**Maximum Input Voltage & Input Protection –** DC coupled 5 VRMS (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 VDC + peak AC.

# Transient Waveform Digitizer





**Fiducial Input –** BNC signal input in parallel with CH 1 for providing a time marker to 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 picoseconds/point) to 5 MS/s (200 microseconds/point).

**ACQUISITION MEMORY**

Standard instrument 128K waveform data points.
Option 10: 512K waveform data point with battery backed-up.
Option 11: 1 MB waveform data points.
Option 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 ≤5 μsec plus pre-trigger fill time.

**TRIGGERING**

**Sources –** Internal from any channel (active or inactive) or External.

**Trigger Coupling & 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) – Channel 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 & 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.) 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 VRMS or 180 to 250 VRMS.

**Power Consumption –** ≤500 Watts fully optioned (typical ≤350 Watts).

**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

**RTD 720A**
Transient Event Digitizer ..... **$23,200**
**Includes:** two input channels and 128K acquisition memory; power cord; fuses; User's Manual (070-8516-00); Programmer's Manual (070-8518-00); Quick Reference Guide (070-8517-00); and rack mount kit.

**Opt. 06 –** Four (4) acquisition channels (adds two additional full function channels) ..... **+$2,500**
**Opt. 10 –** 512K battery backed-up acquisition memory ..... **+$5,500**
**Opt. 11 –** 1 MB acquisition memory ..... **+$5,000**
**Opt. 15 –** 4 MB acquisition memory ..... **+$12,500**
**Opt. 19 –** Optional remote mountable display for waveform viewing and instrument control. ..... **+$2,900**

**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1 –** Universal Euro 220 V, 50 Hz ..... **NC**
**Opt. A2 –** United Kingdom 240 V, 50 Hz ..... **NC**
**Opt. A3 –** Australian 240 V, 50 Hz ..... **NC**
**Opt. A4 –** North American 240 V, 60 Hz ..... **NC**
**Opt. A5 –** Switzerland 220 V, 50 Hz ..... **NC**
See General Customer Information Section for additional description.

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

**PROBES**
**Active –** 1 GHz, 1.9 pF/10 MΩ, 1.5 m. Order P6204 ..... **$1,550**
750 MHz, 2 pF/1 MΩ, 1.5 m. Order P6205 ..... **$495**
4 GHz, 0.4 pF/100 kΩ. Order P6217 ..... **$3,495**
**Differential –** 100 MHz, active differential. Order P6046 ..... **$2,295**
**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 ..... **$335**
**Current –** DC – 50 MHz System. Includes AM503A, A6302, TM502A. Order AM503S ..... **$2,745**

**ADDITIONAL ACCESSORIES**
**Plotter –** Order HC100 with Opt. 01 ..... **$1,260**
**Video –** HC02A ..... **$3,200**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The RTD 720A of Digitizers complies with the IEEE Standard 488.1 and Tektronix Standard Codes and Formats.

# RTD 710A
# TD 1301

# Transient Digitizer Digitizer System

*High resolution, accuracy, and speed.*

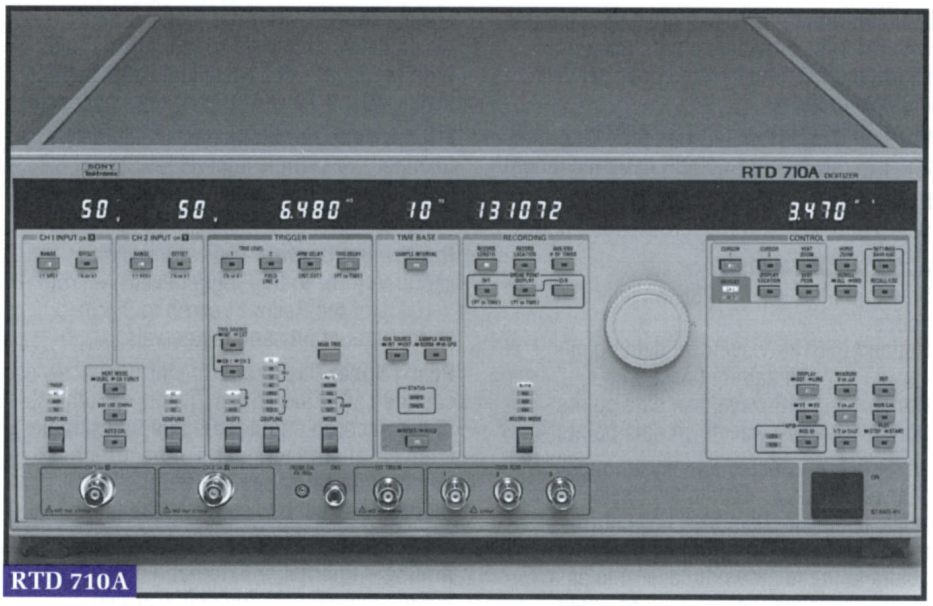
**RTD 710A**

**FEATURES**

- 10-Bit Vertical Resolution
- 200 MS/s Single Channel
- 100 MS/s Dual Channel
- 100 MHz Analog Bandwidth
- 256K Word Waveform Memory
- Hardware Signal Averaging
- Internal/External A/D Clocking
- Cursor Measurements of Time, Voltage and Frequency

**APPLICATIONS**

- Video and HDTV
- Ultrasonics, Radar, Lidar
- High Voltage Impulse Testing
- Power Supply & Power Conversion
- Communications and EW
- CCD Development
- Semiconductor & Hybrid Test
- ATE Systems




*Programmable Waveform Digitizer*

## RTD 710A Waveform Digitizer

- High Resolution and Accuracy
- Synchronized Clocking
- Long Record Length
- Expandable Waveform Memory

**HIGH RESOLUTION, ACCURACY AND SPEED**

The RTD 710A Waveform Digitizer provides 10-Bit vertical resolution at sample rates up to 200 Megasamples per second (MS/s). With four times the resolution of an 8-Bit digitizer and 60 dB of dynamic range, the RTD 710A provides excellent resolution of fine signal details.

The RTD 710A provides real time digitizing up to 200 MS/s in the single-channel mode and to 100 MS/s in dual-channel mode. The high performance amplifier and attenuator system, along with Autocal circuitry, provides excellent signal fidelity prior to conversion from analog to digital form. The input system also provides fine control of full scale input range and offset, maximizing use of the 1024 available digitizing levels.

Other key features of the input system are accurate step response and rapid overdrive recovery. Clean step response is important for accurate capture of transient events. The fast overdrive recovery allows accurate recording of small events occurring near large impulses, such as in pulse-echo applications and decaying exponential signals.

**LONG MEMORY AND FLEXIBLE RECORDING**

The RTD 710A contains 256K (262, 144) words of high-speed memory for storing waveform data. Memory can be allocated entirely to one channel or split between channels for simultaneous dual-channel digitizing.

Record length can be selected from 1024 points to the full 262, 144, in powers of two. When using shorter lengths, a correspondingly larger number of records are available. With a record length of 1024 points, up to 128 records per channel are available in the dual-channel mode, or up to 256 records if single channel is used.

**DIRECT OUTPUT OF A/D DATA**

For applications where the large internal memory of the RTD 710A is not enough, an external output port is provided. The output of both A/D converters is available up to the full 200 MS/s rate. External memory caches, such as the Tektronix 9503/9504 FDC may be added for capture of extremely long time windows with high resolution. Contact your Tektronix Sales Engineer for further information on memory cache products.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

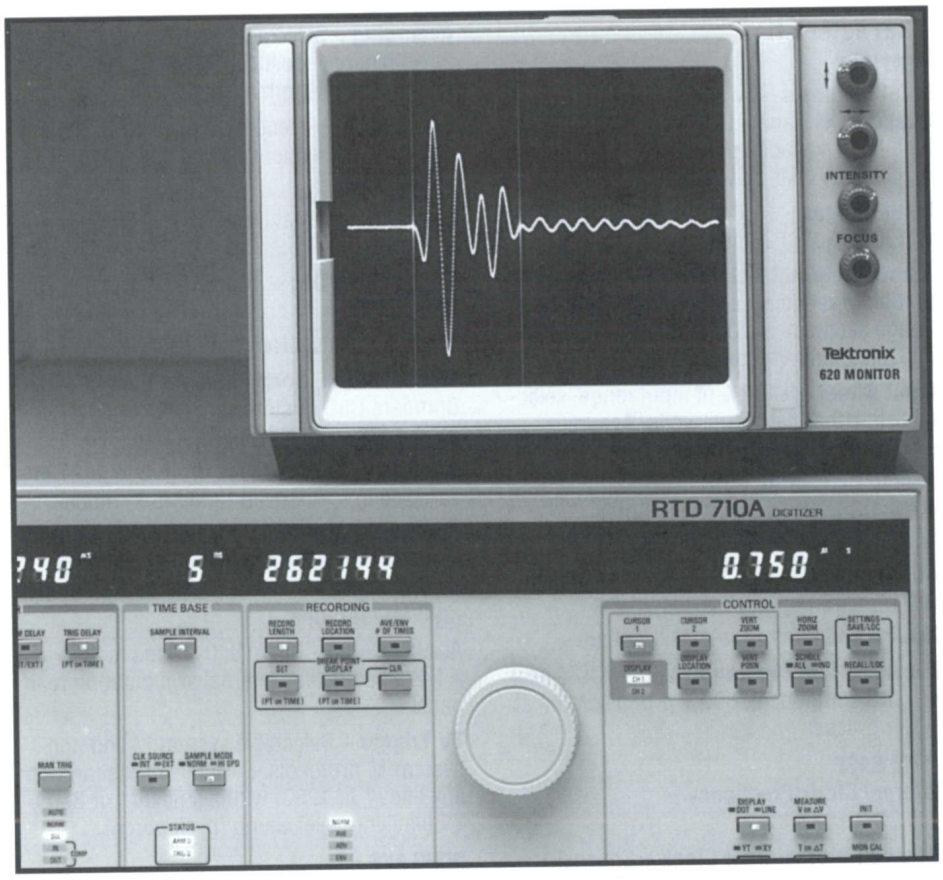
GPIB IEEE-488

The RTD 710A complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Transient Digitizer Digitizer System








### OTHER RECORDING MODES

The Auto-Advance recording mode takes advantage of multiple records by capturing new waveform data on successive trigger events. In this manner a series of transient events can be captured in rapid succession and held for later analysis. Auto-Advance recording is very powerful for capturing a series of lightning strikes, monitoring the time-varying output of a laser system, or recording other sequential transient phenomena.

In addition to the transient recording modes, the RTD 710A has built-in hardware signal averaging capability. This provides selectable powers-of-two averaging up to 16K times to reduce random signal noise.

Envelope capture mode records minimum and maximum values for each data point over successive acquisitions. This offers a powerful technique for capturing spurious events and for monitoring signal drift.

### INTERNAL AND EXTERNAL SAMPLE CONTROL

In addition to 66 internal time base settings, external strobing of the A/D converter system is supported. This provides the ability to synchronize sampling with external phenomena. The RTD 710A can be strobed from DC to 200 MHz. One typical application is CCD development where sampling can be synchronized with the CCD shift clock. Other applications are storage media testing and multiplexed data systems.

Sample rate switching is a unique feature provided to optimize usage of waveform memory. With sample rate switching it is possible to perform fast sampling during periods of interest and switch to a slower rate during quiescent periods. Up to five breakpoints (sample rate changes) are available within a record. One application is ultrasonics, where dead time between impulse and echo events can be sampled at a low rate while maintaining fast sampling over the events of interest. This can significantly reduce the amount of data transferred for processing in a computer.

### VERSATILE TRIGGERING MODES

The RTD 710A offers many trigger modes to simplify the capture of complex signals. Standard oscilloscope-like triggering is provided along with enhancements such as LF or HF Reject, Bislope triggering and a Hysteresis trigger mode. Hysteresis mode allows the user to set an analog qualifying level as well as a trigger level, providing noise immunity and additional trigger selectivity.

A Video Trigger Option is available to allow the user to trigger on horizontal or vertical video sync pulses. This option makes it possible to trigger on a specific line number within a video field. Back porch clamp is provided.

In Comparison triggering mode, the RTD 710A continuously acquires events and compares them to reference-waveform values. If an event deviates from the range of values (Compare Out mode) or lies entirely within them (Compare In mode), the waveform is held for further analysis.

### WAVEFORM ZOOM AND CURSOR MEASUREMENTS

When used in conjunction with an optional X-Y-Z monitor, captured waveforms can be viewed and measured in several ways. Cursors offer the capability to measure time, voltage and frequency. The RTD 710A offers horizontal and vertical display zoom, vertical positioning, and horizontal scrolling for easy viewing of the entire waveform or expansion of smaller portions. Both YT and XY types of displays are available.

*Continued on next page.*

## • ACCESSORY •

### Current Measurement Power

**AM503S**

- Simultaneous AC/DC broadband current measurement system.
- DC to 50 MHz (20A continuous/100A peak) with A6302 probe.
- DC to 515 MHz (100A continuous/500A peak) with A6303 probe.
- Clips onto conductor without having to break current.

*For complete selection information on all Accessory products, see page 424.*

# RTD 710A
# TD 1301

# Transient Digitizer Digitizer System

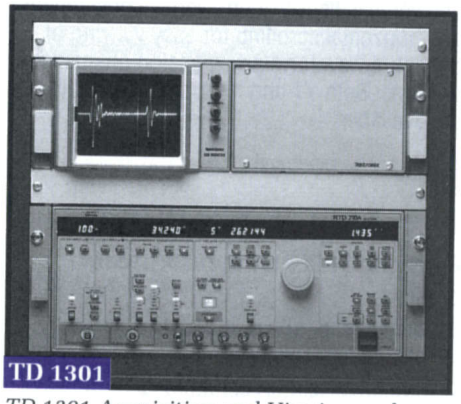
**STANDALONE OR SYSTEM DIGITIZER**

The RTD 710A is fully programmable via the GPIB IEEE-488 and conforms to Tektronix Standard Codes and Formats. It also contains several useful waveform analysis commands, such as Min, Max, and Cross to increase throughput in test systems.

Hardcopies of the display can be made with the HC100 Color Plotter via the GPIB. Option 19 provides a blank instrument front panel. This eliminates the RTD 710A front-panel controls, reducing power consumption, instrument cost and susceptibility to undesired operator adjustment. This is particularly important in test-system environments.

Quicker system set-up time and the convenience of choosing from several previous instrument states is standard on the RTD 710A via non-volatile settings storage. Up to 20 different instrument states can be stored and recalled by either a front-panel push button or under computer control.

Measurement accuracy and proper functioning of the RTD 710A are confirmed by auto-calibration and self-test procedures. Self-test is automatically performed at power-on, and can be user-activated during operation.




*TD 1301 Acquisition and Viewing package includes RTD 710A, 620 monitor, cabinet and mounting hardware.*

## TD1301 System

- RTD 710A, Option 1R Digitizer
- 620 Monitor
- Standard 19-inch Components
- Cables and Rack Slides
- Cabinet

## Characteristics

**VERTICAL**

**Input Channels –** Two, single-ended. Supports X10 and X100 encoded probes for high input-voltage applications. Simultaneous digitizing in dual-channel mode.

**Input Ranges –** ±100 mV to ±50 V (200 mV to 100 V p-p) in 28 steps.

**Autocal Internal Reference –** Provides calibration of range accuracy and zero-offset. Range accuracy is ±0.4% at 1 kHz and 97% full-scale, zero volt offset is ±0.2%.

**Input Offset –** ±199% of input range, selectable in either percent or volts. Accuracy ±1.5% at ±100% DC offset.

**Analog Bandwidth –** DC to 100 MHz, 0°C to 40°C; DC to 90 MHz, 40°C to 50°C. Selectable bandwidth limiting at 20 MHz.

**AC-Coupled Lower** – 3 dB Point – 10 Hz or less.

**Input R and C –** 1 MΩ ±2%, ≈ 24 pF.

**Maximum Input Voltage –** 250 V (DC + peak AC); AC component, 500 V p-p maximum at 1 KHz or less.

**TIME BASE**

**Internal Clock Frequency –** 200 MHz ±0.001%.

**Sample Rate: Internal Clock –** Channel 1 Only Mode: 200 MS/s to 5 S/s, 66 sampling steps. Dual-Channel Mode: 100 MS/s to 5 S/s, 65 sampling steps.

**External Clock –** Channel 1 Only Mode: DC to 200 MHz, Dual-Channel Mode: DC to 100 MHz. ECL levels, periodic or non-periodic clock rate.

**Sample Rate Switching –** Up to five breakpoints within a record.

**DIGITIZING**

**Vertical Resolution –** 10 bits provide 1024 discrete levels (60 dB dynamic range).

**Maximum Sample Rate –**
Single-Channel Mode: 200 MS/s.
Dual-Channel Mode: 100 MS/s.

**Record Length per Channel –**

| CH 1 Only Mode | | Dual-CH Mode | |
|---|---|---|---|
| Records | Length | Records/CH | Length/CH |
| 1 | 262144 | 1 | 131072 |
| 2 | 131072 | 2 | 65536 |
| 4 | 65536 | 4 | 32768 |
| 8 | 32768 | 8 | 16384 |
| 16 | 16384 | 16 | 8192 |
| 32 | 8192 | 32 | 4096 |
| 64 | 4096 | 64 | 2048 |
| 128 | 2048 | 128 | 1024 |
| 256 | 1024 | — | — |

**Averaging –** Selectable from 2 to 16384 in a 2-4-8 binary sequence, 8K per channel maximum record length averaged.

**Enveloping –** Selectable from 1 to 16384 in a 2-4-8 binary sequence or infinite.

**TRIGGERING**

**Sources –** Internal from CH 1 or CH 2, or External.

**Trigger Coupling –** AC, AC LF Reject, DC HF Reject, DC.

**Slope –** Positive, Negative, Bislope.

**Modes –** Auto, Normal, Single, Compare In, Compare Out, Hysteresis.

**Post-Trigger Delay –** From 0 to 262136 samples in Normal Mode, from 0 to 262128 samples in high-speed (200 MS/s) mode.

**Pre-Trigger Capture –** To full record length less 8 samples for normal mode and full record length less 16 samples for high-speed (200 MS/s) mode.

**Arming Delay –** Internal: 0, 10 ms to 10 s in a 1-2-5 sequence; External arm input on rear panel.

**TV Trigger –** Selectable system-M and non-system-M protocols. Selectable triggering on any line (1 to 1280) within a field (1 or 2). TV blanking-level clamp (back porch).

**DISPLAYS**

**Cursor Readout –** 7-digit LED display for time, voltage and frequency.

**Trigger Readout –** 6-digit LED display for trigger level.

**Record Length Readout –** 6-digit LED display for record length and breakpoint location.

**Range/Offset Readout –** 4-digit LED display for range and offset settings; two displays, one for each channel.

# Transient Digitizer Digitizer System





**COMPUTER INTERFACE**

**GPIB –** IEEE-488.1 interface is standard for instrument control and waveform data transfer. Maximum transfer rate ≥250 KB/s. All instrument functions, settings, and operating modes are programmable, with the exception of the power switch.

**Plotter Interface –** HPGL Protocol, IEEE-488 interface.

**Waveform Analysis Commands –** Window, Minimum, Maximum, Base, Top, Positive Cross, Negative Cross, Mid, Mean, Peak to Peak.

**EXTERNAL SIGNALS**

**CRT Display –** X,Y,Z: ±1 and ±5 V p-p, internally selectable (set to ±1 V at factory).

**Trigger Output –** Positive True, TTL.

**External Arm Input –** TTL Compatible.

**External Clock Input –** ECL Signal Level, 50 Ω. DC to 200 MHz.

**Clock Output –** ECL signal level (open emitter out into 50 Ω).

**Probe Calibration Output –** 0 to + 4 V ±1% square wave at 1 kHz ±0.005% into 1 MΩ.

**Feed-Through Connectors –** Three 50 Ω coaxial cables for front-to-rear signal connections.

**Direct A/D Output –** 50-Pin AMPMODU MT connector. CH 1 and CH 2 digitized signals available. ECL-compatible signal levels. Maximum data rate is 100 megawords/s (20-Bit word). Contact Tek Sales Engineer for information on memory cache products and interfacing information.

**ENVIRONMENTAL**

**Temperature Range –** Operating: 0° to 50°C; Nonoperating: –30° to +70°C.

**Humidity –** 0 to 95% relative humidity (noncondensing).

**Altitude –** Operating: 4,570 m (15,000 ft.) max. Nonoperating: 15,240 m (50,000 ft.) max.

**POWER**

**Line Frequency –** 48 Hz to 440 Hz.

**Power Consumption –** 350 W fully optioned.

**Line Voltage Range –** 90 VAC to 132 VAC (115 V); 180 VAC to 250 VAC (230 V).

**PHYSICAL CHARACTERISTICS**

| Dimensions | mm | in. |
|---|---|---|
| Width | 429 | 16.9 |
| Height | 177 | 7.0 |
| Depth | 643 | 25.3 |
| **Weight ≈** | **kg** | **lb.** |
| Net | 23.5 | 51.8 |

## ORDERING INFORMATION

**RTD 710A**
Waveform Digitizer ..... **$22,995**
**Includes:** (161-0123-00); Fuses (8A & 4A); Instruction Manual (070-7204-00); RTD 710A Instrument Interfacing Guide (070-7207-00).
**Opt. 05 –** Video Trigger ..... **+$1,495**
**Opt. 09 –** Adds 9503 Fast Data Cache for 4 megawords total memory ..... **+$24,000**
**Opt. 11 –** Adds 9504 Fast Data Cache for 8 megawords total memory ..... **+$38,000**
**Opt. 19 –** Blank Front Panel (Includes Rack Mount Assembly) ..... **–$200**
**Opt. 1R –** Rack Mount Package ..... **+$395**

**TD 1301**
Acquisition and Viewing Package ..... **$28,000**
**Includes:** RTD710A Opt. 1R; 620 monitor; cables; rack slides; cabinet.
**Opt. 05 –** Video Trigger ..... **+$1,495**
**Opt. 1D –** Delete Cabinet ..... **–$750**
**Opt. 2D –** RTD710A Blank Panel ..... **–$200**
**Opt. 1H –** Add HC100 Plotter (120 V) ..... **+$1,180**
**Opt. 2H –** Add HC100 Plotter (240 V) ..... **+$1,180**
**A/D Out Cable –** RTD 710A to 9503/9504 2 m. Order 012-1117-01 ..... **$205**
**GPIB Cable –** 2 m. Order 012-0991-00 ..... **$170**
**Monitor –** Order 620 ..... **$1,910**

**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1 –** Universal Euro 220 V, 50 Hz ..... **NC**
**Opt. A2 –** United Kingdom 240 V, 50 Hz ..... **NC**
**Opt. A3 –** Australian 240 V, 50 Hz ..... **NC**
**Opt. A4 –** North American 240 V, 60 Hz ..... **NC**
**Opt. A5 –** Switzerland 220 V, 50 Hz ..... **NC**
See General Customer Information Section for additional description.

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M9 –** Repair Protection ..... **+$800**

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

**PROBES**
**Differential –** 100 MHz, active differential, 6 ft. Order P6046 ..... **$2,295**
**Passive –** 100 MHz, 13 pF/10 MΩ, 10X. Order P6109B ..... **$80**
100 MHz, 18 pF/10 MΩ, 1X/10X. Order P6129B ..... **$100**
**High Voltage –**
120 MHz, 1500 V, 2.5 pF/10 MΩ, 9 ft. Order P6009 ..... **$270**
75 MHz, 20 kV, 3.0 pF/100 MΩ, 10 ft. Order P6015A (Opt. 1R) ..... **$1,005**
**Current –** 120 Hz – 60 MHz, 7.5 A peak. Order P6021 ..... **$550**
935 Hz – 120 MHz, 3 A peak. Order P6022 ..... **$595**
DC – 50 MHz System. Includes AM503A, A6302. Order AM503S ..... **$2,745**

**ADDITIONAL ACCESSORIES**
**RTD 710A Service Manuals –**
Vol. 1 Procedures. Order 070-7205-00 ..... **$70**
Vol. 2 Schematics. Order 070-7206-01 ..... **$60**
Rackmount Kit – Order 016-0886-02 ..... **$435**
**Plotter –** Four color. Order HC100 with Opt. 01 ..... **$1,260**
**Cart –** Order K475 ..... **$895**
**Power Strip –** Four Outlet, 6 ft., Noise/Surge Suppression. Order 131-5342-01 ..... **$45**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The RTD 710A Digitizer complies with the IEEE Standard 488.1 and Tektronix Standard Codes and Formats.

# Fast Data Cache



*Extremely high speed digital data storage.*

**9503/9504**

## FEATURES

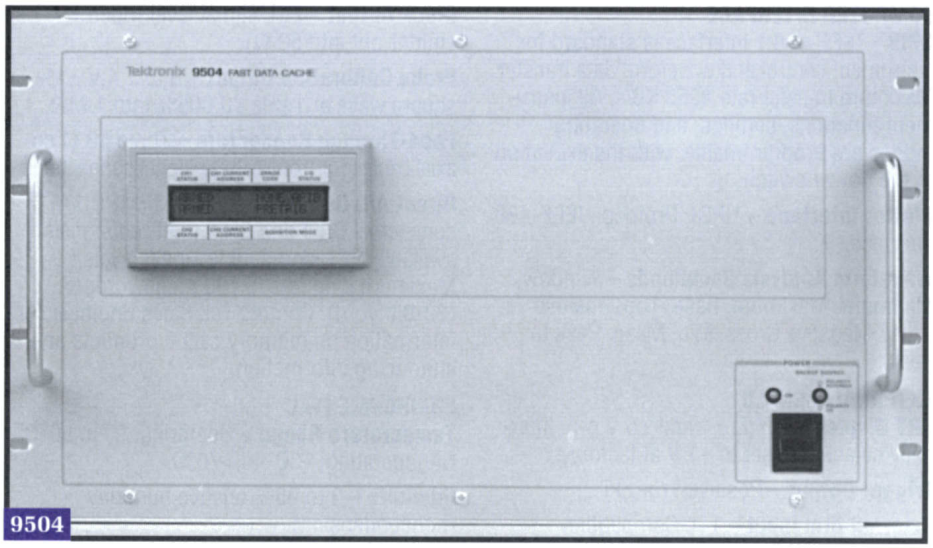
- Long Record Length
  - 4 Mwords Total in 9503
  - Up to 32 Mwords in 9504
- Data Rates to 100 Mwords/s, Dual Channel or Inter-leaved for 200 Mwords/s, Single Channel
- 16-Bit or 8-Bit Word Width Selectable
- GPIB Controlled
- ECL or TTL Data Inputs (25 Mwords/sTTL)

## APPLICATIONS

- Acquisition Memory Extension for the RTD 710A
- High Resolution Video and CCD Test Systems
- "Deep Record" Ultrasonic, Radar, and Lidar Signal Acquisitions
- EW and EMC Signal Capture
- Storage Media Test Systems
- Tempest Applications
- Fast Data Logging of Complex Waveforms

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The 9500 Series of Fast Data Caches complies with the IEEE Standard 488.2 and Tektronix Standard Codes and Formats.




## 9503/9504 Fast Data Cache

- Extremely Long Record Length
- Data rates to 100 megaword/s
- Partitionable Memory
- Very Fast Data Logging

The 9503/9504 Fast Data Cache buffer memories provide significant record length augmentation for high-speed, real time digitizers. The 9503 is a memory buffer configured for two megawords per channel or four megawords single channel. The 9504 is an expandable memory buffer that starts with four megawords total memory and can be increased to a total of 32 megawords.

### LONG RECORD CAPTURE

They provide the economical solution to your digitized data storage needs for the logging of high speed, real time data records. The 9503 and 9504, in conjunction with the RTD 710/A waveform digitizer, provide the fastest real time data logging capability for multiple, complex waveforms in their class. The 9503 and 9504 support the high-speed single channel mode of the RTD 710A to capture data up to 200 megawords/s.

The 9503 or 9504 provides storage of long data records obtained from high speed analog-to-digital converter. Each product accepts up to 16-Bit-wide words plus clock, at up to 100 megawords (samples) per second. Record lengths may be from 256 words to 16 megawords per channel. In either product, the two channels may be concatenated into one long memory.

### FULL DIGITIZER COMPATIBILITY

Full dual-channel operation makes the 9503 and 9504 fully compatible with the A/D outputs of the RTD 710 and RTD 710A waveform digitizers. They also accept data from the RTD 710/A operating in the high-speed mode to provide data storage at an effective sampling rate of 200 megawords/s. The standard configuration for either product provides two megawords of memory per channel. The 9503 memory length is fixed at two megawords per channel.

The 9504 can be configured with additional two megaword memory cards, to provide a maximum of 16 megawords of memory per channel.

### ECL DIFFERENTIAL OR TTL LEVEL INPUTS

The 16-Bit inputs are selectable in groups of four, and can be programmed for either ECL or TTL. Rear-panel BNC connectors allow control of start and trigger of data collection. The trigger input can also be connected to use the highest of the 16-Bits as an information flag.

### MULTIPLE RECORDS CAPABILITY

Memory can be divided into a user-specified number of records with record length specified in segments of 256 words. Each record may be any number of 256-word segments up to the maximum size of the memory in that channel. Up to 64K separate records (256 words each) may be stored per channel in the 9504. Multiple records capability is supported in all operation modes except pretrigger.

### OPERATIONAL MODES

The 9503 and 9504 Fast Data Cache units allow the storage of very long data streams which have been acquired and digitized by high-speed, real time waveform digitizers, such as the RTD 710A. These system units are GPIB-controlled, and stored data is output via GPIB or over the high-speed parallel port.

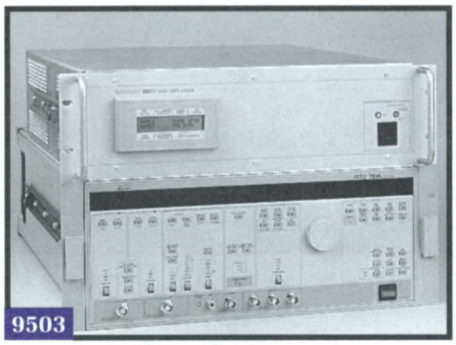
**Normal (Independent) Mode –** Both channels accept independent data streams and triggers.

# Fast Data Cache





**Interleave Mode –** Allows storage of data from Channel 1 memory to be interleaved with data from Channel 2 memory. Supports the RTD 710A high speed mode at 200 megawords/s single channel. Assumes RTD 710A Channel 1 data point zero to be first in combined record.




*RTD 710A with 9503 Fast Data Cache*

**Sequential Mode –** Data is stored in Channel 1 memory until it is full; data storage then continues in the Channel 2 memory. This mode provides for all available memory to be continuous without any break in timing. The data inputs to Channels 1 and 2 must be identical.

**Pretrigger Mode –** This mode connects the available channel memory into a circular buffer. The number of data words to be stored after the "trigger" is user selectable in 256 word increments.

**FAST THROUGHPUT CAPABILITY**

The 9503 and 9504, when used in conjunction with the RTD 710/A or other digitizers having continuous digitized signal output capability, allow the capture and storage of large quantities of signal waveforms at very rapid rates. The chart below shows typical waveform capture rates (data logging throughput) for representative record sizes and sampling rates. A TTL level trigger signal is required for each record.

**TYPICAL WAVEFORM ACQUISITION RATES/SEC**

| Record Size | Max*1 No. of Records Stored (9504) | Input Sample Rate 100 MHz (10 ns) | 50 MHz (20 ns) | 10 MHz (100 ns) |
|---|---|---|---|---|
| 256 | 65,536 | >380K | >190K | >38K |
| 512 | 32,768 | >190K | >95K | >19K |
| 1,024 | 16,384 | >95K | >48K | >9.5K |
| 2,048 | 8,192 | >48K | >24K | >4.5K |
| 8,192 | 2,048 | >12K | >6K | >1.2K |
| 16,384 | 1,024 | >6K | >3K | >0.6K |

**1 Each channel (2X for single channel mode).*

## Characteristics

**DIGITAL INPUT/OUTPUT SIGNALS**

**Number of Channels –** Two independent channels.

**Data Inputs –** 16-Bits, clock, ground; Selectable between ECL and TTL, in groups of 4-Bits.

**Data Input Rates –** Up to 100 MHz: ECL. Up to 25 MHz: TTL.

**Start Input –** Starts data capture in Pretrigger Mode; TTL signal into BNC.

**Trigger Input –** Starts data capture in all modes except Pretrigger and marks trigger location on data. TTL signal into BNC.

**Arm Out –** TTL signal from BNC. TTL low while filling data record. Inhibits RTD 710/A rearm while 9503/9504 record is filling.

**MEMORY SIZE**

9503: 2 megawords/CH: or 4 megawords total.
9504: 2 megawords/CH; Expandable to 16 megawords/CH or 32 megawords total.

**COMPUTER INTERFACES**

**GPIB –** IEEE-488.2 and Tektronix Standard Codes and Formats.

**Parallel Port –** A waveform data (output only) 16-Bit parallel port is provided capable of 5 MB (2.5 megawords/s). This provides TTL level outputs and has operating modes to allow use with a wide range of computers.

**ENVIRONMENTAL**

**Temperature Range –** Operating: 0°C to 50°C. Nonoperating: –20°C to +60°C.

**Relative Humidity –** 0 to 95%; noncondensing.

**Altitude –** Operating: 4,750 m (15,000 ft.) max. Nonoperating: 15,240 m (50,000 ft.) max.

**POWER**

**Line Frequency –** 48 to 63 Hz.

**Maximum Power Consumption –** 9503: max 360 W (285 W typical). 9504: max 735 W (580 W typical) for maximum memory.

**Battery Backup –** Connector for battery on rear of instrument. 9503: 4.75 to 15 VDC, 100 mA maximum (fused). 9504: 4.75 to 15 VDC, 450 mA maximum (fused).

**PHYSICAL CHARACTERISTICS**

| Dimensions | 9503 mm | 9503 in. | 9504 mm | 9504 in. |
|---|---|---|---|---|
| Height | 133 | 5.25 | 267 | 10.5 |
| Rack Depth | 574 | 22.6 | 574 | 22.6 |
| Overall Depth | 622 | 24.5 | 622 | 24.5 |
| Width | 483 | 19.0 | 483 | 19.0 |
| **Weight ≈** | **lb.** | **kg** | **lb.** | **kg** |
| Net | 12.3 | 27 | 17.3 | 38 |

## 9504F01 Fast Data Cache Memory Module

Two megawords (4 MB). Adds two megawords of additional storage to one channel of the 9504 Fast Data Cache unit. Order in pairs to extend both channels by the same amount.

## ORDERING INFORMATION

**9503**
Fast Data Cache Unit ..... **$25,000**

**9504**
Fast Data Cache Unit ..... **$25,000**

**9504F01**
Fast Data Cache. two-megaword memory Module ..... **$8,000**

**INSTRUMENT OPTIONS (9504 only)**

**Opt. 11 –** (8 MW total) Adds 2 ea. 9504F01 ..... **+$14,000**
**Opt. 12 –** (12 MW total) Adds 4 ea. 9504F01 ..... **+$28,000**
**Opt. 13 –** (16 MW total) Adds 6 ea. 9504F01 ..... **+$42,000**
**Opt. 14 –** (20 MW total) Adds 8 ea. 9504F01 ..... **+$56,000**
**Opt. 15 –** (24 MW total) Adds 10 ea. 9504F01 ..... **+$70,000**
**Opt. 16 –** (28 MW total) Adds 12 ea. 9504F01 ..... **+$84,000**
**Opt. 17 –** (32 MW total) Adds 14 ea. 9504F01 ..... **+$98,000**

**INTERNATIONAL POWER PLUG OPTIONS**

**Opt. A1 –** Universal Euro 220 V, 50 Hz ..... **NC**
**Opt. A2 –** United Kingdom 240 V, 50 Hz ..... **NC**
**Opt. A3 –** Australian 240 V, 50 Hz ..... **NC**
**Opt. A4 –** North American 240 V, 60 Hz ..... **NC**
**Opt. A5 –** Switzerland 220 V, 50 Hz ..... **NC**

See General Customer Information Section for additional description.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488

The 9500 Series of Fast Data Caches complies with the IEEE Standard 488.2 and Tektronix Standard Codes and Formats.

# TLS 216 Logic Scope

*A new class of test instrumentation designed to simplify the task of debugging digital hardware.*

**TLS 216**

**FEATURES**

- 2.5 pF, 1MΩ Podlet Style FET Probes
- Display Modes: Analog, Timing Diagram and BusForm Display Types
- <+/– 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**

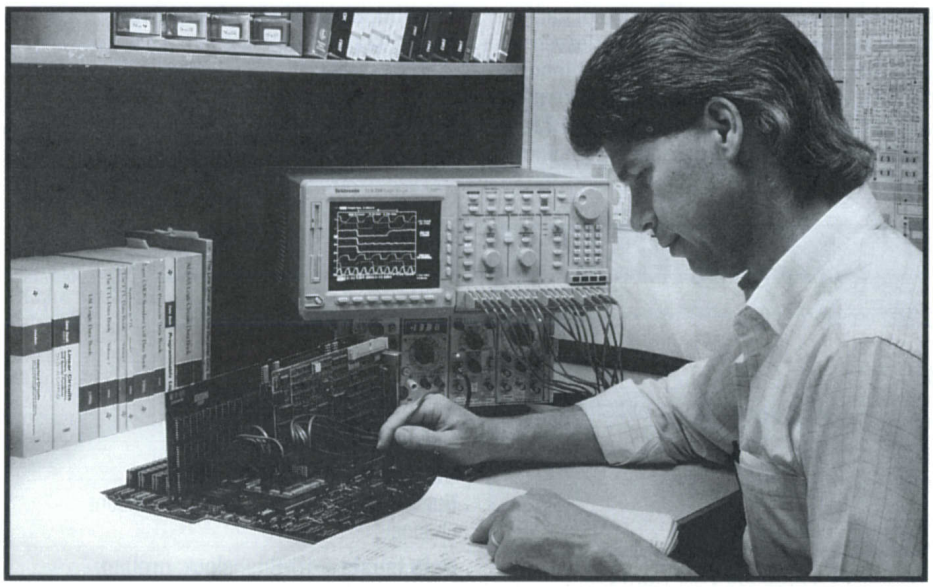
- Facilitates Hands-Free Connection to SMT Devices
- Low Capacitance, Probe For Non-intrusive Probing
- Powerful Triggering System Reduces Time to Identify Problems
- Flexible Display Modes Simplify Recognition of Timing Faults
- High Speed Acquisitions on All Channels Facilitates Analysis of Complex System Interactions
- Bolsters Documentation of Problem and Solutions With NuColor™ Monitor and Internal Floppy Drive

**APPLICATIONS**

- Debug Digital Hardware
- Multi-Channel Data Acquisition

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The TLS 216 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.



## 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 the analog acquisition system of a high speed digital storage oscilloscope (DSO) with the triggering and display systems of a logic analyzer in a single instrument. The 500MHz 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.

### 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 decrease 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.

### 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 which allow the instrument to directly trigger on common digital circuit behavior. The industries 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 hand-shake 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 external trigger-input can be used as a "Trigger Arm" which enhances cross-triggering between two instruments simplifying the task of using a logic scope with other test equipment.

### MULTIPLE DISPLAY FORMATS SIMPLIFIES PROBLEM IDENTIFICATION

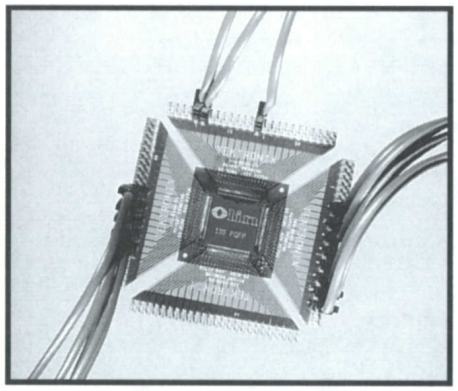
The Logic Scope integrates the analog acquisition system of a modern DSO with the display flexibility of a logic analyzer. The Logic Scope offers three display formats to simplify the process of identifying logic timing anomalies or violations. Acquired data can be displayed as either 8-Bit analog waveforms, like a traditional DSO, or as dual threshold timing diagrams or BusForms™, similar to a logic analyzer. The operator can easily change the display format without having to re-acquire data, a feature that is critical when debugging elusive, infrequent problems. Dual threshold timing diagrams and BusForms™ show the transition time of a signal which eases identification of such problems as ground bounce, signal contention or noise margin violations.

# Logic Scope

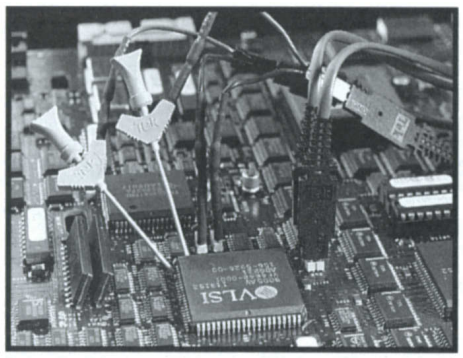


## Connect to the Design

- Low Mass Podlet Probes
- Low Capacitance, 2.5 pF
- 20 mil & 25 mil FlexLead™ Adapters
- Hand-Held Adapter and Probing Accessories
- 50 Ω Coax Adapter



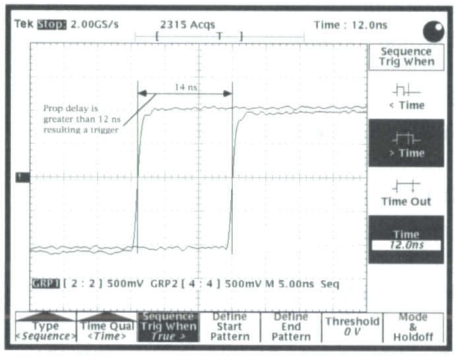
*FlexLead™ Adapter offers connection to SMT devices of 20 and 25 mil spacing.*



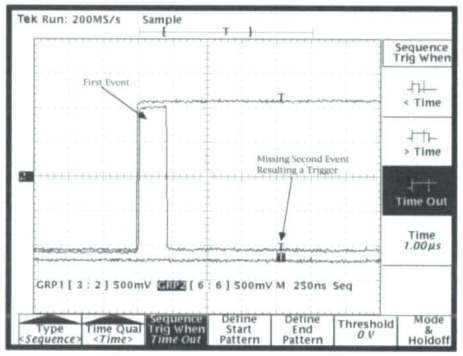
*The array of probing accessories provides flexible connections to DUT. The Podlet-Style low-mass probe head simplifies hands free probing.*

## Setup & Identify the Problem

- Powerful Triggering System: Edge, State, Pattern, Pulse, Sequence, Time-Out, and Time-Qualified
- NuColor™ Display
- Graphical User Interface



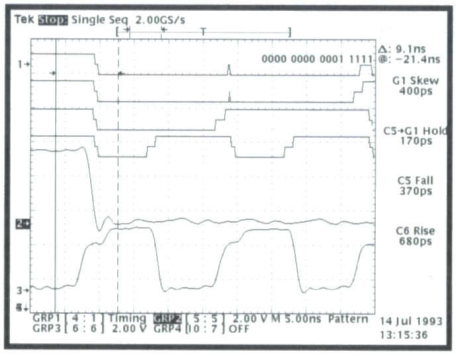

*The triggering system of Logic Scope can trigger on setup time, hold time, or propagation delay violations.*



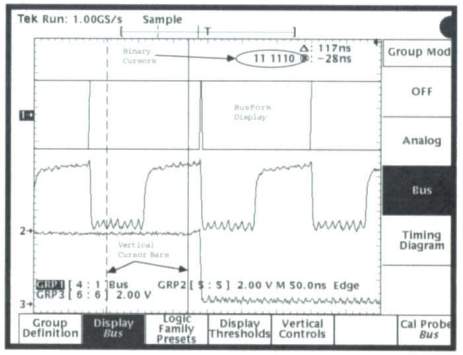

*The time-out trigger simplifies detection of incomplete or missing system events.*

## Capture & Visualize the Cause

- 2 GS/s Sample Rate on All Channels
- 500 MHz Bandwidth
- 8-Bit Vertical Resolution
- ±100 ps Timing Accuracy
- Multiple Display Formats: Analog, Timing, and BusForms
- Binary Cursor Readouts



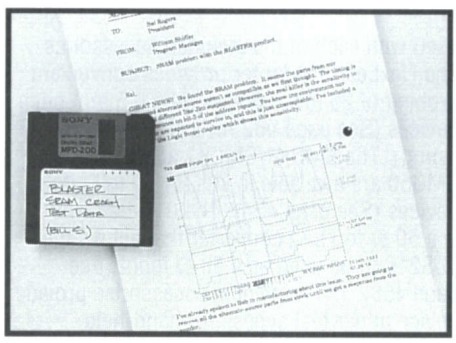

*The dual-threshold Timing Diagram provides visual information at each transition.*



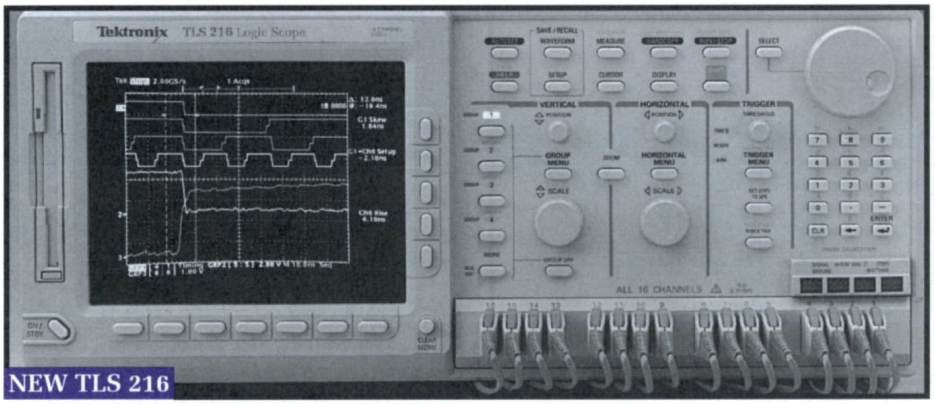

*Binary cursors show the logic values of each waveforms at the vertical cursor.*

## Analyze & Solve the Problem

- 28 Automatic Measurements including Setup Time, Hold Time, and Skew
- Desktop Documentation Formats: PC, BMP, TIFF, EPS, etc.



# TLS 216 Logic Scope




NEW TLS 216

## 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 Divisions |
| 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), 12-Bits with averaging.

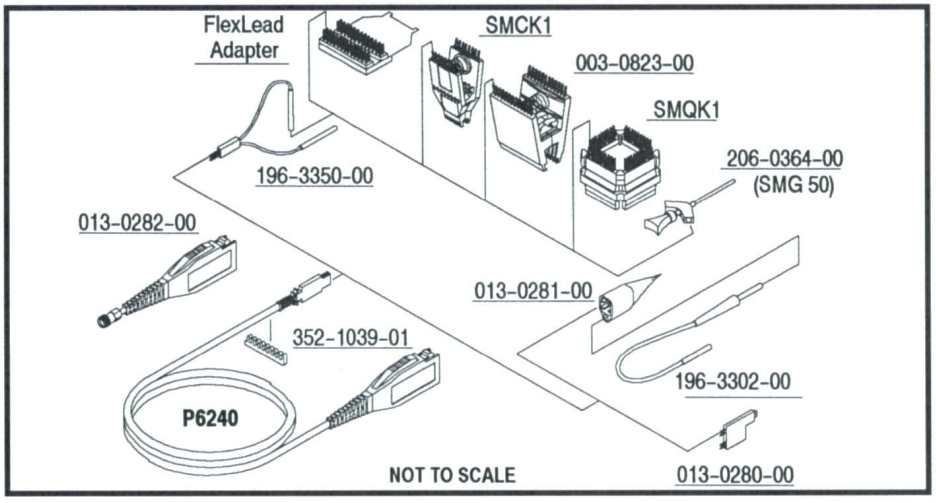
**Analog Bandwidth Selection –** 20 MHz, and full.

**Input Coupling –** DC.

**Input Impedance –** 50 Ω w/coax adapter, 1 MΩ w/probe.

**Maximum Input Voltage –** Max non-destructive input ±25 V (DC + Peak AC).

**Dynamic Range –** 15 V to –12 V with probe.




### P6240 SIGNAL ACQUISITION ATTACHMENTS STORY

The TLS216 is shipped with 16 P6240 FET Probes and associated accessories. The included Sampler Kit demonstrates how signal acquisition from a wide variety of devices is easily and efficiently achieved when using the P6240 FET probe. If your particular application is not covered by one of the included samples, please see pages 452 to 455 or 458 for additional attachment accessories. The figure above shows the P6240 and how it may be used with each of the included accessories. The FlexLead™ Adapter provides convenient probing of 25 mil, 0.65 mm and 0.5 mm pitch devices (See page 452 for a total package listing). The SMQK1/SMCK1 adapters and SMG50 are available in kits for 50 mil pitch devices (See page 454). The 013-0282-00 is a 50 Ω to 75 Ω converter that allows the TLS216 to be used as a 50 Ω input (See page 458). The remaining accessories provide device under test access for hand-held probing situations.

### 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 2000 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 BusForms display formats that simplifies recognition of digital timing faults and signal anomalies. BusForms display compresses many input signals into 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.

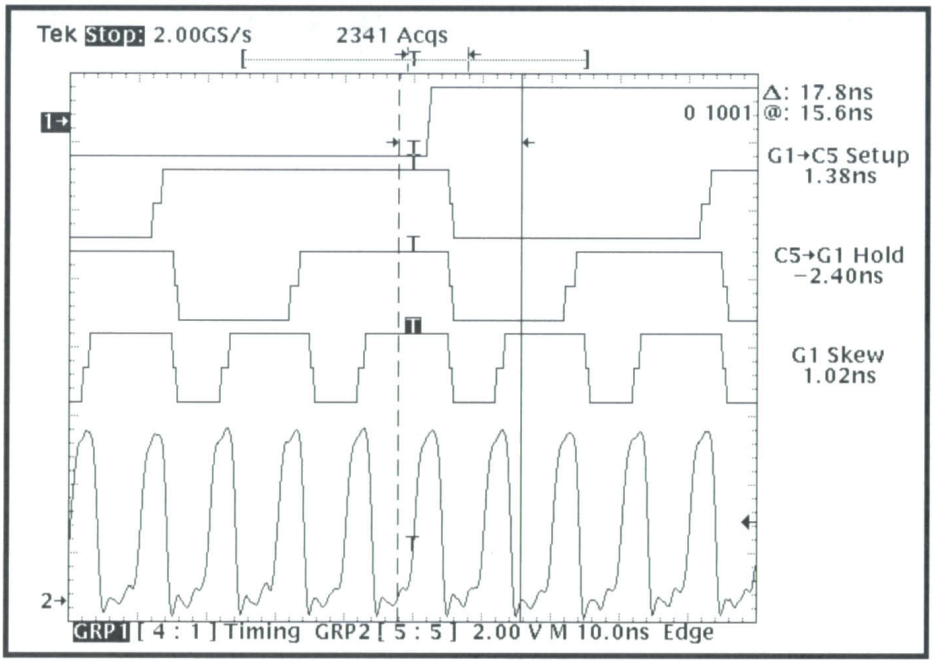
# Logic Scope





## 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 & lower limit 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 & lower limit 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 of a 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 & lower limit or outside the limits |
| Time-out | Trigger at the end of a user defined time period if the user defined end events do 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. |




*The Logic Scope features twenty-eight Automatic Measurements including Setup, Hold and Skew measurements.*

### 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 ≤10μs); 15.1 ns to 250 s (time/div ≤25μs).

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

**AUX Trigger Input –** TTL compatible; Max input voltage is +6 V: −1 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 | Set-up 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.

# Logic Scope



**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, RS232 (Talk only).

**Floppy Disk Drive –** 3.5 in. 1.44 MB DOS format.

**VGA Output –** 15-Pin analog output. (Color)

**STORAGE**
**Waveforms –** 16 full 2000 point 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.

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

**Line Frequency –** 47 to 63 Hz.

**Power Consumption –** 300 Watts max.

**ENVIRONMENTAL AND SAFETY**
**Temperature –** Operating: 4 to +50°C. Nonoperating: –40 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

**TLS 216 –** Logic Scope ..... *1
**Includes:** 16 each P6240 2.5 pF, FET Probes, 2 each Hand-held Adapters (013-0281-00), 2 each 7" Ground Leads (196-3302-00), 2 packages of 10 each Y-leadsets (020-2008-00), 3 packages of 12 each KlipChips (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. B1 –** Service Manual ..... *1
**Opt. 1B –** Package of 16 50 Ω Coax Adapters ..... *1
**Opt. 1K –** K420 Instrument Cart ..... +$695
**Opt. 1P –** HC100 4 Pen Color Plotter ..... +$1,260
**Opt. 2P –** Phaser 200e Color Printer and Cable ..... *1
**Opt. 4P –** Bubble Jet Monochrome Printer ..... +$349
**Opt. 1R –** Rack Mount Kit ..... *1
**Opt. 9C –** NIST & MIL-STD-45662A Calibration Certificates ..... *1
**Opt. 24 –** Four Additional P6240 Probes ..... *1
**Opt. M2 –** Standard 1-year product warranty plus four additional years of repair services for a total of five years coverage ..... *1
**Opt. M3 –** Standard 1-year product warranty plus four years of calibration service and four years of repair services four a total of five years coverage ..... *1
**Opt. M8 –** Calibration Service ..... *1

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

**PROBES**
**FET Probes only –** Order P6240 ..... $200
**SMD Adapters –** See pages 450 – 455.
**Plotter –** GPIB and Centronics Interfaces Standard. Order HC100 w/ Opt. 01 ..... $1,260
**Printer –** Cannon BJ10-Ex Bubble Jet. Order HC220 ..... $349
**Cart –** Order K420 ..... $695
**Camera –** Order C-9, Opt. 1P, 05 ..... $725
**Camera Hood Adapter –** Order 016-1145-00 ..... $70

**ADDITIONAL ACCESSORIES**
**Service Manual –** ..... *1
**Soft-sided Carrying Case –** ..... *1
**Hard Transit Case –** ..... *1
**Power Strip** – Four Outlet, 6 ft., Noise/Surge Suppression. Order 131-5342-01 ..... $45

**CABLES**
**GPIB –** 1 meter. ..... *1
**GPIB –** 2 meter. ..... *1

**INTERNATIONAL POWER CORDS**
**Opt. A1 –** Universal European 220V, 50 Hz ..... NC
**Opt. A2 –** UK 240V, 50 Hz ..... NC
**Opt. A3 –** Australian 240V, 50 Hz ..... NC
**Opt. A4 –** North American 240V, 60 Hz ..... NC
**Opt. A5 –** Switzerland 220V, 50 Hz ..... NC

**1 Contact your local Tektronix representative for price and ordering information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The TLS 216 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Logic Analyzers
## & Digital Analysis Systems

Tektronix offers products to support the system analysis of large complex systems (DAS®) and general purpose logic analysis of medium sized designs (3000 Series).

### The Enterprise Digital Analysis System

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 512K bits 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.

### 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 8 tools in one module, offers an outstanding value in a general purpose logic analyzer. In addition, the GPX supports today's leading microprocessors, including the Intel 66 MHz Pentium, and is available in three different mainframe configurations. Other modules add a digital oscilloscope, high speed timing analyzer, and low cost microprocessor support capabilities.

NEW this year is a deeper memory version of the GPX with four times larger acquisition memory. Also new this year is more configurability. GPX systems are now available from 20 channels to 360 channels in 20 channel increments. Buy what you need today and upgrade later by simply adding additional channels. Upgrades can be done easily without disassembling the unit.

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# Logic Analyzers
## & Digital Analysis Systems

*Performance Leader in Digital Analysis tools*

**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

**3000 SERIES LOGIC ANALYZERS**

- Best Value
- Comprehensive Microprocessor Support
- Portable and Benchtop Configurations

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 logic analyzers and digital analysis systems before deciding whether our products fit well into your evolving digital design needs. This section contains important introductory information about Tektronix logic analyzers and digital analysis systems.

### VLSI Integration for High Performance and Low Cost

We utilize VLSI in our products to increase reliability and performance. One fundamental question is whether to 'horizontally' integrate an 'LA on a chip'... that is several full channels of logic analysis onto a single ASIC, or to integrate 'vertically'... by putting one function for all channels, such as clocking or triggering, or memory, into an ASIC.

The former choice yields the lowest cost per channel, but limits performance and enhancability. The latter approach, if well implemented, offers unmatched performance but economies of scale are lower.

Our approach at Tektronix is to use each architecture where appropriate.

In our Digital System Analysis products we make no trade off which will compromise system capability. In our logic analyzer line we use LA-on-a-chip architectures which meet the cost per channel goals of mid-range users. In every case we keep acquisition memory off chip to allow memory depth scalability. Our VLSI integration is state of the art, allowing us to offer acquisitions systems that are affordable and fast enough to keep up with today's technology.

### Probing for Ease and Accuracy

Probes are the highest volume component in a logic analyzer, and if they are quality probes they represent a large fraction of the total cost. No component is more critical to long term end user satisfaction, since the probes are a major factor in both ease of use and high performance acquisition.

Probing quality varies greatly among analyzers on the market today. There is little in common between an inexpensive woven ribbon cable, and precision NiCR Coax with 7 component passive hybrids embedded in each podlet. The former may cost less, but may experience cross talk, provide inadequate grounding performance, or present a real EMI hazard.

Another fundamental capability is single probing for timing and state. Do not confuse claims of 'dual acquisition per point' with single probe state and timing simultaneous acquisition, even for high end products.

Tektronix' LASI-3 (logic analyzer standard interface) probing standards enforce strict mechanical and electrical performance standards. When we design probing for high performance microprocessor like the Intel 66 MHz Pentium, we design in the same high signal integrity features we use on our oscilloscope probes.

# Logic Analyzers
## & Digital Analysis Systems





*The Tektronix family of general-purpose logic analyzers: the portable 3001GPX; and the modular 3002 series that includes a desktop (3002C) and and portable (3002P) model. All offer a wide range of communications, hard disk storage, and expansion-slot options.*

### State-of-the-Art Microprocessors Require Powerful Clocking

A few short years ago acquiring data from a microprocessor was not much different than acquiring data from digital sources in general. With today's microprocessors employing complex bus & clocking schemes, other logic analyzer vendors put a variety of logic, including latches, on their microprocessor probes to sort out what to acquire and when. These are called 'preprocessors'.

We believe an inherently better approach to complex clocking needs is to find a way to keep as much logic off the probe as possible, thus allowing timing and state data to be acquired through a single probe. To do this we have implemented a series of hardware and software tools that allow the clocking behavior of any microprocessor to be modeled in a software controlled state machine built into each acquisition module. This proprietary clocking state machine is closely coupled to software tools that allow us to quickly build new clocking and disassembly support for today's most complex RISC and CISC microprocessors.

### 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 toolset. 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.

### Memory Depth... Link Between Symptom and Cause

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 are committed to scalable designs.

### Disassembly... Much More Than Inverse Assembly

In years past if one acquired state data off 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.

Tektronix offers 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.

# Logic Analyzers
## & Digital Analysis Systems



### Digital System Analysis

General purpose logic analysis is one activity, and detailed analysis of complex digital systems is another. In the latter, a richer suite of hardware and software tools are needed, including support for high level language debug tools, very deep acquisition memories, networking, hosting on workstations, routine data exchange with other design tools, multi-analyzer/multi-microprocessor support, integrated pattern generation & high speed timing analysis, tight correlation of data, and more. We believe customers with these needs should have access to:

1. Symbol support that displays high level symbols, such as subroutine name calls, in disassembly listings.
2. Abstraction modes of display that allow views of prototype activity including high speed timing analysis, state analysis, hardware bus disassembly, software disassembly, control flow trace, subroutine trace, and graph mode.
3. Performance analysis for software optimization.
4. LA Connect, which provides a linkage with popular high level language tools to give you a complete debug environment.
5. Workstation hosted user interfaces, LAN capability, hard disk and compatible floppy storage, and a high speed application bus for tight intermodule coupling.
6. Super deep acquisition memories with no trade offs between depth and other functions.

### Specifications

Unlike other test equipment, logic analyzer performance to specification may not be readily visible to the user. We have invested in a unique, ultra high performance logic analyzer test station.

We test every design, and every analyzer off the production line, to insure full performance across the range of channel count, bandwidth, logic swing, and setup/hold time. If a Tektronix specification errs, it errs on the side of understatement. We spec at the probe tip, not the BNC. And we stand behind our specifications.

We now offer a simple low cost verification fixture (CENTRAK) which can help you determine the quality of an analyzer before you decide which one to purchase.

### Support

Our logic analyzers are supported by a staff of field specialists and applications engineers, as well as by toll free telephone hotline support. Our manuals are complete and consistent, and we have a wide library of support and application notes.

Our accessories include what it takes to get the job done. We include appropriate items such as additional sockets, sample REFMEMs, and leadsets to help insure you will not face unplanned delays.

### Tool Choices

Each project creates unique debug and optimization challenges. Tektronix' set of logic analyzers and digital analysis systems offers a wide range of tools to address these evolving needs. This catalog provides an overview of these tools. Contact your local Tektronix sales representative for help in selecting the appropriate tool set for your specific application.

# Microprocessor Support Chart



## MICROPROCESSOR SUPPORT SELECTION GUIDE

| Microprocessor | DAS Series | | 3000 Series | |
|---|---|---|---|---|
| Type & Package | 92A96/ D/XD/SD | 92A90/D | 32GPX/GPD | 30MPX |
| **AMD** | | | | |
| AM80386DX QFP-132 (soldered) | | | √ | √ |
| 29000 PGA-169 (socketed) | √ | | | |
| 29050 PGA-169 (socketed) | √ | | | |
| 29205 QFP-100 (soldered) | √ | | √ | |
| **AT&T** | | | | |
| DSP3210 QFP-132 (soldered) | √ | | √ | |
| **CYPRESS SEMICONDUCTOR** | | | | |
| CY7C601 Sparc PGA-208 (socketed) | √ | | | |
| **FUJITSU** | | | | |
| MB86903 Sparc PGA-208 (socketed) | √ | | | |
| **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) | √ | | | |
| **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) | √ | √ | √ | √ |

**MICROPROCESSOR SUPPORT:**

- Symbolic Address Display
- Multiple Disassembly Formats
- Shows Which Instructions Were Executed
- Simultaneous State and Timing Analysis
- Time Correlated Displays
- Performance Analysis
- Superior Microprocessor Probing
- Multiple Microprocessor Analysis

*Continued on next page.*

*Tektronix offers a wide range of microprocessor support.*

# Microprocessor Support Chart

**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 Type & Package | DAS Series 92A96/ D/XD/SD | DAS Series 92A90/D | 3000 Series 32GPX/GPD | 3000 Series 30MPX |
|---|---|---|---|---|
| 83C537 PLCC-84 (soldered) | √ | √ | √ | √ |
| 8096 PGA-68 (socketed) | √ | | √ | |
| 8096 PLCC-68 (socketed) | √ | | √ | |
| 8096 PLCC-68 (soldered) | √ | | √ | |
| 80C196 PGA-68 (socketed) | √ | | √ | |
| 80C196 PLCC-68 (socketed) | √ | | √ | |
| 80C196 PLCC-68 (soldered) | √ | | √ | |
| 8085 DIP-40 (socketed) | √ | √ | √ | |
| 8085 DIP-40 (soldered) | √ | √ | √ | |
| 8086 DIP-40 (socketed) | √ | √ | √ | √ |
| 8086 DIP-40 (soldered) | √ | √ | √ | √ |
| 8086 PLCC-44 (socketed) | √*2 | √*2 | √*2 | √*2 |
| 8086 PLCC-44 (soldered) | √*2 | √*2 | √*2 | √*2 |
| 80C86 DIP-40 (socketed) | √ | √ | √ | √ |
| 80C86 DIP-40 (soldered) | √ | √ | √ | √ |
| 80C86 PLCC-44 (socketed) | √*2 | √*2 | √*2 | √*2 |
| 80C86 PLCC-44 (soldered) | √*2 | √*2 | √*2 | √*2 |
| 8088 DIP-40 (socketed) | √ | √ | √ | √ |
| 8088 DIP-40 (soldered) | √ | √ | √ | √ |
| 8088 PLCC-44 (socketed) | √*2 | √*2 | √*2 | √*2 |
| 8088 PLCC-44 (soldered) | √*2 | √*2 | √*2 | √*2 |
| 80C88 DIP-40 (socketed) | √ | √ | √ | √ |
| 80C88 DIP-40 (soldered) | √ | √ | √ | √ |
| 80C88 PLCC-44 (socketed) | √*2 | √*2 | √*2 | √*2 |
| 80C88 PLCC-44 (soldered) | √*2 | √*2 | √*2 | √*2 |
| 80186 PGA-68 (socketed) | √ | √ | √ | √ |
| 80186 LCC-68 (socketed) | √ | √ | √ | √ |
| 80186 PLCC-68 (socketed) | √ | √ | √ | √ |
| 80186 PLCC-68 (soldered) | √ | √ | √ | √ |
| 80186 QFP-80 (soldered) | √*2 | √*2 | √*2 | √*2 |
| 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) | √*2 | √*2 | √*2 | √*2 |
| 80188 PGA-68 (socketed) | √ | √ | √ | √ |
| 80188 LCC-68 (socketed) | √ | √ | √ | √ |
| 80188 PLCC-68 (socketed) | √ | √ | √ | √ |
| 80188 PLCC-68 (soldered) | √ | √ | √ | √ |
| 80188 QFP-80 (soldered) | √*2 | √*2 | √*2 | √*2 |
| 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) | √*2 | √*2 | √*2 | √*2 |
| 80286 PGA-68 (socketed) | √ | √ | √ | √ |
| 80286 LCC-68 (socketed) | √ | √ | √ | √ |
| 80286 PLCC-68 (socketed) | √ | √ | √ | √ |
| 80286 PLCC-68 (soldered) | √ | √ | √ | √ |
| 80376 PQFP-100 (socketed) | | √ | | √ |
| 80376 PQFP-100 (soldered) | √ | √ | √ | √ |
| 80386SX PQFP-100 (socketed) | | √ | | √ |
| 80386SX PQFP-100 (soldered) | √ | √ | √ | √ |
| 80386DX PGA-132 (socketed) | √ | √ | √ | √ |
| 80486SX PGA-168 (socketed) | √ | | | |
| 80486DX PGA-168 (socketed) | √ | | | |
| 80486DX-50 PGA-168 (socketed) | √ | | | |
| 80486DX2 PGA-168 (socketed) | √ | | | |

*1 Uses general purpose probes rather than configured probe adapter
*2 Uses commercial accessory (not available through Tektronix)
*3 Disassembly support available, but not sold as a formal product – contact sales representative for detail

Continued on next page.

# Microprocessor Support Chart

| Microprocessor Type & Package | DAS Series 92A96/ D/XD/SD | DAS Series 92A90/D | 3000 Series 32GPX/GPD | 3000 Series 30MPX |
|---|---|---|---|---|
| 80487SX PGA-168 (socketed) | √ | | √ | |
| 80487DX PGA-168 (socketed) | √ | | √ | |
| Pentium™ PGA-273 (socketed) | √ | | √ | |
| 80960KA PGA-132 (socketed) | √ | | | |
| 80960KA QFP-164 (soldered) | √*2 | | | |
| 80960KB PGA-132 (socketed) | √ | | | |
| 80960KB QFP-164 (soldered) | √*2 | | | |
| 80960MC PGA-132 (socketed) | √ | | | |
| 80960MC QFP-164 (soldered) | √*2 | | | |
| 80960CA QFP-196 (socketed) | √*2 | | √*2 *3 | |
| 80960CA PGA-168 (socketed) | √ | | √*3 | |
| 80960CF PGA-168 (socketed) | √ | | √*3 | |
| i860XR PGA-168 (socketed) | √ | | | |
| i860XP | √*1, *3 | | | |
| **LSI LOGIC** | | | | |
| 64811 Sparc PGA-208 (socketed) | √ | | | |
| R3000 PGA-145 (socketed) | √ | | | |
| R3000A PGA-175 (socketed) | √ | | | |
| R4000PC PGA-179 (socketed) | √ | | | |
| R4000SC PGA-447 (socketed) | √ | | | |
| R4000MC PGA-447 (socketed) | √ | | | |
| **MOTOROLA** | | | | |
| 6800 DIP-40 (socketed) | | | √ | |
| 6800 DIP-40 (soldered) | | | √ | |
| 6802 DIP-40 (socketed) | | | √ | |
| 6802 DIP-40 (soldered) | | | √ | |
| 6805 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) | √*1, *3 | √*1, *3 | √ | √ |
| 68HC11 DIP-40 (soldered) | √*1, *3 | √*1, *3 | √ | √ |
| 68HC11 DIP-48 (socketed) | √*1, *3 | √*1, *3 | √ | √ |
| 68HC11 DIP-48 (soldered) | √*1, *3 | √*1, *3 | √ | √ |
| 68HC11 PLCC-44 (socketed) | √*1, *3 | √*1, *3 | √ | √ |
| 68HC11 PLCC-44 (soldered) | √*1, *3 | √*1, *3 | √ | √ |
| 68HC11 PLCC-52 (socketed) | √*1, *3 | √*1, *3 | √ | √ |
| 68HC11 PLCC-52 (soldered) | √*1, *3 | √*1, *3 | √ | √ |
| 68HC11 PLCC-68 (socketed) | √*1, *3 | √*1, *3 | √ | √ |
| 68HC11 PLCC-68 (soldered) | √*1, *3 | √*1, *3 | √ | √ |
| 68HC11 PLCC-84 (socketed) | √*1, *3 | √*1, *3 | √ | √ |
| 68HC11 PLCC-84 (soldered) | √*1, *3 | √*1, *3 | √ | √ |
| 68HC16 QFP-132 (soldered) | | | √ | |
| 68HC16 Eval. Brd. | | | √ | |
| 68302 PGA-132 (socketed) | √*1 | √*1 | √ | √ |
| 68302 QFP-132 (soldered) | √*1 | √*1 | √ | √ |
| 68331 QFP-132 (socketed) | √ | √*1, *3 | √ | √ |
| 68332 QFP-132 (socketed) | √ | √*1, *3 | √ | √ |
| 68340 PGA-145 (socketed) | √ | √*1, *3 | √ | √ |
| CPU-32 BCC | √ | √*1, *3 | √ | √ |
| 68000 DIP-64 (socketed) | √ | √ | √ | √ |
| 68000 PGA-68 (socketed) | √ | √ | √ | √ |
| 68000 PLCC-68 (soldered) | √ | √ | √ | √ |
| 68000 PLCC-68 (socketed) | √ | √ | √ | √ |

*1 Uses general purpose probes rather than configured probe adapter
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# Microprocessor Support Chart

**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 Type & Package | DAS Series 92A96/ D/XD/SD | DAS Series 92A90/D | 3000 Series 32GPX/GPD | 3000 Series 30MPX |
|---|---|---|---|---|
| 68EC000 PLCC-68 (socketed) | | | √ | |
| 68EC000 PLCC-68 (soldered) | | | √ | |
| 68HC000 PGA-68 (socketed) | √ | √ | √ | √ |
| 68HC000 DIP-64 (socketed) | √ | √ | √ | √ |
| 68HC000 PLCC-68 (soldered) | √ | √ | √ | √ |
| 68HC000 PLCC-68 (socketed) | √ | √ | √ | √ |
| 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) | √*2 | | √ | |
| 68020 QFP-132 (socketed) | √*2 | | √ | |
| 68EC020 PGA-100 (socketed) | | | √ | |
| 68EC020 QFP-100 (socketed) | | | √ | |
| 68030 PGA-128 (socketed) | √ | √ | √ | √ |
| 68030 QFP-132 (soldered) | √*2 | | √ | |
| 68030 QFF-132 (socketed) | √ | √ | √ | √ |
| 68EC030 PGA-128 (socketed) | √ | √ | √ | √ |
| 68040 PGA-179 (socketed) | √ | | √ | |
| 68EC040 PGA-179 (socketed) | √ | | √ | |
| 68LC040 PGA-179 (socketed) | √ | | √ | |
| 88100 PGA-181 (socketed) | √ | | | |
| 88110 PGA-300 (socketed) | √ | | √ | |
| 56000 PGA-88 (socketed) | √*1,*3 | √*1,*3 | √ | √ |
| 56000 QFP-132 (soldered) | √*1,*3 | √*1,*3 | √ | |
| 56001 PGA-88 (socketed) | √*1,*3 | √*1,*3 | √ | √ |
| 56001 QFP-132 (soldered) | √*1,*3 | √*1,*3 | √ | |
| 56002 PGA-132 (socketed) | | | √ | |
| 56002 QFP-132 (soldered) | | | √ | |
| 96002 PGA-223 (socketed) | √ | √ | | |
| **NEC** | | | | |
| R3000 PGA-145 (socketed) | √ | | | |
| R3000A PGA-175 (socketed) | √ | | | |
| R4000PC PGA-179 (socketed) | √ | | | |
| R4000SC PGA-447 (socketed) | √ | | | |
| R4000MC PGA-447 (socketed) | √ | | | |
| **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) | √ | | | |
| **TEXAS INSTRUMENTS** | | | | |
| TMS32020 PGA-68 (socketed) | √*1,*3 | √*1,*3 | √ | |
| TMS32020 PLCC-68 (socketed) | √*1,*3 | √*1,*3 | √ | |
| TMS320C25 PGA-68 (socketed) | √*1,*3 | √*1,*3 | √ | |
| TMS320C25 PLCC-68 (socketed) | √*1,*3 | √*1,*3 | √ | |
| TMS320C26 PLCC-68 (socketed) | √*1,*3 | √*1,*3 | √ | |
| TMS320C30 PGA-181 (socketed) | √ | | √ | |
| TMS320C31 QFP-132 (soldered) | √ | | √ | |
| TMS320C40 PGA-325 (socketed) | √ | | √ | |
| TMS320C50 QFP-132 (soldered) | √*1,*3 | | | |

*1 Uses general purpose probes rather than configured probe adapter
*2 Uses commercial accessory (not available through Tektronix)
*3 Disassembly support available, but not sold as a formal product – contact sales representative for detail

Continued on next page.

# Microprocessor Support Chart

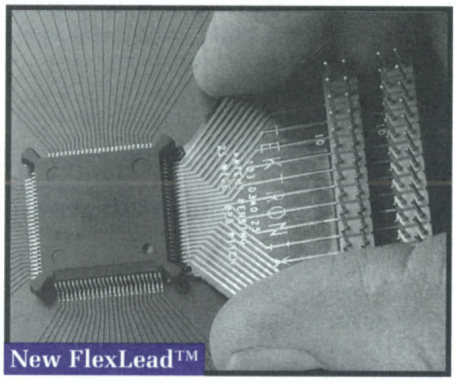
| Microprocessor Type & Package | DAS Series 92A96/ D/XD/SD | DAS Series 92A90/D | 3000 Series 32GPX/GPD | 3000 Series 30MPX |
|---|---|---|---|---|
| **ZILOG** | | | | |
| Z80 DIP-40 (socketed) | √ | √ | √ | √ |
| Z80 DIP-40 (soldered) | √ | √ | √ | √ |
| **Mil-Std 1750A** | | | | |
| PACE 1750 | √*1,*3 | √ | √*1,*3 | |
| F9450 | √*1,*3 | √ | √*1,*3 | |
| Mil-Std 1750A | √*1,*3 | √ | √*1,*3 | |
| **BUS Support** | | | | |
| IEEE-488 (GPIB) | √ | | √ | |
| Futurebus+ | √ | | | |
| Mil. Std. 1553 | √ | | √ | |
| SCSI I/II | √ | | √ | |
| VME | √*2 | | √*2 | |
| ISA | √*2 | | √*2 | |
| EISA | √*2 | | √*2 | |
| Micro Channel | √*2 | | √*2 | |
| PCI | √*2 | | √*2 | |

**1 Uses general purpose probes rather than configured probe adapter*
**2 Uses commercial accessory (not available through Tektronix)*
**3 Disassembly support available, but not sold as a formal product – contact sales representative for detail*

**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.

## Surface Mount Device Probing FlexLead™ Adapter

As the pitch, 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 new 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.


New FlexLead™

| Package Type | Nomenclature (Package of 8) |
|---|---|
| JEDEC, 0.025 in. Pitch 68 lead (17 x 17) (soldered) | PJ25X17 |
| 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 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 |
| 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 144 lead (36 x 36) (soldered) | PE50X36 |
| EIAJ, 0.5 mm Pitch 208 lead (52 x 52) (soldered) | PE50X52 |
| EIAJ, 0.5 mm Pitch 304 lead (76 x 76) (soldered) | PE50X76 |
| EIAJ, 0.65 mm Pitch 112 lead (28 x 28) (soldered) | PE65X28 |
| EIAJ, 0.65 mm Pitch 144 lead (36 x 36) (soldered) | PE65X36 |

*Note: See page 452 for further information.*

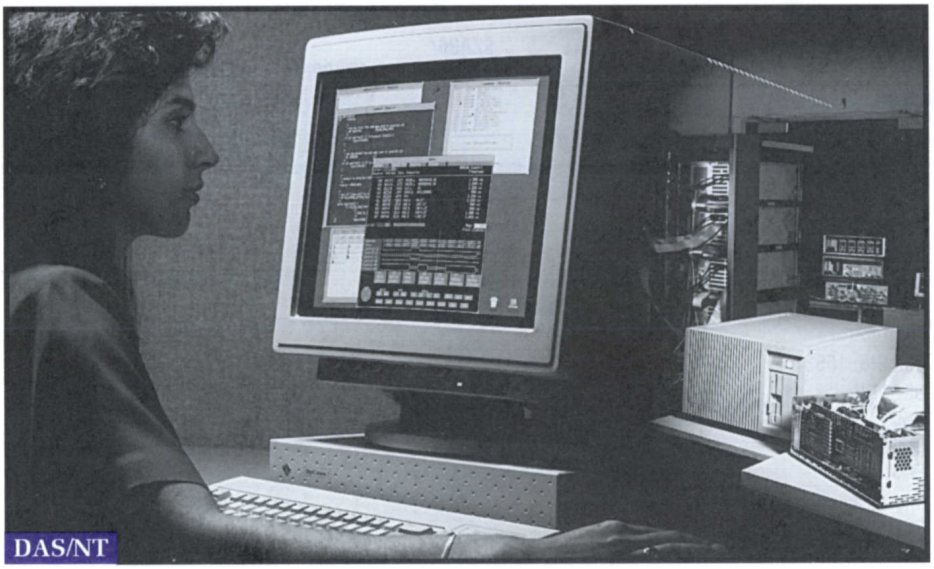
# Digital Analysis System



*DAS/NT provides workstation-based analysis*

**DAS/NT**

- Full Control and Data Display from your Workstation
- Up to 1536 Channels with 10 ns Resolution
- Up to 160 Channels with 500 ps Resolution
- More than 500 Channels of 100 MHz Pattern Generation
- Acquisition Memory Depth of 8K, 32K, 128K, 512K
- 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




## 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 set of configured Digital Analysis Systems 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 multi-processor 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 certified to be fully compatible with SUN SPARCSTATIONS running X. Compatible with X11/R4 and R5 servers, the display has been demonstrated on many other workstations offering compatible X 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.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# Digital Analysis System

## DAS/NT
## DAS/XP






*The 92XTERM support allows the DAS to be controlled from any SPARC-based Sun workstation.*

### A WIDE RANGE OF ACQUISITION CARDS

For state analysis or microprocessor support, the solutions are the 92A90 and 92A96 acquisition cards. The 92A90 handles 40 MHz clock rates and 20 MHz bus rates. The 92A90 is available in 32K and 128K memory depths. The 92A96 handles clock and bus rates up to 100 MHz without performance compromises and is available with memory depths of either 8K, 32K, 128K, or 512K. The 92A96 is 96 channels wide and can be extended to 384 channels operated as a single module.

For high speed timing, there are the 92A16 and the 92HS8. The 92A16 offers 200 MHz clock and bus rate acquisition with 4K memory depth. The 92A16 is 16 channels and can be expanded to 96. The 92HS8 is eight-channels wide and can sample at 2 GHz (500 ps) across as many as 160 channels.

The extremely sophisticated triggering of these instrument modules offer unmatched power and flexibility. To simplify triggering, editable pre-programmed libraries of triggering set-ups are included. The libraries are easily modified and expanded to allow full utilization of the powerful triggering capabilities.

### 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 100 MB Hard Disk, a PC compatible 1.2 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. Module setups and acquired data can be printed to the DAS serial printer port in ASCII, Epson FX, Epson LQ, IBM Proprinter, and Postscript formats. This data can also be output to a file for printing on a network printer.

The DAS92E9 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 DAS92E9 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 sub-systems 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 warranty. (This support may not be available in all geographic areas. Check with your local Tektronix sales engineer.) Warranty-Plus service options may be purchased to extend coverage to two or three years at the time you purchase your system. A toll-free, telephone "Hot Line" (U.S. Only) is also accessible as part of the Software Subscription Service offered for the DAS.

# 92A96D
# 92A96XD
# 92A96SD

# Digital Analysis System
## 100 MHz Acquisition

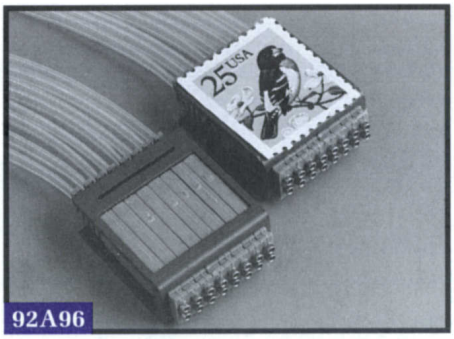
*92A96 family provides the deepest acquisition memory in the industry.*

**92A96D/XD/SD MODULE**

- 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 8K, 32K, 128K, or 512K Memory Depths
- Time-Correlated to Other State/Timing Modules
- Bus-Form Timing Display
- Compact, High Bandwidth Probes
- Provides Timing Analysis Through Same Probes




*The 92A96SD offers an unprecedented memory depth of 512K bits per channel.*




*The 92A96 provides accessibility to signals with 8-channel probes as small as a US postage stamp.*

### State Analysis or Microprocessor Support

For high speed state analysis or microprocessor support, the solution is the family of 92A96 Centurion acquisition cards. The 92A96 Centurion handles clock and bus rates up to 100 MHz without compromising any performance features and is available with memory depths of 8K, 32K, 128K, or 512K. The 92A96 Centurion is 96 channels wide and can be extended to 384 channels.

**TIMING AND HIGH SPEED STATE ANALYSIS**

In timing mode, 92A96 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.

**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 92A96 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 92A96 has analog bandwidth greater than 150 MHz and can easily handle 100 MHz synchronous acquisition with a setup and hold window of 5 ns or less.

**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-channel probes of the 92A96 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?**

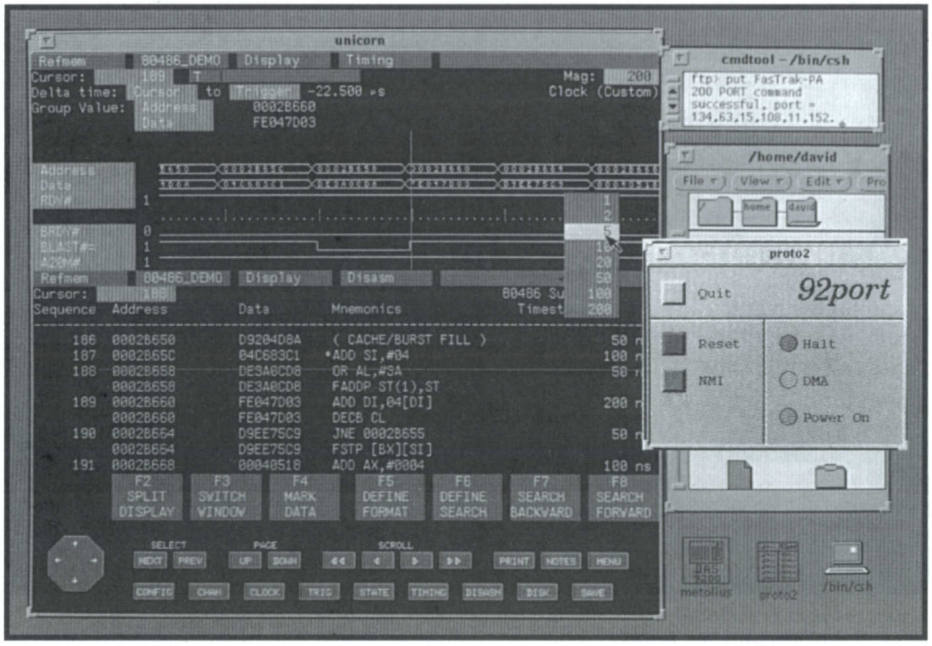
In most situations, triggering starts on a visible symptom of a problem. With microprocessor-based designs, the cause of a problem is often separated from the symptom by a long period of time and a lot of bus activity. To trace down the cause of the symptom, you need to go backwards in acquisition memory to the time of the cause. Only a deep trace buffer with full trigger positioning can prepare you for this kind of problem.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# Digital Analysis System
## 100 MHz Acquisition








### INTEGRATE THE DAS WITH HIGH LEVEL SOFTWARE TOOLS

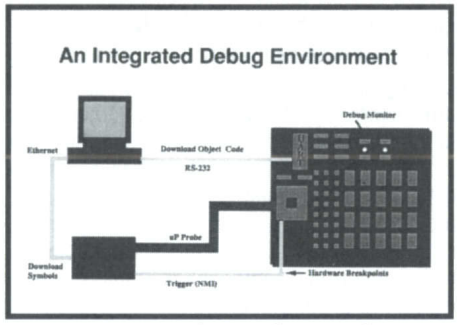
With LA-CONNECT, Tektronix has linked up to popular software tools so you can link the DAS to your high level debug tools. Real time trace and hardware breakpoints can be added to your debugger by integrating it with the DAS. Cross compilers, debug monitors, and source level debuggers are all available through LA-CONNECT. The new network tools allow simple data transfer for symbol tables, results, etc.

### UPGRADE EXISTING SYSTEMS TO FULL CAPABILITY

Existing DAS9200 systems can easily be upgraded to full workstation (DAS/NT) or standalone lab (DAS/XP) operation with cost effective upgrades. This allows a design team to economically take advantage of new capabilities available with the new DAS systems.

### Control Your Target System from the Workstation

The 92PORT application software provides control and monitoring of the target system through a port on the DAS mainframe. Eight output bits and eight input bits are displayed in an X window on the workstation (DAS/NT) or X terminal (DAS/XP) 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. The 92PORT operates as X client software on the DAS mainframe and is compatible with any X11/R4 server software on a workstation or X terminal.



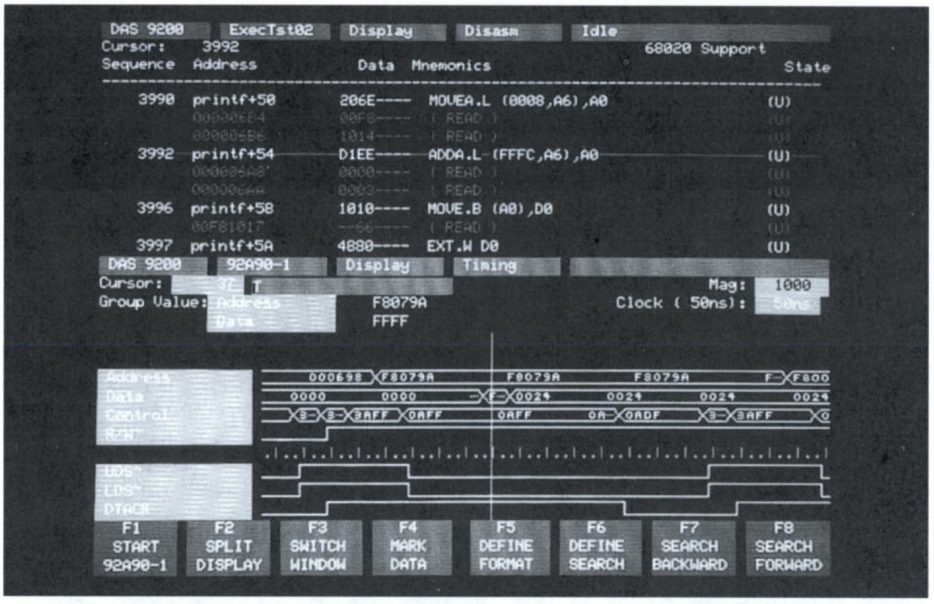

*LA CONNECT combines a logic analyzer, a debug monitor, and a source level debugger to provide a real time debug environment for today's fastest and most complex microprocessors.*

# Digital Analysis System
## Microprocessor Support

*The DAS supports the latest RISC and CISC microprocessors.*

*Data links to high level language tools provide robust symbolic data presentation.*

- Support for many Popular RISC/CISC Microprocessors
- Multiprocessor Support for up to 8 CPUs at Once
- State or Timing Displays with the Same Probes




*Using the time correlated, split-screen display, you can observe detailed system interactions in any format you choose.*

### Configured Support Packages Ease Microprocessor Debug

Debugging a system with several microprocessors would require the attachment of hundreds of probes. After you attach those probes, and you acquire megabytes worth of data, how do you analyze it all? The DAS provides you with a variety of display format options. You can start with a macroscopic view of subroutine entry and exit points. Then, without re-acquiring, gradually zoom in on specific activities and values. You can view control flow, assembly instructions, and cycle-by-cycle bus activity.

Tektronix microprocessor support doesn't limit you to simple inverse disassembly. Instead of merely translating data on a line-by-line basis, the 92A96 and has a sixteen state, clocking state machine that emulates the behavior of a complex microprocessor bus, actually predicting branches and cache flushes, and automatically re-synchronizing disassembly.

#### EDITABLE AND DOWNLOADABLE SYMBOL TABLES

The DAS has 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. LA-LINK and CSI-LINK software will extract symbol information from the output of various compilers and convert it to Tektronix' symbol format. This allows the linking of a high level language trace display to the data acquired by the logic analyzer.

#### DATA IS FORMATTED FOR CLEAR ANALYSIS

Hardware display format helps you track problems specific to hardware/software interaction by showing you every bus transaction in order of occurrence. Software display format shows you what would be found in an assembly listing, with data transfers optionally included. Control flow mode displays only the instructions that cause program branching. And in subroutine trace mode, you see only subroutine calls and returns, obtaining a high-level overview of program execution.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# Digital Analysis System
## Microprocessor Support





**INTEGRATION IS PREVALENT IN TODAY'S DESIGNS**

Hardware is linked to microprocessors, software to hardware, and multiple processors to one another. Dozens of engineers may be working together on a project. Multiple components, multiple designs, and multiple levels of complexity mean problems are built-in from the very beginning.

What's more, these problems usually are not discovered until the integration stage, when the interactions of many designs are tested and debugged. At this point, they're difficult to correct, and they have a critical impact on your project schedule. A time-correlated, split-screen display lets you scroll through disassembly of time-stamped data acquired from any two processors, and quickly understand what each is doing at a single point in time. You can lock the cursors in separate display windows so both screens scroll together in accurate time alignment.

Real time event handshaking between the different instrument cards lets you identify data across multiple acquisition modules and trigger them simultaneously to acquire the data necessary for time alignment. And pattern generation lets you simulate interactions of hardware that's not properly working. Perhaps best of all, you can debug hardware and software components and system interactions using the same card modules, reconfiguring them from the keyboard without physically moving them.

## ORDERING INFORMATION

**92DM09A** – 80386DX Support ..... **$2,500**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$700**
**Opt. 04** – (1) 90-CH Interface ..... **+$950**

**92DM10** – 80386SX Support ..... **$2,500**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$950**
**Opt. 1S** – Sub. Soldered 100-Pin PQFP Probe Adapter ..... **NC**
**Opt. 3S** – Sub. AMP 100-Pin PQFP Adapter ..... **+$225**
**Opt. 04** – (1) 90-CH Interface ..... **+$950**

**92DM12** – 80486 Support ..... **$4,950**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$750**
**Opt. 2S** – Sub. Low Profile Probe Adapter ..... **NC**

**92DM13A** – Pentium Support ..... **$6,000**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$1,500**

**92DM17** – 80960 Support ..... **$4,950**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$750**
**Opt. 2S** – Sub. Low Profile Probe Adapter ..... **NC**

**92DM31A** – 68020 Support ..... **$2,500**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$700**
**Opt. 04** – (1) 90-CH Interface ..... **+$950**

**92DM33A** – 68030 Support ..... **$2,500**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$700**
**Opt. 04** – (1) 90-CH Interface ..... **+$950**

**92DM34A** – 68040 Support ..... **$4,950**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$750**

**92DM35A** – 88100 Support ..... **$4,950**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$1,950**
**Opt. 04** – (2) 90-CH Interfaces ..... **+$1,900**
The 92DM35A requires two acquisition modules.

**92DM72A** – AMD 29000/050 Support ..... **$4,950**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$750**
The 92DM72A requires two acquisition modules.

**92DM74** – MIPS R3000/A Support ..... **$4,950**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$750**
**Opt. 2S** – Sub. Low Profile Probe Adapter ..... **NC**

**92DM75A** – R4000 Support ..... **$4,950**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$750**
**Opt. 2S** – Sub. R4000SC/MC Probe Adapter ..... **+$250**

**92DM77A** – SPARC CY7C601/L64811/MB86903 Support .. **$4,950**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$750**

**92DM81** – 8096/C16 Support ..... **$2,500**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$650**
**Opt. 2S** – Sub. PLCC-68 Probe Adapter ..... **NC**

**92DM901** – MCS-51 Support ..... **$800**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$550**

**92DM902** – 8085 Support (DIP) ..... **$450**
**Opt. 1D** – Delete Probe Accessories (Software only) ..... **–$200**

**92DM911** – Futurebus+ Support ..... **$9,950**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$8,000**

**92DM912** – 68000/10 Support ..... **$1,200**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$650**
**Opt. 2S** – Sub. PGA Probe Adapter ..... **NC**
**Opt. 3S** – Sub. PLCC Probe Adapter ..... **NC**

**92DM913** – Z80 Support ..... **$800**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$550**

**92DM914** – 96002 Support ..... **$1,500**
**Opt. 1D** – Delete Probe Accessories (Software only) ..... **–$750**

**92DM916** – 80960KA/KB/MC Support ..... **$1,500**
**Opt. 1D** – Delete Probe Accessory (Software only) ..... **–$750**

**92DM920** – TMS320C3X Support ..... **$1,500**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$750**
**Opt. 2S** – Sub. PGA Probe Adapter ..... **NC**

**92DM921** – TMS320C40 DSP Support ..... **$2,700**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$1,950**

**92DM923** – 88110 RISC Support ..... **$2,700**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$1,950**

**92DM925** – R3051/52/81 RISC Support ..... **$1,500**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$750**
**Opt. 2S** – Sub. PLCC-84 Probe Adapter ..... **NC**

**92DM926** – DSP3210 DSP Support ..... **$1,000**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$750**

**92DM927** – 29205 RISC Support ..... **$1,000**
**Opt. 1D** – Delete Probe Adapter (Software only) ..... **–$750**

**ADDITIONAL ACCESSORIES**
**CART** – Order K475 ..... **$595**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# Digital Analysis System
## Instrument Modules and Extended Support



*Instrument Modules and Extended Support.*

**DAS**

- One Year Warranty
- Extended Support
- On-site Installation Available

### 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 DAS92E9 expansion mainframe, depending on the cards. Each mainframe includes sufficient power for all card slots. Additional options are available, please consult your local Sales Engineer.

| MODULE TYPE Acquisition | Description | Fastest Internal Clock | Fastest External Clock | Maximum Channels per Card | Channels per System | Memory Depth (per Ch.) | Price |
|---|---|---|---|---|---|---|---|
| 92A16 | Master | 5 ns | 5 ns | 16 | 384 | 4K | **$9,750** |
| 92A16E | Expander | 5 ns | 5 ns | 16 | NA | 4K | **$9,550** |
| 92A90D | Master | 50 ns | 50 ns | 90 | 540 | 128K | **$16,900** |
| 92A96 | Master or Expander | 2.5 ns | 10 ns | 96 | 1,536 | 8K | **$14,950** |
| 92A96D | Master or Expander | 2.5 ns | 10 ns | 96 | 1,536 | 32K | **$17,950** |
| 92A96XD | Master or Expander | 2.5 ns | 10 ns | 96 | 1,536 | 128K | **$20,950** |
| 92A96SD | Master or Expander | 2.5 ns | 10 ns | 96 | 1,536 | 512K | **$25,950** |
| 92HS8 | Master | 500 ps | 1.43 ns | 8 | 160 | 8K | **$25,980** |
| 92HS8E | Expander | 500 ps | | 8 | NA | 8K | **$25,980** |
| **Pattern Generator** | | | | | | | |
| 92S16 | Algorithmic | 20 ns | 20 ns | 18 | 936 | 1K | **$7,290** |
| 92S32 | Sequential or Expander | 20 ns | 20 ns | 36 | 1008 | 8K | **$9,430** |
| 92SX109 | Algorithmic | 10 ns | 10 ns | 9 | 468 | 2K | **$9,600** |
| 92SX118 | Sequential or Expander | 10 ns | 10 ns | 18 | 504 | 16K | **$12,500** |

### WARRANTY, INSTALLATION, AND EXTENDED SUPPORT

All DAS products and pre-configured systems are covered by a 1 year comprehensive, on-site warranty. This warranty provides you with a priority response if ever your system needs service. There are no materials, time, travel, or expense costs to deal with. Plus, you have toll-free access to the National Support Center (NSC) (US only). The NSC is staffed from 6:00 am to 6:00 pm PST. Questions regarding the systems capabilities or operation can now be easily answered in just one free phone call.

You have the option to extend this support at the time you purchase your system for a total coverage period of two or three years.

## ORDERING INFORMATION

### STANDARD CONFIGURATIONS

The most popular standard configuration includes the DAS9221 mainframe, a 9202XT X terminal, and one to four 92A96 acquisition modules. These may be ordered either for workstation use as a DAS/NT configuration or for standalone use as a DAS/XP. For other configurations, please see your local sales specialist or for full ordering information see configuration guide.

### WORKSTATION OPERATION

**DASNTD1**
96-CH High-Performance Processor Support ..... **$32,900**
**Includes:** One 92A96D with a DAS9221 mainframe.

**DASNTD2**
96-CH High-Performance Processor Support ..... **$49,800**
**Includes:** Two 92A96Ds with a DAS9221 mainframe.

**DASNTX1**
96-CH High-Performance Processor Support ..... **$35,900**
**Includes:** One 92A96XD with a DAS9221 mainframe.

**DASNTX2**
96-CH High-Performance Processor Support ..... **$55,800**
**Includes:** Two 92A96XDs with a DAS9221 mainframe.

**DASNTS1**
96-CH High-Performance Processor Support ..... **$40,900**
**Includes:** One 92A96SD with a DAS9221 mainframe.

**DASNTS2**
96-CH High-Performance Processor Support ..... **$65,800**
**Includes:** Two 92A96SDs with a DAS9221 mainframe.

### STANDALONE OPERATION

**DASXPD1**
96-CH High-Performance Processor Support ..... **$29,950**
**Includes:** One 92A96D with a DAS9221 mainframe.

**DASXPD2**
96-CH High-Performance Processor Support ..... **$46,860**
**Includes:** Two 92A96Ds with a DAS9221 mainframe.

**DASXPX1**
96-CH High-Performance Processor Support ..... **$32,950**
**Includes:** One 92A96XD with a DAS9221 mainframe.

**DASXPX2**
96-CH High-Performance Processor Support ..... **$52,860**
**Includes:** Two 92A96XDs with a DAS9221 mainframe.

**DASXPS1**
96-CH High-Performance Processor Support ..... **$37,950**
**Includes:** One 92A96SD with a DAS9221 mainframe.

**DASXPS2**
96-CH High-Performance Processor Support ..... **$62,860**
**Includes:** Two 92A96SDs with a DAS9221 mainframe.

*Continued on next page.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# Digital Analysis System
## Instrument Modules and Extended Support



## ORDERING INFORMATION

**DAS MAINFRAMES**

**DAS9221**
Basic Mainframe.....**$14,750**
**Includes:** 40 MHz CPU, 16 MB RAM, 100 MB Hard Disk, 1.2 MB Floppy Drive and Ethernet LAN interface.

**DAS9229**
Basic System.....**$16,500**
**Includes:** DAS9221 Mainframe and 9202XT Display.

**DAS92E9**
8 Card Slot Expansion Mainframe .....**$6,850**

**92FXSE**
Upgrades DAS9219/9220 Mainframe to DAS9221 (DAS/XP).....**$9,500**
**Includes:** CPU card, DAS/OS, 100 MB HDD, and X Terminal.

**92FXNET**
Upgrades DAS9219/9220 Mainframe to workstation compatible DAS9221 (DAS/NT).....**$11,900**
**Includes:** 92FXSE and 92XTERM.

**OPTIONS COMMON TO ALL DAS MAINFRAMES**

**Opt. 1A** – 115V/15A Power Cord .....**N/C**
**Opt. 1B** – 125/208V 3-Phase Power Supply .....**+$180**
**Opt. 05** – Rackmount Kit .....**+$400**
**Opt. 2C** – GPIB/Expansion Interface (92C02).....**+$1,950**
**Opt. 18** – Sub. Removable HD for Std. HD .....**+$350**

**WARRANTY-PLUS SERVICE PLANS OPTIONS**

**Opt. Q0** – Installation Service.....*1
**Opt. W2** – Customer Site HW/SW Service.....*1

**SOFTWARE**

**92PA**
DAS Performance Analysis Software .....**$1500**

**92PORT**
DAS Target Control Software.....**$950**

**92LANP**
LAN Programmatic Control Language Software .....**$950**
**Includes:** DAS9220 Application S/W, C Source Code for Host Computer, and Documentation.

**COMMUNICATION INTERFACES**

**92C02**
GPIB/Mainframe Expansion Interface.....**$1,950**

**92LANSE**
Ethernet LAN Interface.....**$950**

**DAS ACQUISITION CARDS**

**92A16**
16-CH, 200 MHz Sync/Async, Master Acquisition Card, 4K deep .....**$9,750**
**Includes:** Two P6461 probes and leadsets.
**Opt. 2S** – Sub. two P6460 probes for two P6461 .....**–$1,700**

**92A16E**
16-CH, 200 MHz Sync/Async, Expansion Acquisition Card, 4K deep.....**$9,550**
**Includes:** Two P6461E probes and leadsets.
**Opt. 2S** – Sub. two P6460 probes for two P6461 .....**–$1,300**

**92HS8**
8-CH, 2 GHz Async/350 MHz Ext. Async, Master Acquisition Unit, 8K deep .....**$25,980**
**Includes:** Probes, leadsets, and MF Interface.
**Opt. 05** – Rackmount Kit .....**+$300**

**92A90**
90-CH, 20 MHz Sync/Async, Master/Slave Acq. Card, 32K deep .....**$12,700**
**Includes:** Probe and general purpose leadset.
**92A90D** – 128K deep.....**$16,900**

**92A96**
96-CH, 100 MHz Sync/400 MHz Async, Master/Slave Acq. Card.
**Includes:** probes and leadsets
**92A96** – 8K deep card .....**$14,950**
**92A96D** – 32K deep card.....**$17,950**
**92A96XD** – 128K deep card.....**$20,950**
**92A96SD** – 512K deep card.....**$25,950**
**Opt. 01** – 90-CH Microprocessor Interface.....**+$950**
**Opt. 02** – Coax Ribbon Cables .....**+$2,950**

**DAS PATTERN GENERATOR CARDS**

**92S16**
18-CH, 50 MHz Algorithmic Pat. Gen., 1K deep. .....**$7,290**
**Includes:** Two P6464 probe and leads.
**Opt. 2S** – Sub. two P6465 probes for two P6464 probes.....**+$600**

**92S32**
36-CH, 50 MHz Sequential Pat. Gen., 8K deep. .....**$9,430**
**Includes:** Four P6464 probes and leads.
**Opt. 1S** – Sub. One P6465 probe for One P6464 probe.....**+$300**
**Opt. 2S** – Sub. two P6465 probes for P6464 probes .....**+$1,200**
**Opt. 3S** – Sub. four P6463 probes for four P6464 probes..**–$1,600**
**Opt. 4S** – Sub. two P6463 probes for two P6464 probes..**–$3,600**

**92SX109**
9-CH, 100 MHz Algorithmic Pat. Gen., 2K deep. .....**$9,600**
**Includes:** One Pat. Gen. Multiplexer, and one P6464 probe and leads
**Opt. 09** – Add one P6464 Output Data Probe.....**+$1,400**
**Opt. 11** – Add one P6460 External Control Probe.....**+$750**

**92SX118**
18-CH, 100 MHz Sequential Pat. Gen., 16K deep .....**$12,500**
**Includes:** Two Pat. Gen Multiplexers, and two P6464 probe and leads.
**Opt. 09** – Add two P6464 Output Data Probe.....**+$2,800**

*1 Contact your local Tektronix representative for price information.

Note: Option 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.

To gain the benefit of these services, specify the following options with your order:

**Option Q0** – On-Site Installation
**Option W2** – 2-year HW/SW Support & NSC Hotline Access
**Option W3** – 3-year HW/SW Support & NSC Hotline Access

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# GPX Logic Analyzers

*Eight tools in one low cost instrument. The GPX logic analyzer provides a complete set of features for the whole design team. Multiple tools are available in 3 mainframes to customize your system to your exact needs.*

**GPX LOGIC ANALYZER**

- 1 GHz High Speed Timing Analysis
- 200 MHz Timing Analysis
- 80 MHz State Analysis
- 8K or 32K 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

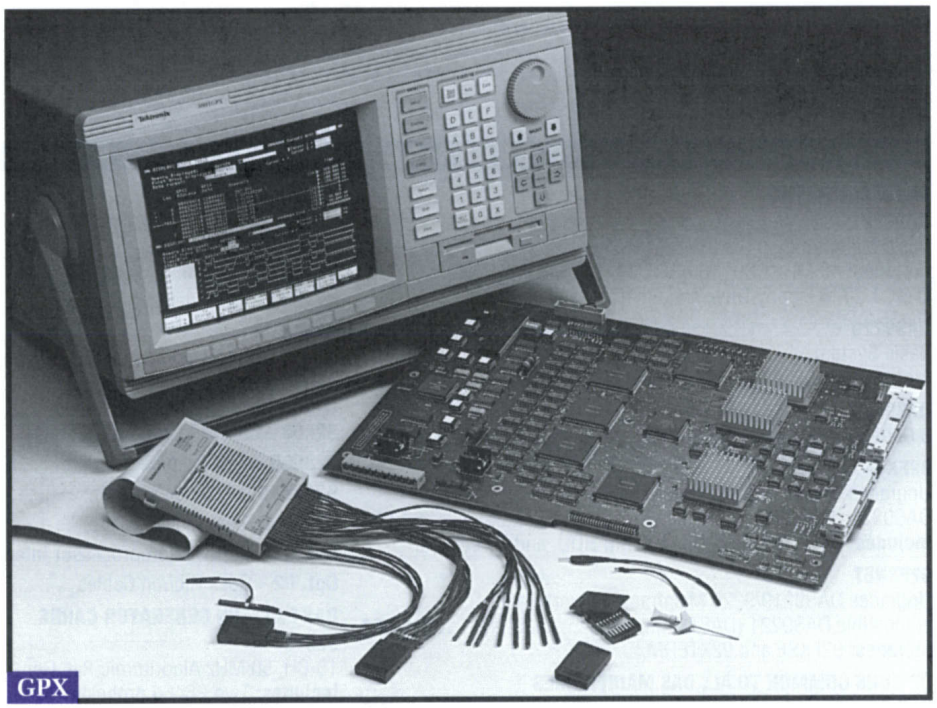
**ADDITIONAL MODULES**

- 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

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99




## GPX™ Logic Analyzer

The GPX Logic Analyzer is an outstanding value in general purpose logic analysis. The monolithic 3001GPX is designed for medium size applications or where portability is important. The modular 3002 based GPX systems can house up to four modules in a single system and is suited for larger, more complex applications.

**NEW DEEP MEMORY GPX**

A new GPX module is now available with four times the memory depth. The 32GPX has 8K of acquisition memory and the new 32GPD has all of the same features of the 32GPX but with 32K of acquisition memory. Both modules are available in the 3001GPX or the 3002 based systems.

**NEW 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.

**8 TOOLS IN ONE INSTRUMENT**

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 only afford one instrument, the GPX is the one to choose.

**3000 SERIES APPLICATION MODULE SELECTION GUIDE**

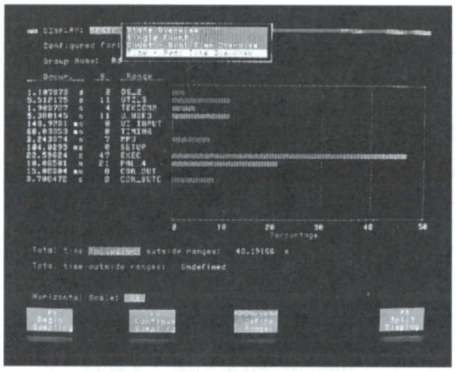
| Product | Application | Channels/Card | Rate | Clock Type | Memory*3 | Triggering |
|---|---|---|---|---|---|---|
| 32GPX (page 170) | General Purpose<br>Microprocessor<br>Hardware/Software Integration | 80-160*1<br>80-160*1<br>16-32*1 | 80 MHz<br>200 MHz<br>1 GHz | Synchronous<br>Transitional<br>Conventional | 4K/16K<br>8K/32K<br>40K/160K | 4 States/16 levels<br>4 Word/Range recognizers<br>2 Counter/Timers |
| 30MPX (page 172) | 8/16/32-Bit Microprocessor Hardware/Software Integration | 96<br>9 | 16 MHz*2<br>200 MHz or 90 MHz | Synchronous<br>Transitional Synchronous | 8K<br>2K 2K | 7 States<br>8 Word/Range recognizers<br>8 Counter/Timers |
| 30HSM (page 174) | High Speed Hardware Analysis | 20<br>or 4<br>or 20<br>or 18 | 400 MHz<br>2 GHz<br>200 MHz<br>95 MHz | Transitional<br>Transitional<br>Dual Threshold<br>Synchronous | 24K<br>120K<br>12K<br>6K | 15 Trigger Tests<br>4 Levels<br>2 Counter/Timers<br>4 Word Recognizers<br>4 TekLink Signals |
| 30DSM (page 175) | Analog Waveform Analysis | 1<br>or 2 | 400 MS/s<br>200 MS/s | NA<br>NA | 32K<br>16K | Edge: rising/falling<br>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*

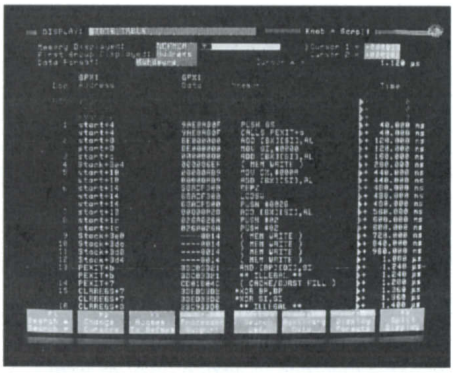
# GPX Logic Analyzers



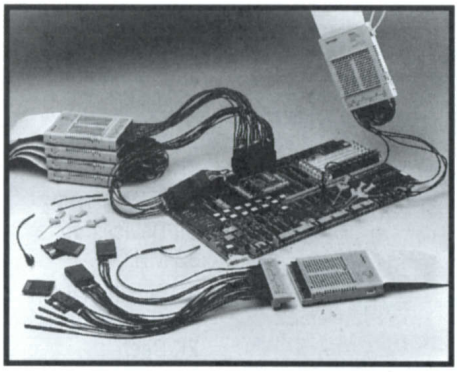




*Real time PA provides you the capability to easily determine how to optimize your system for better performance.*



*GPX offers 4 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 testclips and probing accessories.*

## 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.

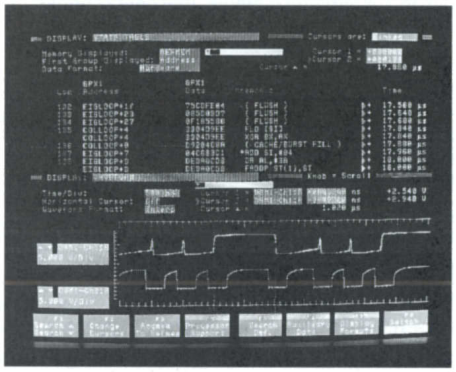
### COMPREHENSIVE MICROPROCESSOR SUPPORT

In addition to being a powerful general purpose logic analyzer, the GPX offers support for today's popular microprocessors including the 66 MHz Pentium, DSPs, micro-controllers 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.

### 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 173) lets you examine and change memory for quick patches to your program



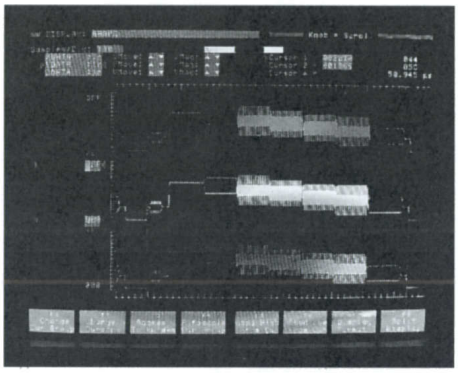
*Complimentary modules are available such as a DSO (above) and a high speed module. Split screen displays allow you to view your data simultaneously, time-correlated.*

### 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 set-ups that can be used in the majority of cases. You can easily customize any of these set-ups 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.



*With Graph Display, you can plot the "value" of your acquired data vs. memory location. You can simultaneously view up to 3 groups as separate, overlaid, or with an offset. Display features include autoscaling, interpolation (linear or sin(x)/x), and data as signed or unsigned.*

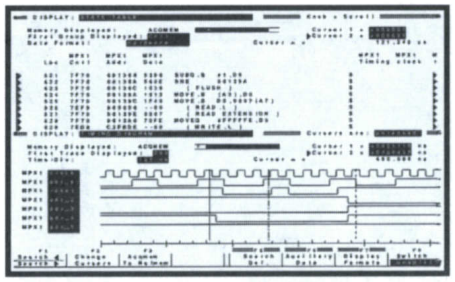
# Microprocessor Analysis



*The 30MPX module provides the support you need for developing a microprocessor based design in one low cost module.*

**30MPX**

- Combined State and Timing Analysis
- 96 State Channels, 8K Deep
- Support 8/16/32-Bit Devices up to 33 MHz
- 9 Transitional Timing Channels, 2K 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 8K 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 9 additional channels of 200 MHz transitional or 90 MHz synchronous acquisition with each channel storing 2K transitions.

High speed timing analysis compliments 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 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.

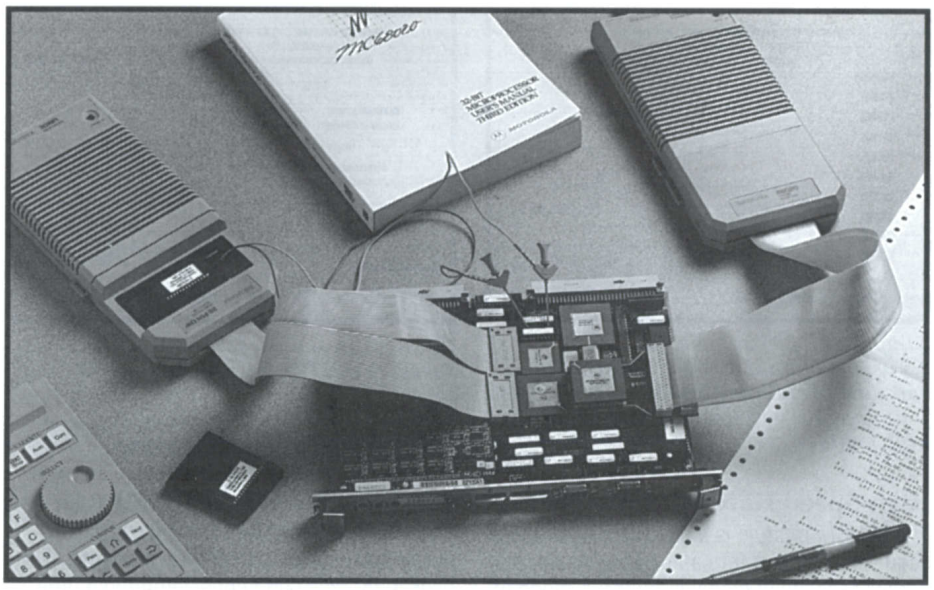
With real time performance analysis you can identify where in your program you should focus your efforts to fine tune your system for its optimum performance.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# Software/Hardware Integration







*Connection to your prototype is a simple matter of plugging EPROM probe adapters into your ROM sockets.*

**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

*Low cost option to the 32GPX, 32GPD, or 30MPX – ROM Emulation.*

## 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). General Purpose PDT supports any microprocessor by plugging the 30RP2 probes into your system's EPROM sockets. With General Purpose 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.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

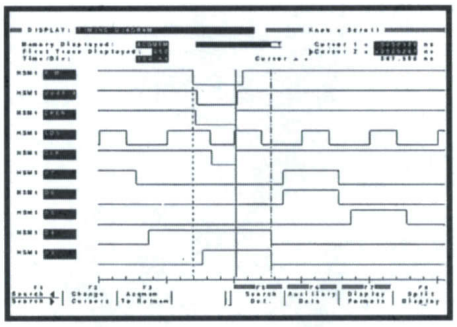
# High-Speed Analysis



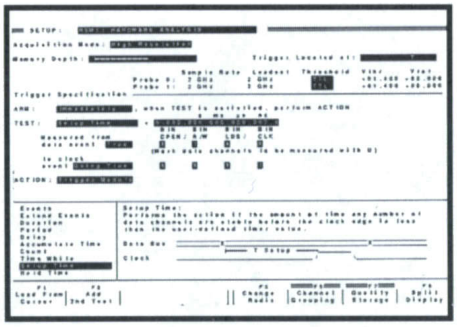
*High Speed Acquisition Module for accurate timing analysis.*

**30HSM**

- 2 GHz, 4 Channels
- 400 MHz, 20 Channels
- 95 MHz Synchronous, 18 Channels
- Dual Thresholds
- 24K Transitionally Stored Memory
- 15 Preset Trigger Tests
- 2.5 ns Glitch Detection



*Sampling all 20 channels simultaneously at 2.5 ns, the 30HSM assures that you can make detailed timing measurements even if your design is based on the very newest logic families.*



*Application specific triggering and context-sensitive HELP make using the 30HSM a breeze.*

## 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 & Hazards
- Glitches
- Setup & Hold Violations
- Propagation Delays
- 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

The high resolution mode provides 400 MHz timing (2.5 ns) across 20 channels. Each channel can record 24K 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 12K 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 120K 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 6K 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

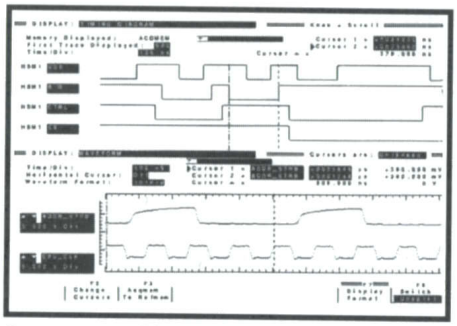
The 30HSM makes setting up triggers easy by providing 15 predefined trigger tests for measuring timing related problems. Trigger resources include four 20-Bit word recognizers, two counter/timers, and four intermodule TekLink signals.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

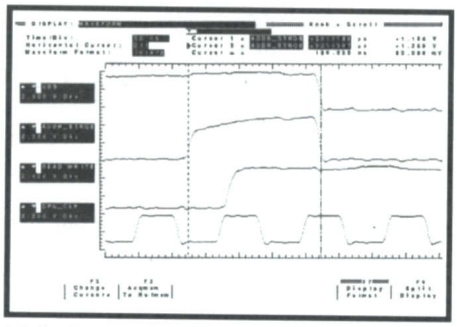
# Waveform Analysis







*Data acquired by any 3000 Series module is automatically time-correlated with all other data. Here a split screen display shows data acquired by the 30HSM correlated to signals acquired by the 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, multi-channel 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 32K 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 32K record length or the dual channel, 200 MS/s mode with a 16K 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 by the 30DSM can be displayed to nearly the full 14 in. 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. You can even display multiple copies of the same signal.

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. As an example, you can assign Cursor 1 to Channel 1 and Cursor 2 to Channel 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 will be able to 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.

**30DSM**

- 400 MS/s Digitizing
- 100 MHz Single Shot Bandwidth
- 32K-Bit Record Length
- 8-Bit Vertical Resolution

*Multi-channel Digital Storage Oscilloscope for solving tough analog problems.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# Configurations



*Multiple mainframes and options allow you to select the most appropriate configuration for your application.*

**3000 SERIES**

- 64 MB Hard Disk
- MS-DOS Compatible, 3.5 in. Disk
- Postscript/EPSON Printer Support
- Full Size QWERTY Keyboard
- RS-232 and GPIB Support

## 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 64 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 9 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 stand-alone 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 9-inch CRT, function key pads and control knob (a keyboard is optional), an optional 64 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.

### 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.

### 3000 SERIES SYSTEM SELECTION GUIDE

| Product | Description | Module | Display | Mass Storage | Price |
|---|---|---|---|---|---|
| 3001GPX*[1]<br>opt 1S | 1-slot portable | one 32GPX or one 32GPD | 9 in. Mono | 64 MB (opt)/720 KB | $8,995<br>$10,995 |
| 3001MPX | 1-slot portable | one 30MPX | 9 in. Mono | 64 MB (opt)/720 KB | $6,995 |
| 3001HSM | 1-slot portable | one 30HSM | 9 in. Mono | 64 MB (opt)/720 KB | $8,995 |
| 3002CG*[1]<br>opt 1S | 2-slot system | one 32GPX or one 32GPD | 14 in. Color | 64 MB/720 KB | $13,995<br>$15,995 |
| 3002CGG*[1]<br>opt 1S | 2-slot system | two 32GPX or two 32GPD | 14 in. Color | 64 MB/720 KB | $19,990<br>$21,990 |
| 3002CGH*[1]<br>opt 1S | 2-slot system | one 32GPX or one 32GPD, one 30HSM | 14 in. Color | 64 MB/720 KB | $19,995<br>$21,995 |
| 3002CGD*[1]<br>opt 1S | 2-slot system | one 32GPX or one 32GPD, one 30DSM | 14 in. Color | 64 MB/720 KB | $19,995<br>$21,995 |
| 3002CX | 2-slot system | one 30MPX | 14 in. Color | 64 MB/720 KB | $9,995 |
| 3002CXX | 2-slot system | two 30MPX | 14 in. Color | 64 MB/720 KB | $14,995 |
| 3002CH | 2-slot system | one 30HSM | 14 in. Color | 64 MB/720 KB | $9,995 |
| 3002CHH | 2-slot system | two 30HSM | 14 in. Color | 64 MB/720 KB | $14,995 |
| 3002CXH | 2-slot system | one 30MPX, one 30HSM | 14 in. Color | 64 MB/720 KB | $14,995 |
| 3002CXD | 2-slot system | one 30MPX, one 30DSM | 14 in. Color | 64 MB/720 KB | $14,995 |
| 3002CHD | 2-slot system | one 30HSM, one 30DSM | 14 in. Color | 64 MB/720 KB | $14,995 |

**[1] The 32GPX and 32GPD modules can be configured for 20, 40, 60, or 80 channels. Prices are for fully configured 80 channel modules.*

TD

3001 GPX available within 24 hours through TekDirect Call 1-800-426-2200.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488

The 3000 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Configurations

## ORDERING INFORMATION

Our most popular configurations are listed here. For complete ordering information please see configuration guide. Part number 5EA 8297-3 (U.S.) or 5EW 8297-3 (International).

### 3001 SERIES LOGIC ANALYZERS

**3001GPX**
General Purpose and Microprocessor Analysis Instrument ..... TD **$8,995**
**Includes:** 16-CH @ 1 GHz Timing, 80-CH @ 200 MHz timing, 80-CH @ 80 MHz State, 8K Acquisition memory, 4 P6490 Probes, and 720 KB floppy.
**Opt. 1A** – 32PA Performance Analysis Software ..... TD **+$650**
**Opt. 1D** – Delete 20 Channels (60 total) ..... **–$1,000**
**Opt. 2D** – Delete 40 Channels (40 total) ..... **–$2,000**
**Opt. 3D** – Delete 60 Channels (20 total) ..... **–$3,000**
**Opt. 1K** – Add QWERTY Keyboard ..... **+$500**
**Opt. 1M** – Add 64 MB Hard Disk ..... TD **+$840**
**Opt. 1S** – Substitute 32K Acquisition Memory ..... TD **+$2,000**

**3001MPX**
8/16/32-Bit Microprocessor Analysis Instrument ..... **$6,995**
**Includes:** 96-CH state and 9-CH @ 200 MHz timing (req. opt 1H), P6480 state probe w/o leadset, and 720 KB floppy.
**Opt. 1A** – 30DA01 Performance Analysis Software ..... **+$650**
**Opt. 1F** – P6480 General Purpose Probe Adapter ..... **+$450**
**Opt. 1H** – One P6486 Timing Probe ..... **+$1000**
**Opt. 1K** – Add QWERTY Keyboard ..... **+$500**
**Opt. 1L** – One P6486 High Performance Leadset ..... **+$500**
**Opt. 1M** – Add 64 MB Hard Disk ..... **+$840**

**3001HSM**
High Speed Acquisition Instrument ..... **$8,995**
**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 ..... **+$500**
**Opt. 1L** – Add two 400 MHz leadsets ..... **+$1,000**
**Opt. 4L** – Add one 2 GHz leadset ..... **+$1,200**
**Opt. 5L** – Add two 2 GHz leadsets ..... **+$2,400**
**Opt. 1M** – Add 64 MB Hard Disk ..... **+$840**
**Opt. 2A** – Add 18-CH 95 MHz synch mode (req. 1L) ..... **+$750**

### PRECONFIGURED 3002 LOGIC ANALYZERS

**3002CG**
3002C M/F with one 32GPX ..... **$13,995**
**Includes:** 3002C, 14 in. color monitor, 64 MB HDD, 720 KB Floppy, keyboard, one 32GPX, four P6490s & Performance Analysis SW.
**Opt. 1S** – Substitute one 32GPD with 32K Acquisition Memory ..... **+$2,000**

**3002CGG**
3002C M/F with two 32GPXs ..... **$19,990**
**Includes:** 3002C, 14 in. color monitor, 64 MB HDD, 720 KB Floppy, keyboard, two 32GPXs, eight P6490s & Performance Analysis SW.
**Opt. 1S** – Substitute two 32GPDs with 32K Acquisition Memory ..... **+$2,000**

**3002CGH**
3002C M/F with one 32GPX & one 30HSM ..... **$19,995**
**Includes:** 3002C, 14 in. color monitor, 64 MB HDD, 720 KB Floppy, keyboard, one 32GPX, four P6490s , one 30HSM, two P6487s & Performance Analysis SW.
**Opt. 1S** – Substitute one 32GPD with 32K Acquisition Memory ..... **+$2,000**

**3002CGD**
3002C M/F with one 32GPX & one 30DSM ..... **$19,995**
**Includes:** 3002C, 14 in. color monitor, 64 MB HDD, 720 KB Floppy, keyboard, one 32GPX, four P6490s, one 30DSM, two P6109Bs, & Performance Analysis SW.
**Opt. 1S** – Substitute one 32GPD with 32K Acquisition Memory ..... **+$2,000**

**3002CX**
3002C M/F with one 30MPX ..... **$9,995**
**Includes:** 3002C, 14 in. color monitor, 64 MB HDD, 720 KB Floppy, keyboard, one 30MPX, one P6480 & Performance Analysis SW.

**3002CXX**
3002C M/F with two 30MPXs ..... **$14,995**
**Includes:** 3002C, 14 in. color monitor, 64 MB HDD, 720 KB Floppy, keyboard, two 30MPXs, two P6480s, & Performance Analysis SW.

**3002CH**
3002C M/F with one 30HSM ..... **$9,995**
**Includes:** 3002C, 14 in. color monitor, 64 MB HDD, 720 KB Floppy, keyboard, one 30HSM, and two P6487s.

**3002CHH**
**Includes:** 3002C, 14 in. color monitor, 64 MB HDD, 720 KB Floppy, keyboard, two 30HSMs, and four P6487s.

**3002CXH**
3002C with one 30MPX & one 30HSM ..... **$14,995**
**Includes:** 3002C, 14 in. color monitor, 64 MB HDD, 720 KB Floppy, keyboard, one 30MPX, one P6480, one 30HSM, two P6487s & Performance Analysis SW.

**3002CXD**
3002C with one 30MPX & one 30DSM ..... **$14,995**
**Includes:** 3002C, 14 in. color monitor, 64 MB HDD, 720 KB Floppy, keyboard, one 30MPX, one P6480, one P6486, one 30DSM, two P6109Bs, & Performance Analysis SW.

**3002CHD**
3002C with one 30HSM & one 30DSM ..... **$14,995**
**Includes:** 3002C, 14 in. color monitor, 64 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 ..... **$6,000**
**Includes:** 14 in. color monitor, 64 MB hard disk, 720 KB floppy, QWERTY keyboard.

**3002P**
Two-slot System Mainframe W/EL Flat-Panel Display ..... **$6,700**
**Includes:** 9 in. electro-luminescent flat panel display, 64 MB hard disk, 720 KB floppy, and QWERTY keyboard.

**3002E**
Two-slot System Expansion Mainframe ..... **$2,000**
**Includes:** 9 in. & 4 ft. TEKLink cable, mainframe mounting plate.

### INTERNATIONAL POWER PLUGS OPTIONS

**Opt. A1** – Universal Euro: 220 V, 50 Hz ..... **NC**
**Opt. A2** – United Kingdom: 240 V, 50 Hz ..... **NC**
**Opt. A3** – Australian: 240 V, 50 Hz ..... **NC**
**Opt. A4** – North American: 240 V, 60 Hz ..... **NC**
**Opt. A5** – Switzerland: 220 V, 50 Hz ..... **NC**

See Customer Information Section for additional description.

*Continued on next page*

TD
3001 GPX plus Opt. 1A, Opt. 1M, and Opt. 1S available within 24 hours through TekDirect Call 1-800-426-2200.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The 3000 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Configurations

## ORDERING INFORMATION

### 3002 SERIES INSTRUMENT MODULES

**32GPX**
General Purpose & Microprocessor Analysis Module ..... **$7,995**
**Includes:** 8K Acquisition Memory & four P6490 probes and leadsets.
**Opt. 1A** – 32PA Performance Analysis Software ..... **+$650**
**Opt. 2W** – Add one welding connector ..... **+$35**

**32GPD**
General Purpose & Microprocessor Analysis Module ..... **$9,995**
**Includes:** 32K Acquisition Memory & four P6490 probes and leadsets.
**Opt. 1A** – 32PA Performance Analysis Software ..... **+$650**
**Opt. 2W** – Add one welding connector ..... **+$35**

**30MPX**
8/16/32-Bit Microprocessor Analysis Application Module ..... **$6,000**
**Includes:** P6480 state probe w/o leadset.
**Opt. 1A** – 30DA01 Performance Analysis Software ..... **+$650**
**Opt. 1F** – P6480 General Purpose Probe Adapter ..... **+$450**
**Opt. 1H** – One P6486 Timing Probe ..... **+$1000**
**Opt. 1L** – One P6486 high performance leadset ..... **+$500**

**30HSM**
High Speed Application Module ..... **$6,000**
**Includes:** two P6487 with standard leadset.
**Opt. 2A** – 18-CH 95 MHz sync mode adapter (Req Opt. 1L) .. **+$750**
**Opt. 1L** – Add two high performance leadsets ..... **+$1,000**
**Opt. 4L** – Add one 2 GHz leadset ..... **+$1,200**
**Opt. 5L** – Add two 2 GHz leadsets ..... **+$2,400**

**30DSM**
Digitizing Oscilloscope Module ..... **$6,000**
**Includes:** Two P6109B – 10:1 probes.

**WARRANTY-PLUS SERVICE OPTIONS**
Contact your nearest Tektronix representative for available service options.

### ADDITIONAL ACCESSORIES

**P6490**
32GPX Data Acquisition Probe ..... **$1,200**

**P6480**
30MPX State Data Acquisition Probe w/o Lead ..... **$750**
**Opt. 1F** – Add General Purpose Probe Adapter ..... **+$450**

**P6486**
High-Speed Data Acquisition Probe with Standard Leadset for 30MPX ..... **$1,000**
**Opt. 1L** – Add one high performance leadset ..... **+$500**

**P6487**
High-Speed Data Acquisition Probe with Standard Leadset for 30HSM ..... **$1,100**
**Opt. 1L** – Add one high performance leadset ..... **+$500**
**FasTrak** – Micro-Training Package ..... **$450**
**CenTrak** – High-Speed Demo Fixture ..... **$450**

**1200C01**
RS-232 COMM Pack ..... **$750**

**30C02**
GPIB COMM Pack ..... **$850**

### PROTOTYPE DEBUG TOOL SUPPORT PACKAGES

**30RP2**
General Purpose PDT w/ROM Probe ..... **$2,000**
**Opt. 01** – Add 24/28/32-Pin Gen. Purpose ROM Probe Adapter ..... **+$350**
**Opt. 02** – Add 40-Pin DIP ROM Probe Adapter ..... **+$350**

### 32GPX/32GPD MICROPROCESSOR SUPPORT PACKAGES

**32DM02**
8085 Disassembly Software, Socketed 40-Pin DIP ..... **$1,000**

**32DM04**
8086//8088/80C86/80C88 Disassembly Software, Socketed 40-Pin DIP ..... **$1,500**

**32DM06**
80186/80188/80C186/80C188 Disassembly Software, Socketed 68-Pin PGA ..... **$1,500**
**Opt. 1S** – Substitute Socketed 68-Pin PLCC ..... **NC**

**32DM07**
8031/8051 Disassembly Software, Socketed 40-Pin Dip ..... **$1,000**

**32DM08**
80286/80C286 Disassembly Software, Supports Socketed 69-Pin PGA ..... **$1,500**
**Opt. 1S** – Substitute Socketed 68-Pin PLCC ..... **NC**

**32DM09**
80386DX Disassembly Software, Socketed 132-Pin PGA ..... **$2,000**
**Opt. 1S** – Substitute Soldered 132-Pin JEDEC PQFP (AMD Devices Only) ..... **NC**

**32DM10**
80386SX Disassembly Software, Soldered 100-Pin JEDEC PQFP ..... **$2,000**

**32DM12**
80486DX/DX2/486SX/487SX Disassembly Software, Socketed 168-Pin PGA ..... **$2,000**

**32DM13A**
Pentium Disassembly Software, Socketed 273-Pin PGA ..... **$4,000**

**32DM21**
6800/2/8 Disassembly Software, Socketed 40-Pin DIP ..... **$1,000**

**32DM24**
6809/6809E Disassembly Software, Socketed 40-Pin DIP ..... **$1,000**

**32DM27**
68000/68010/68HC000/68HC001/68EC000 Disassembly SW, Socketed 64-Pin DIP (68000/010/HC000) ..... **$1,500**
**Opt. 1S** – Substitute Socketed 68-Pin PGA (68000/010/HC000/HC001) ..... **NC**
**Opt. 2S** – Substitute Socketed 68-Pin PLCC (68EC000) ..... **NC**
**Opt. 3S** – Substitute Socketed 68-Pin PLCC (68HC000) ..... **NC**

**32DM31**
68020/68EC020 Disassembly Software, Socketed 114-Pin PGA (68020) ..... **$2,000**
**Opt. 1S** – Substitute Socketed 100-Pin PGA (68EC020) ..... **NC**
**Opt. 2S** – Substitute Soldered 132-Pin JEDEC CQFP (68020) ..... **NC**

**32DM33**
68030/68EC030 Disassembly Software, Socketed 128-Pin PGA ..... **$2,000**
**Opt. 1S** – Substitute Soldered 132-Pin JEDEC CQFP ..... **NC**

*Continued on next page*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The 3000 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Configurations



## ORDERING INFORMATION

**32DM34**
68040/EC040/LC040 Disassembly Software, Socketed 179-Pin PGA ..... **$2,000**

**32DM41**
Z80 Disassembly Software, Supports Socketed 40-Pin DIP ..... **$1,000**

**32DM81**
8096/C196 Disassembly Software, Socketed 68-Pin PGA ..... **$1,500**
**Opt. 1S** – Substitute 68-Pin PLCC ..... **NC**

**32DM91**
68HC11 Disassembly Software, Socketed 52-Pin PLCC ..... **$1,000**

**32DM92**
68302 Disassembly Software, Socketed 132-Pin PGA ..... **$1,500**
**Opt. 1S** – Substitute Soldered 132-Pin JEDEC CQFP/PQFP ..... **NC**

**32DM93**
68331/68332 Disassembly Software, Soldered 132-Pin JEDEC PQFP/CQFP ..... **$2,000**
**Opt 1A** – Add Preconfigured Interface for Motorola M68331/68332EVS Evaluation Board ..... **$750**

**32DM96**
68HC16 Disassembly Software, Soldered 132-Pin JEDEC PQFP/CQFP ..... **$1,500**

**32DM101**
DSP56000/1/2 Disassembly Software, Socketed 88-Pin PGA (56000/1) ..... **$2,000**
**Opt. 1S** – Substitute Soldered 132-Pin JEDEC CQFP (56000/1) ..... **NC**
**Opt. 2S** – Substitute Socketed 132-Pin PGA (56002) ..... **NC**
**Opt. 3S** – Substitute Soldered 132-Pin CQFP/PQFP (56002) ..... **NC**

**32DM122**
TMS32020/TMS320C25/TMS320C26 Disassembly Software, Socketed 68-Pin PGA ..... **$2,000**
**Opt. 1S** – Substitute Socketed 68-Pin PLCC ..... **NC**

**32DM123**
TMS320C30/31 Disassembly Software, Socketed 181-Pin PGA ..... **$2,000**
**Opt. 1S** – Substitute soldered 132-Pin PLCC ..... **NC**

**32DM921**
TMS320C40 Disassembly Software, Socketed 181-Pin PGA ..... **$2,700**

**32DM923**
88110 Disassembly Software, Socketed 300-Pin PGA ..... **$2,700**

**32DM924**
6805 Disassembly Software ..... **$545**

**32DM925**
R3051/52/81 Disassembly Software, Socketed 84-Pin PGA ..... **$1,500**

**32PA**
32GPX Performance Analysis Software ..... **$650**

**30DA01**
30MPX Performance Analysis Software ..... **$650**

### 30MPX MICROPROCESSORS SUPPORT PACKAGES

**30DM04**
8086/88 SW and Probe Adapter, DIP Socketed ..... **$1,150**
**Opt. 1S** – Substitute DIP Soldered ..... **NC**

**30DM06**
80186/188 SW and Probe Adapter PGA Socketed ..... **$1,150**
**Opt. 1S** – Substitute PLCC Socketed ..... **+$500**
**Opt. 2S** – Substitute LCC Socketed ..... **+$400**
**Opt. 3S** – Substitute PLCC Soldered ..... **+$500**

**30DM07**
8031/51 SW and Probe Adapter, DPI Socketed ..... **$800**

**30DM08**
80286 SW and Probe Adapter, PGA Socketed ..... **$1,150**
**Opt. 1S** – Substitute PLCC Socketed ..... **+$500**
**Opt. 2S** – Substitute LCC Socketed ..... **+$400**
**Opt. 3S** – Substitute PLCC Soldered ..... **+$500**

**30DM09A**
80386 SW and Probe Adapter, PGA Socketed ..... **$1,800**

**30DM10**
80386SX, 80376 SW and Probe Adapter, 3M PQFP ..... **$1,800**
**Opt. 3S** – Substitute AMP PQFP Socketed ..... **+$225**

**30DM27**
68000/10 SW and Probe Adapter, DIP Socketed ..... **$1,150**
**Opt. 1S** – Substitute DIP Soldered ..... **NC**
**Opt. 2S** – Substitute PGA Socketed ..... **NC**
**Opt. 3S** – Substitute PLCC Socketed ..... **+$800**
**Opt. 4S** – Substitute PLCC Soldered ..... **+$500**

**30DM31**
68020 SW and Probe Adapter, PGA Socketed ..... **$1,800**

**30DM33**
68030 SW and Probe Adapter, PGA Socketed ..... **$1,800**

**30DM41**
Z80 (8 MHz) SW and Probe Adapter, DIP Socketed ..... **$800**
**Opt. 1S** – Substitute DIP Soldered ..... **NC**

**30DM41F**
Z80 (20 MHz) SW and Probe Adapter, DIP Socketed ..... **$1,150**

**30DM91**
68HC11 SW and Probe Adapter, 52-Pin PLCC Socketed and Soldered ..... **$800**

**30DM92**
68302 SW and Probe Adapter, PGA Socketed ..... **$1,150**

**30DM93**
68331/332 SW and Probe Adapter, PQFP ..... **$1,800**

**30DM993**
CPU 32 SW and Probe Adapter ..... **$1,800**

**30DM101**
56000/1 SW and Probe Adapter, PGA Socketed ..... **$1,150**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

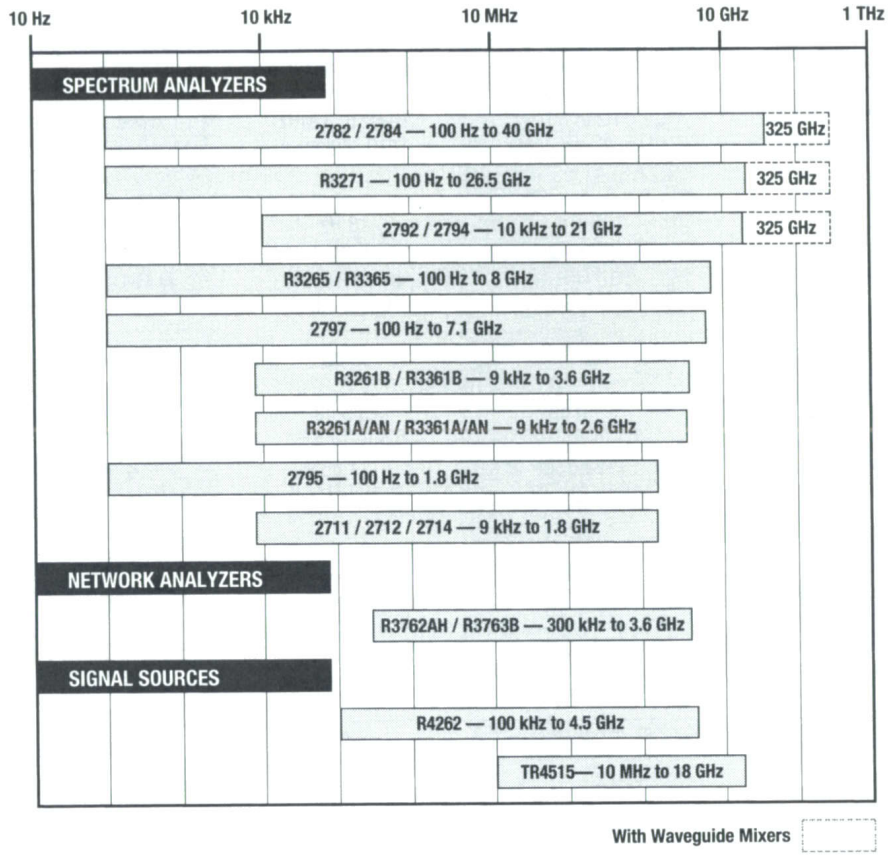
GPIB IEEE-488 The 3000 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Microwave and RF Products

## Tektronix Microwave and RF Capabilities Cover A Broad Spectrum!

Tektronix offers a complete line of microwave products: Spectrum analyzers, with a variety of performance enhancing features, covering a frequency range from 100 Hz to 40 GHz (325 GHz with waveguide mixers); Network analyzers, with a choice of internal or external test sets, covering a measurement range from 300 kHz to 3.6 GHz; Microwave signal sources, with exceptionally low phase noise and versatile sweep capability, providing signal output from 100 kHz to 18 GHz; and to complete your measurement system, ancillary equipment including waveguide mixers, tracking generators, antennas and RF probes, application and utility software, and more. The chart below provides a guide to the performance range covered by Tektronix Microwave Products. For further information on specific products, refer to the following catalog pages.

### MICROWAVE AND RF PRODUCTS PERFORMANCE CHART




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# Microwave and RF Products

## SPECTRUM ANALYZER SELECTION GUIDE

### FULL RANGE MICROWAVE SPECTRUM ANALYZERS

| Specifications | 2784 | 2782 | R3271 | 2794 | 2792 |
|---|---|---|---|---|---|
| Frequency Range | 100 Hz to 40 GHz | 100 Hz to 33 GHz | 100 Hz to 26.5 GHz | 10 kHz to 21 GHz | 10 kHz to 21 GHz |
| Frequency Measurement Accuracy | ±145 Hz @ 20 GHz CF | ±145 Hz @ 20 GHz CF | ±210 Hz @ 10 GHz CF | ±18 Hz @ 10 GHz CF | ±1010 Hz, Opt. 03 @ 10 GHz CF |
| Resolution BW Range | 3 Hz to 10 MHz 1, 3, 10 sequence | 3 Hz to 10 MHz 1, 3, 10 sequence | 10 Hz to 3 MHz 1, 3, 10 sequence | 10 Hz to 3 MHz 1, 10 sequence | 1 kHz to 3 MHz 1, 10 sequence |
| Residual FM | ≤1 Hz | ≤1 Hz | 3 Hz | ≤3 Hz | ≤12 Hz |
| Phase Noise | –105 dBc/Hz @ 20 GHz CF, 10 kHz offset | –105 dBc/Hz @ 20 GHz CF, 10 kHz offset | –102 dBc/Hz @ 10 GHz CF, 10 kHz offset | –94 dBc/Hz @ 10 GHz CF, 10 kHz offset | –94 dBc/Hz @ 10 GHz CF, 10 kHz offset |
| CRT Display Range | 100 dB | 100 dB | 100 dB | 90 dB | 80 dB |
| Frequency Response | ±5.0 dB | ±4.5 dB | ±4.0 dB 5.4 to 26.5 dB | ±3.5 dB 5.4 to 18 GHz | ±4.0 dB 5.4 to 18 GHz |
| Sensitivity | –125 dBM @ 20 GHz CF | –125 dBM @ 20 GHz CF | –123 dBM @ 10 GHz CF | –111 dBM @ 10 GHz CF | –94 dBM @ 10 GHz CF |
| Environmental | MIL-T-28800C Class 3 | MIL-T-28800C Class 3 | MIL-T-28800 Class 5 | MIL-T-28800C Class 3 | MIL-T-28800C Class 3 |
| Weight | 20 kg (44 lb.) | 20 kg (44 lb.) | 22 kg (48.5 lb.) | 22.2 kg (48 lb.) | 21.3 kg (46 lb.) |
| **Features / Options** | | | | | |
| Intelligent Markers | 2 | 2 | 8 | 2 | 2 |
| Tracking Generator | No | No | No | Yes, external TR503 | Yes, external, TR503 |
| Card Reader | No | No | Yes | No | No |
| Preamplifier | No | No | No | No | No |
| Quasi Peak Detector | No | No | Yes | No | No |
| CISPR Bandwidths | No | No | Yes | No | No |
| Frequency Counter | Yes | Yes | Yes | Yes | Yes |
| Analog Display | Yes | Yes | Yes | Yes | Yes |
| 75Ω Input | No | No | No | Yes, Opt. 07 | Yes, Opt. 07 |
| AM/FM Demodulator | No | No | Yes | No | No |
| GPIB | Yes, 2 port | Yes, 2 ports | Yes | Yes | Yes |
| RS-232 | No | No | No | No | No |
| Page | 186 | 186 | 200 | 193 | 193 |

# Microwave and RF Products



## SPECTRUM ANALYZER SELECTION GUIDE

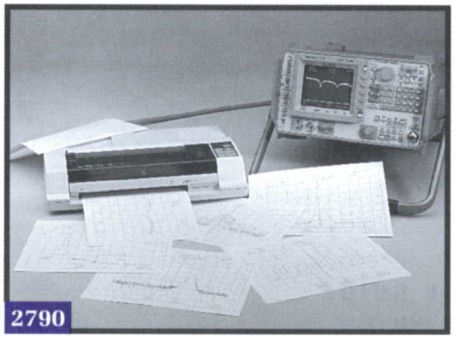
| | QUASI MICROWAVE SPECTRUM ANALYZERS | | | | RF / VHF / UHF SPECTRUM ANALYZERS | | | |
|---|---|---|---|---|---|---|---|---|
| **Specifications** | **R3265 R3365** | **2797** | **R3261B R3361B** | **R3261A/AN R3361A/AN** | **2795** | **2712** | **2714** | **2711** |
| Frequency Range | 100 Hz to 8 GHz | 100 Hz to 7.1 GHz | 9 kHz to 3.6 GHz | 9 kHz to 2.6 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 | ±106 Hz @ 5 GHz CF | ±11 Hz, Opt. 02 @ 5 GHz CF | ±25 Hz @ 1 GHz CF | ±25 Hz @ 1 GHz CF | ±6 Hz @ 1 GHz CF | ±510 Hz @ 1 GHz CF | ±510 Hz @ 1GHz CF | ±15 kHz @ 1 GHz CF |
| Resolution BW Range | 10 Hz to 3 MHz 1, 3, 10 sequence | 10 Hz to 3 MHz 1, 10 sequence | 30 Hz to 1 MHz 1, 3, 10 sequence | 30 Hz to 1 MHz 1, 3, 10 sequence | 10 Hz to 3MHz 1, 3 sequence | 300 Hz to 5 MHz 1, 3, 10 sequence | 300 Hz to 5MHz 1, 3, 10 sequence | 3 kHz, 30 kHz, 300 kHz, 5 MHz |
| Residual FM | ≤3 Hz | ≤3 Hz | ≤20 Hz | ≤20 Hz | ≤3 Hz | ≤100 Hz | ≤100 Hz | ≤2 kHz |
| Phase Noise | –108 dBc/Hz @ 5 GHz CF, 10 kHz offset | –103 dBc/Hz @ 5 GHz CF, 10 kHz offset | –105 dBc/Hz @ 1 GHz CF, 20 kHz offset | –105 dBc/Hz @ 1 GHz CF, 20 kHz offset | –105 dBc @ 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 | 100 dB | 90 dB | 80 dB | 80 dB | 90 dB | 80 dB | 80 dB | 80 dB |
| Frequency Response | ±1.5 dB | ±2.5 dB | ±1 dB | ±0.5 dB | ±1.5 dB | ±1.5 dB | ±1.5 dB | ±1.5 dB |
| Sensitivity | –135 dBm @ 5 GHz CF | –127 dBm @ 5 GHz CF | –128 dBm @ 1 GHz CF | –128 dBM @ 1 GHz CF | –131 dBm @ 1 GHz CF | –127 dBm, –139 dBm w/ Preamp @1 GHz CF | –127 dBm, –139 dBm w/ Preamp @1 GHz CF | –117 dBm, –129 dBm w/ Preamp @1 GHz CF |
| Environmental | MIL-T-28800 Class 5 | MIL-T-28800 Class 3 | MIL-T-28800 Class 5 | MIL-T-28800 Class 5 | MIL-T-28800 Class 3 | MIL-T-28800 Class 5 | MIL-T-28800 Class 5 | MIL-T-28800 Class 5 |
| Weight | 22 kg (48.5 lb.) | 20.8 kg (45 lb.) | 15 kg (33.1 lb.) | 15 kg (33.1 lb.) | 19.44 kg (42 lb.) | 9.5 kg (21 lb.) | 9.5 kg (21 lb.) | 9.5 kg (21 lb.) |
| **Features / Options** | | | | | | | | |
| Intelligent Markers | 8 | 2 | 2 std, 8 Opt. 70 | 2 std, 8 Opt. 70 | 2 | 2 | 2 | 2 |
| Tracking Generator | Yes, R3365 | Yes, external TR503 | Yes, R3361B | Yes, R3361A, R3361AN | Yes, external TR503 | Yes, Opt. 04 internal, Opt. 05 external | Yes, Opt. 05 external | Yes, Opt. 04 internal, Opt. 05 external |
| Card Reader | Yes | No | Yes | Yes | No | No | No | No |
| Preamplifier | No | No | No | No | No | Yes | Yes | Yes |
| Quasi Peak Detector | Yes | No | Yes | Yes | No | Yes, Opt, 12 | No | No |
| CISPR Bandwidths | Yes | No | Yes | Yes | No | Yes, Opt. 12 | No | No |
| Frequency Counter | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Opt. 02 |
| Analog Display | No | Yes | No | No | Yes | Yes | Yes | Yes |
| 75 Ohm Input | No | Yes, Opt. 07 | No | Yes, R3261AN, R3361AN | Yes, Opt. 07 | Yes, external matching pad | Yes | Yes, external matching pad |
| AM/FM Demodulator | Yes | No | Yes | Yes | No | Yes | Yes | Yes |
| GPIB | Yes | Yes | Yes | Yes | Yes | Yes | Yes, Opt. 03 (N/C) | Yes, Opt. 03 |
| RS-232 | No | No | Yes, Opt. 02 | Yes, Opt. 02 | No | Yes, Opt. 08 (N/C) | Yes Opt. 08 (N/C) | Yes, Opt. 08 |
| Page | 203 | 193 | 216 | 216 | 193 | 208 | 212 | 208 |

# Microwave and RF Products

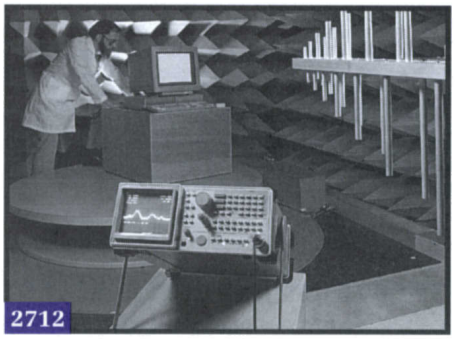
*Complete spectrum analysis to cover your measurement needs*

**APPLICATIONS**

- Bio-Medical
- Cable TV
- Education
- EMC
- Design and Development
- Manufacturing Test
- Research
- Satellite Communication
- Service
- Wireless Communications




Tektronix 2790 Series Spectrum Analyzers provide convenience features usually not available at the affordable prices of these products. Shown above, a GPIB plotter provides a permanent results record while the spectrum analyzer continues to acquire new signals. Buffer memory storage permits simultaneous operation of the plotter and spectrum analyzer.




Tektronix spectrum analyzers offer solutions for many 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 '92, and other EMC requirements.

## Tektronix Microwave and RF Products – At Home Where Your Measurements Are!

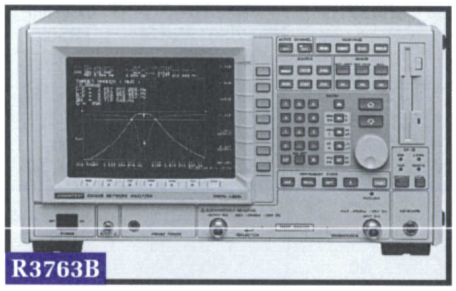
Tektronix Microwave and RF Products are versatile performers – they're at home wherever your measurements are – in the lab, in the field, or on the manufacturing floor.

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've only shown 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.




Tektronix 2712 Spectrum Analyzer provides the ideal platform for learning and demonstrating spectrum analyzer concepts. It features full performance, programmability, and an intuitive user interface at an attractive price.




Built-in test set and controller functions allow the R3763B Network Analyzer to provide a compact solution to your testing needs.

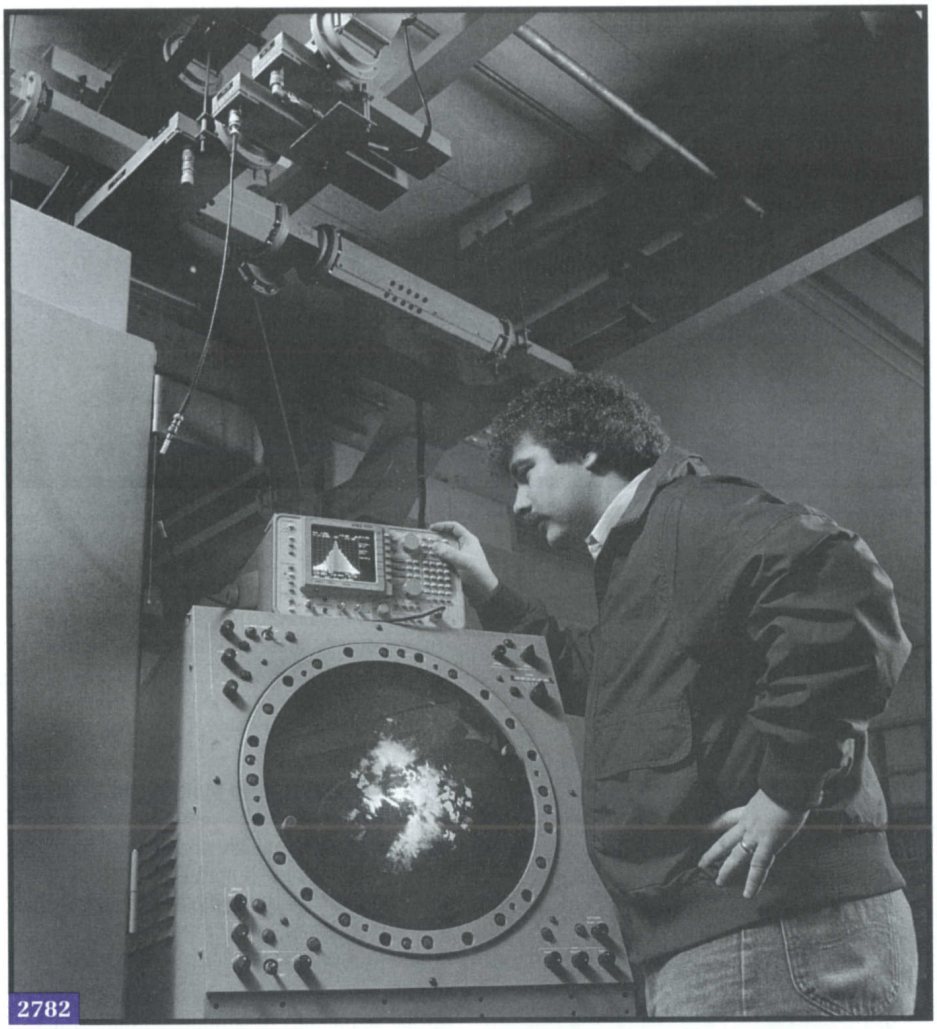



Easy to use and easy to move, the rugged and portable Tektronix 2790 Series Spectrum Analyzers are just right for manufacturing testing.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

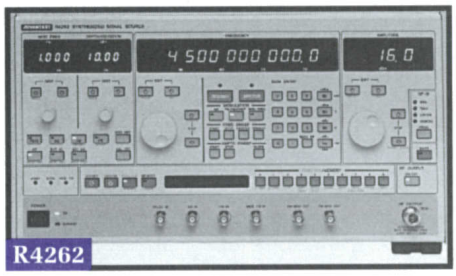
# Microwave and RF Products





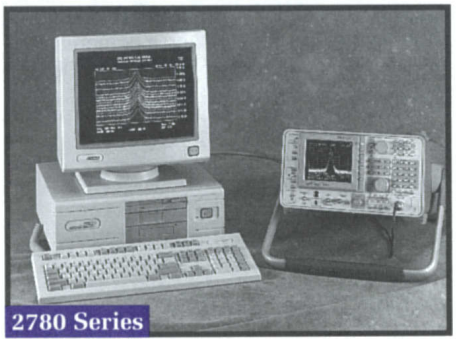

### 2782

The small size and rugged design to withstand environmental extremes equips the Tektronix 2782 for providing unmatched microwave performance for applications such as radar performance verification.



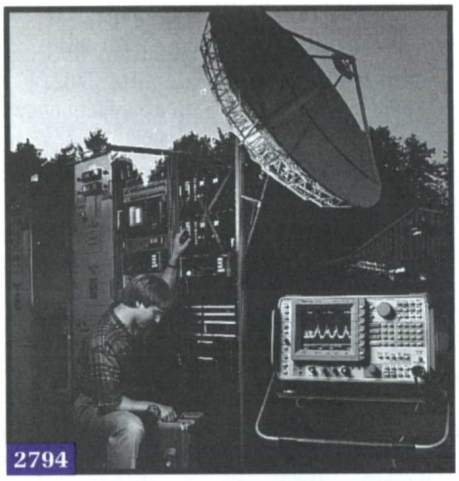

### R4262

Covering a wide frequency range, the R4262 Synthesized Signal Source offers outstanding signal purity and performance. Frequency settings can be made with 0.1 Hz resolution with –137 dBc/Hz (at 1 GHz) phase noise.




### 2780

With powerful microwave measurements including 3 Hz to 10 MHz resolution and 40 GHz coaxial input capability, the Tektronix 2780 Series Spectrum Analyzers also provide advanced software-based capabilities. A time flow "waterfall" spectrum display is shown on the computer monitor.




### 2794

A frequency range of 10 kHz through 325 GHz makes the Tektronix 2794 ideal for satellite communication system installation and maintenance.




### 2714

Cable TV proof-of-performance measurements in the field have never been easier. With the 2714 Cable TV Spectrum Analyzer, all commonly needed cable TV spectrum measurements can be preconfigured for simple push-button execution and data collection. High portability allows the 2714's 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

## Premium Microwave Performance in a Ruggedized Portable with Color Display

*For the most demanding applications in the field or lab: Digital Microwave Radio, Satellite Communication, Microwave and RF Source Design, Avionics, Millimeter Wave R&D.*

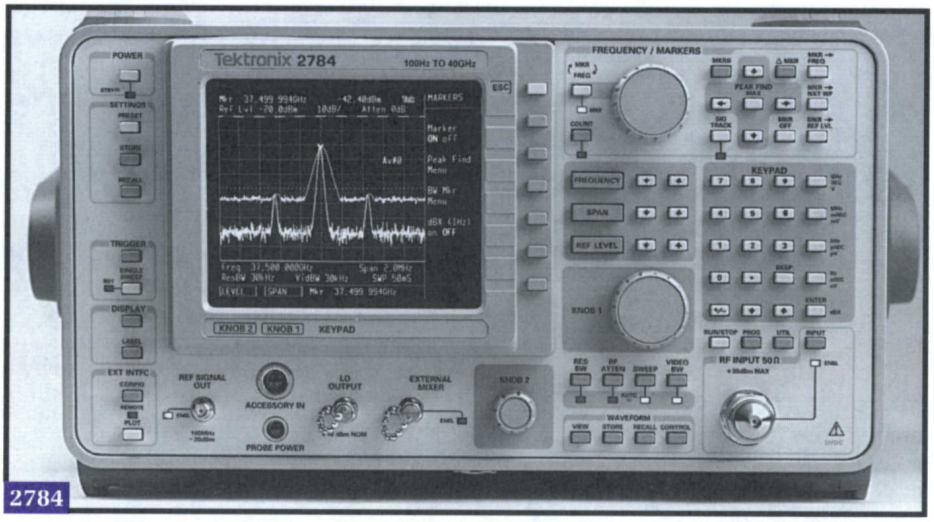
**2782/2784**

- 100 Hz to 40 GHz (33 GHz, 2782) Coaxial Frequency Range
- External Waveguide Mixer Support to 325 GHz
- Full-range Sweep from 0 Hz to 40 GHz (33 GHz, 2782)
- 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
- Mixer Input Level Decoupling from RF Attenuator by up to 30 dB
- Intelligent Markers/ Signal Processing: Search, Sort, and Mark CW, Pulse, or All Signals
- Exclusive 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 40K of NVRAM
- Store up to 20 Front-Panel Key Sequences
- Store up to 20 Waveforms with Readout Information
- Store up to 20 Instrument States

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488

The 2782, 2784 comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.




### 2782/2784 Spectrum Analyzers

The Tektronix 2782 and 2784 offer leadership measurement performance, not just through minor enhancements, but by truly extending the state of the art. For example, the 40 GHz (33 GHz, 2782) coaxial input gives you more frequency range without resorting to external mixers. And you can see it all with the full-range 0 Hz to 40 GHz (33 GHz, 2782) sweep.

Whatever you need to measure, from close-in phase noise to demodulated pulsed RF, the 2782 and 2784 provide 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 (33 GHz 2782) and external mixers are used, the 2782 and 2784 provide as much as 25 dB better measurement sensitivity than ever before possible. Set-up 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 2782 and 2784 are 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.

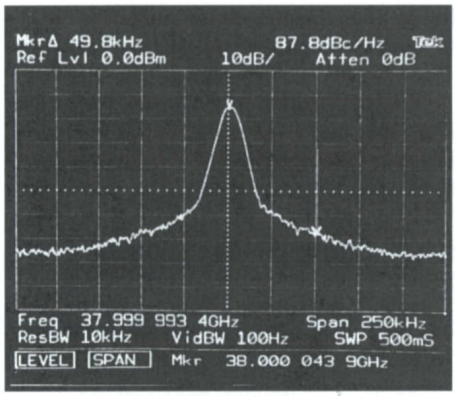
Additionally, you can store front-panel keystroke sequences to simplify complex measurements, or even create single-key executable macros for the most complex applications.

# Spectrum Analyzers

## Premium Microwave Performance in a Ruggedized Portable with Color Display

**2782**
**2784**






### HIGHLY EFFICIENT SYSTEMS COMPONENT

With full programmability and two GPIB ports, the 2782 and 2784 offer a new level in systems convenience and efficiency. For example, the 2782 and 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 2782 and 2784. And with its small size, the 2782 and 2784 provide more performance in less rack space than any other spectrum analyzer on the market.

## Characteristics

Except as noted, the following tables of electrical characteristics and features apply after a 30-minute warm-up.

### ELECTRICAL CHARACTERISTICS

Direct coaxial input for the 2782 applies to 33 GHz. All performance specifications from 33 GHz to 40 GHz are for the 2784 only.

### FREQUENCY RELATED

**Frequency Range –** 100 Hz to 40 GHz in coax, to 325 GHz with external waveguide mixers.

**Frequency Readout Accuracy –**
$\pm[F(RE + 10^{-10})] + D + M$
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 = L.O. 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 = L.O. harmonic.
LSD = least significant digit.

**Frequency Reference Accuracy –**
Aging $<1 \times 10^{-6}$/year $<7 \times 10^{-9}$/day.
Drift $<5 \times 10^{-7}$ 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 peak-to-peak over one second; >2 MHz span, 25N kHz peak-to-peak over 500 ms.
Drift (after one hour warm up): ≤2 MHz span 5N kHz/minute of sweep time, >2 MHz span 5N kHz/minute of sweep time (Typical).

**Notes:** N=L.O. Harmonic. Errors due to drift are not cumulative from sweep to sweep.

**2782 and 2784 Resolution Filter Bandwidths –**

| (Specified) 6 dB | (Typical) 3 dB | (Typical) Random Noise | (Typical) Impulse |
|---|---|---|---|
| 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 attn.) –**

| 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 |

2782
2784

# Spectrum Analyzers

## Premium Microwave Performance in a Ruggedized Portable with Color Display

**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 correcting temp.
Accuracy, Lin, ±5%.
Accuracy, 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 attn., and after 2 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 | (Typical) <–65 dBc | (Typical) <–55 dBc |

**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

## Premium Microwave Performance in a Ruggedized Portable with Color Display

**2782**
**2784**



**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: 40K of RAM.
Instrument Calibration Data: Separate EEPROM.

**Inputs and Outputs:**

**RF Input** – Frequency Range: 100 Hz to 33 GHz (2782), 100 Hz to 40 GHz (2784). 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 Attn | 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 Watts peak, 1 µs and <0.005 duty factor with ≥50 dB attenuation.
DC: 0 volts, <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 Horiz and Vert: 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: +5V ±5% @ 100 mA max
pin 2: ground
pin 3: –15V ±5% @100 mA max
pin 4: +15V ±5% @ 100 mA max

**Power Requirements** –
Input Voltage: 90 to 132 VAC, 47 to 440 Hz, 180 to 250 VAC, 47 to 63 Hz.
Power: At 115 VAC, 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: 15,000 ft. Nonoperating: 40,000 ft.

**Vibration** – Resonant search in all axes from 5 to 15 Hz with displacements up to 0.060 in., 15 to 25 Hz with displacements up to 0.040 in., and 25 to 55 Hz with displacements up to 0.020 in..

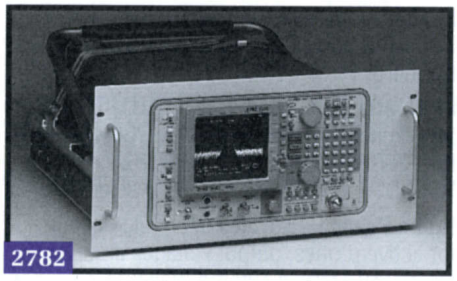
**Shock** – Operating and Non-Operating: Tested to withstand three shocks of 30 g, one-half sine, 11 ms duration each direction along each major axis.

**Transit Drop** – Tested to withstand eight-inch drops, one per each of six faces and eight corners.

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2784

# Spectrum Analyzers

## Premium Microwave Performance in a Ruggedized Portable with Color Display




*Convenient rackmounting with the rack adapter or Option 30.*

**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.




*Microwave Chip Research and Development: The 2780 Series is shown here monitoring microwave component research and development in a lab clean room.*

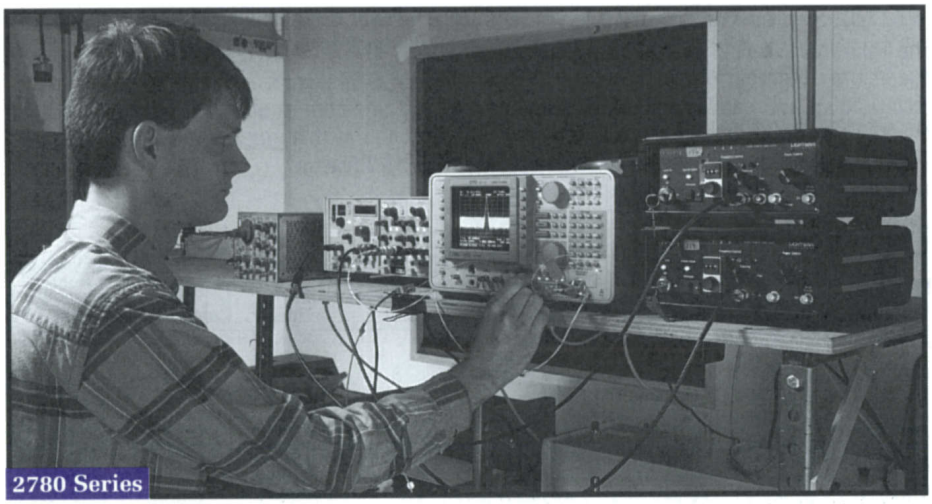
**PHYSICAL CHARACTERISTICS**
**Weight –** 44 lb. (20 kg); with standard accessories, cover, and no manuals.

**Dimensions –** 8.05 x 12.90 x 18.59 in. (without front cover, handle, or feet) (204.47 x 327.66 x 472.19 mm); 8.05 x 15.75 x 21.64 in. (with front cover, handle folded back, and feet) (213.36 x 400.05 x 549.11 mm); 8.05 x 15.75 x 24.75 in. (with front cover, handle fully extended, and feet) (204.47 x 400.05 x 624.28 mm).

**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

## Premium Microwave Performance in a Ruggedized Portable with Color Display




*Opto-Electronic Research and Development: The 2780 Series finds wide use in opto-electric modulator-demodulator design and development.*

## ORDERING INFORMATION

**2784**
Microwave Spectrum Analyzer ..... **$71,500**

**2782**
Microwave Spectrum Analyzer ..... **$63,500**
**Includes:** N-male to BNC-female adapter (103-0045-00); N to Planar Crown adapter (131-4329-00); Cable, 50 Ω SMA (012-0649-00); Line fuses: 4 A, 125 VAC (159-0319-00); 4 A, 250 VAC (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 & Performance Verification Manual (070-8067-00).

**Opt. 04 –** IF output tailored for 3050 Series DSP System ..... **+$2,500**
**Opt. 16 –** 49X/275X/279X Series GPIB Language ..... **NC**
**Opt. 18 –** WM782 Bands Q, U, V, E, and W (frequency coverage from 33-110 GHz) ..... **+$14,125**
**Opt. 19 –** WM782 Bands A, U, E, F, G, and J (frequency coverage from 26-325 GHz) ..... **+$22,870**
**Opt. 20 –** Utility Software for PC, includes GPIB card ..... **+$1,530**
**Opt. 30 –** Rackmount adapter (19 in) ..... **+$525**

**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1** – Universal Euro 220 V, 50 Hz ..... **NC**
**Opt. A2** – United Kingdom 240 V, 50 Hz ..... **NC**
**Opt. A3** – Australian 240 V, 50 Hz ..... **NC**
**Opt. A4** – North American 240 V, 60 Hz ..... **NC**
**Opt. A5** – Switzerland 220 V, 50 Hz ..... **NC**
See Customer Information Section for additional description.

**Opt. B1 –** Two Service Manuals prepared to the component-level ..... **+$250**
**Opt. B2 –** Complete set of manuals, including Service Manual ..... **+$350**

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M3 –** 5 Year Calibration and Repair Protection
2782 ..... **+$6,350**
**Opt. M7 –** Calibration Service
2784 ..... **+$1,980**
2782 ..... **+$1,835**
**Opt. M9 –** Repair Protections
2784 ..... **+$1,890**
2782 ..... **+$1,745**

**SOFTWARE**
See Page 226 for complete description.
**2782/2784 PC Utility –** Order S26UT00 ..... **$1,400**

**RECOMMENDED ACCESSORIES**
See page 424 of Accessories section for complete selection information.

**PROBES**
**Active –**
900 MHz, 1.5 pF/100 KΩ. Order P6201 ..... **$1,550**
4 GHz, 0.4 pF/100 KΩ, (Requires 1103 Power Supply) Order P6217 ..... **$3,495**
Power Supply. Order 1103 ..... **$600**

**CAMERAS/PLOTTERS**
**Camera –** Low cost. Order C-9 Opt. 1A & Opt. 20 ..... **$875**
**Plotter –** Four color. Order HC100 Opt. 01 ..... **$1,260**
**Cart –** Order K218 ..... **$745**

**GPIB Cables –**
0.5 m. Order 012-1282-00 ..... **$150**
1 m. Order 012-0991-01 ..... **$170**
2 m. Order 012-0991-00 ..... **$170**
4 m. Order 012-0991-02 ..... **$260**
**Waveguide Mixer Cables –** Use with WM782 Waveguide Mixers. Order 012-1346-00 ..... **$45**

**GPIB CARDS**
**PC-GPIB Card –** IBM PC, AT, and compatibles. Order S3FG210 ..... **$395**
**AT-GPIB Card –** IBM AT Bus (high speed card). Order S3FG220 ..... **$495**
**MC-GPIB Card –** IBM PS/2 with Microchannel Bus. Order S3FG230 ..... **$495**

**ADDITIONAL ACCESSORIES**
**EMC Ancillary Devices –** See Page 223.
**Rackmount Adapter –** Order 016-1019-00 ..... **$825**
**Optical to Electrical Converter –** Order SA-42 ..... **$3,995**
**Service Manual –** Module Level. Order 070-8244-00 ..... **$250**
**Transit Case –** Order 016-0658-00 ..... **$990**
**Soft Side Case –** Order 016-0659-00 ..... **$155**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The 2782, 2784 comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

**WM782 SERIES**

# Waveguide Mixers

*High performance waveguide mixers for 2782 and 2784 spectrum analyzers.*

**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
- Precision Gold-Plated Brass Body

**APPLICATIONS**

- Spectrum Analysis for Millimeter Wave Frequencies
- Swept Frequency Response Measurements
- Power Level Measurements for Millimeter Wave Frequencies
- Harmonic Generator/ Frequency Up/Down Conversion

## WM782 Series Waveguide Mixers

The Tektronix WM782 Series of Waveguide Mixers are a high-performance, broadband, zero DC bias, anti-parallel dual-diode type mixers for use with the Tektronix 2782 and 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.

The WM782 mixers are of uniform size and shape, and consist of a gold-plated solid brass core with a tough protective outer shell of LEXAN plastic.

## 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 2782 and 2784 Spectrum Analyzer in 1 kHz resolution bandwidth.*
**2 Maximum amplitude variation across each waveguide mixer band using a 2782 and 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 (cm) | Weight (g) |
|---|---|---|---|---|
| WM782A<br>26 to 40 GHz | WR-28 | UG-599/U | 9.525x2.54x4.32<br>3.75x1.00x1.70 | 113.4<br>4.0 |
| WM782Q<br>33 to 50 GHz | WR-22 | UG-383/U | 8.89x2.54x4.32<br>3.50x1.00x1.70 | 113.4<br>4.0 |
| WM782U<br>40 to 60 GHz | WR-19 | UG-383/U-M | 8.89x2.54x4.32<br>3.50x1.00x1.70 | 113.4<br>4.0 |
| WM782V<br>50 to 75 GHz | WR-15 | UG-385/U | 8.89x2.54x4.32<br>3.50x1.00x1.70 | 113.4<br>4.0 |
| WM782E<br>60 to 90 GHz | WR-12 | UG-387/U | 8.89x2.54x4.32<br>3.50x1.00x1.70 | 113.4<br>4.0 |
| WM782W<br>75 to 110 GHz | WR-10 | UG-387/U-M | 8.89x2.54x4.32<br>3.50x1.00x1.70 | 113.4<br>4.0 |
| WM782F *1<br>90 to 140 GHz | WR-08 | UG-387/U-M | 8.89x2.54x4.32<br>3.50x1.00x1.70 | 113.4<br>4.0 |
| WM782D *1<br>110 to 170 GHz | WR-06 | UG-387/U-M | 8.89x2.54x4.32<br>3.50x1.00x1.70 | 113.4<br>4.0 |
| WM782G *1<br>140 to 220 GHz | WR-05 | UG-387/U-M | 8.89x2.54x4.32<br>3.50x1.00x1.70 | 113.4<br>4.0 |
| WM782J 220 to 325 GHz | WR-03 | | | |

**1 All mixers have with Standard UG-xxx/U-type flanges. MIL-F-3022-type flanges available in F, D, & G bands.*

## ORDERING INFORMATION

**WM782 Waveguide Mixers and Sets**

**26 to 40 GHz** – Order WM782A ..... **$2,257.45**
**33 to 50 GHz** – Order WM782Q ..... **$2,627.75**
**40 to 60 GHz** – Order WM782U ..... **$3,116.50**
**50 to 75 GHz** – Order WM782V ..... **$3,536.25**
**60 to 90 GHz** – Order WM782E ..... **$3,841**
**75 to 110 GHz** – Order WM782W ..... **$3,938.75**
**90 to 140 GHz** – Order WM782F ..... **$4,220.15**
**110 to 170 GHz** – Order WM782D ..... **$5,881.10**
**140 to 220 GHz** – Order WM782G ..... **$5,240**
**220 to 325 GHz** – Order WM782J ..... **$7,768.25**
**26 to 60 GHz Set** – Includes WM782A and WM782U. Order WM7826 ..... **$5,117.50**
**26 to 90 GHz Set** – Includes WM7826 plus WM782E. Order WM7827 ..... **$8,958.50**
**26 to 140 GHz Set** – Includes WM7827 plus WM782F. Order WM7828 ..... **$13,178.65**
**26 to 220 GHz Set** – Includes WM7828 plus WM782G. Order WM7829 ..... **$18,418.65**
**33 to 75 GHz Set** – Includes WM782Q and WM782V. Order WM78210 ..... **$5,865**
**33 to 110 GHz Set** – Includes WM78210 plus WM782W. Order WM78211 ..... **$9,614**
**33 to 170 GHz Set** – Includes WM78211 plus WM782D. Order WM78212 ..... **$15,214.50**
**Cable** – Required for use. Order 012-1346-00 ..... **$95**

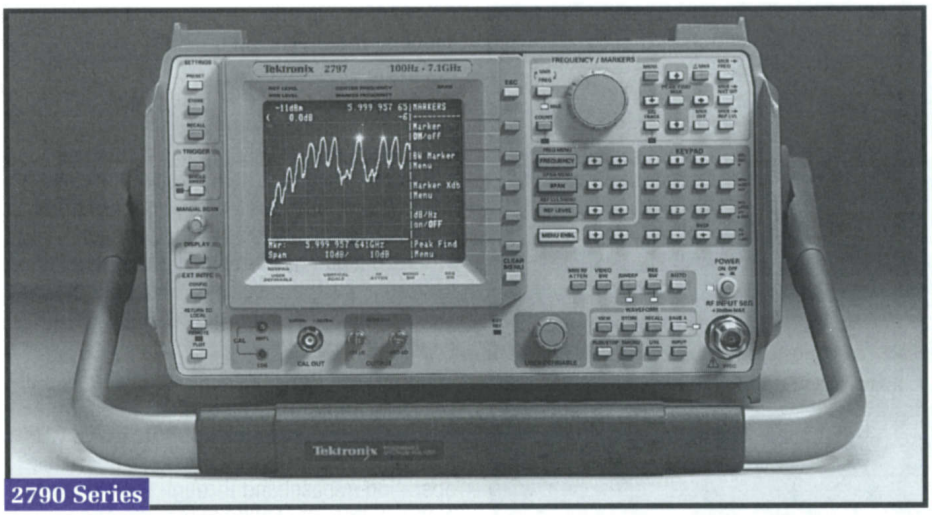
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Spectrum Analyzers

## Portable, Rugged with Accessible Performance

**2794** **2797**
**2792** **2795**






2790 Series

### 2790

The Tektronix 2790 Series Spectrum Analyzers are proud successors to the venerable Tektronix 490 Series which has proven itself in years of reliable, rugged service around the world. All units provide full IEEE-488 (GPIB) programmability, which means you can change front-panel settings, read data from the CRT display, and send waveforms from internal digital source memory to other GPIB devices. Frequency ranges of the instruments are as follows:

2794: 10 kHz to 325 GHz
2792: 10 kHz to 26.5 GHz
2797: 100 Hz to 7.1 GHz
2795: 100 Hz to 1.8 GHz

Built to rugged MIL-T-28800C environmental specifications, these units can withstand transportation shock and vibration to a remote site. Or they can simply be moved from the engineering lab to the production floor with complete confidence in measurement accuracy.

A wide array of price/performance alternatives are available. If you need 10 Hz resolution for an exacting close-in spectral purity measurement, consider the 2794. For more routine uses, such as microwave transmitter maintenance, the 2792 may be the most cost-effective solution.

**A WIDE ARRAY OF INTELLIGENT FEATURES**

Downloadable programming (macro) capability lets you execute your frequently-used measurement routines from the Spectrum Analyzer's nonvolatile memory. In addition, these Spectrum Analyzers can store up to 10 complete front-panel measurement parameter setups in nonvolatile memory to save measurement time. You can also save up to 9 waveform displays, a real benefit when data analysis must be delayed.

Tedious, time-consuming, and often incorrect carrier-to-noise ratio calculations are eliminated; the instrument handles it all with a single keystroke, with automatic noise normalization to 1 Hz and automatic conversion for reference units such as dBm, dBmV, dBV, dBμV, and dB/Hz.

An internal high-stability reference provides marker or center frequency accuracy approaching $10^{-9}$/day in the 2794. For added confidence in measurements, a built-in microwave signal counter in the 2794 with 134 dB compression-to-noise dynamic range means you can determine the exact frequency of marked signals only 30 Hz apart – or count the exact delta-frequency between two marked signals – even with greatly differing amplitudes. You also have the flexibility of tying in with a system clock, using the external reference lock capacity.

A permanent record of CRT displays can be obtained at the push of a button, without a controller, using the direct plot capability and a GPIB plotter such as the Tektronix HC100.

Menu-selected dynamic markers automatically update frequency and amplitude data with every sweep. Unprecedented signal processing power results when you use these markers in conjunction with the built-in intelligence. With PULSE Mode, you can mark the peak of a main lobe and peaks of side lobes at the push of a button. The CW Mode locates signals that exhibit CW characteristics and ignores all other signals. The SPUR Mode marks all signals that meet user-defined or automatic threshold criteria. User-definable threshold criteria are available for all signal processing modes.

**2794/2792/ 2797/2795**

- 100 Hz to 325 GHz Frequency Coverage
- Continuous-Resolution Frequency Tuning
- Up to 90 dB Viewable Dynamic Range
- Built-in Frequency Counters Provide Frequency Determination to within 0.0000001% ($1x10^{-9}$/day ref.)
- Sensitivities to –134 dBm
- Built-in Intelligence for Signal Processing/Marker Functions
- Push Button Noise-Normalization Functions
- Macro Capability with Nonvolatile Memory
- Optional Switch-Selectable 50/75 Ω Impedances
- Nonvolatile Memory for up to Nine Waveforms and Ten Front Panel Settings
- GPIB Programmability with Tektronix Codes and Formats

**APPLICATIONS**

- Manufacturing ATE
- Avionics
- Broadcasting
- CATV
- Cellular Radio
- Design and Engineering
- Nuclear Physics
- Radio Astronomy
- Satellite Communications
- Terrestrial Microwave
- Two-Way Radio

*Accessible performance at your fingertips.*

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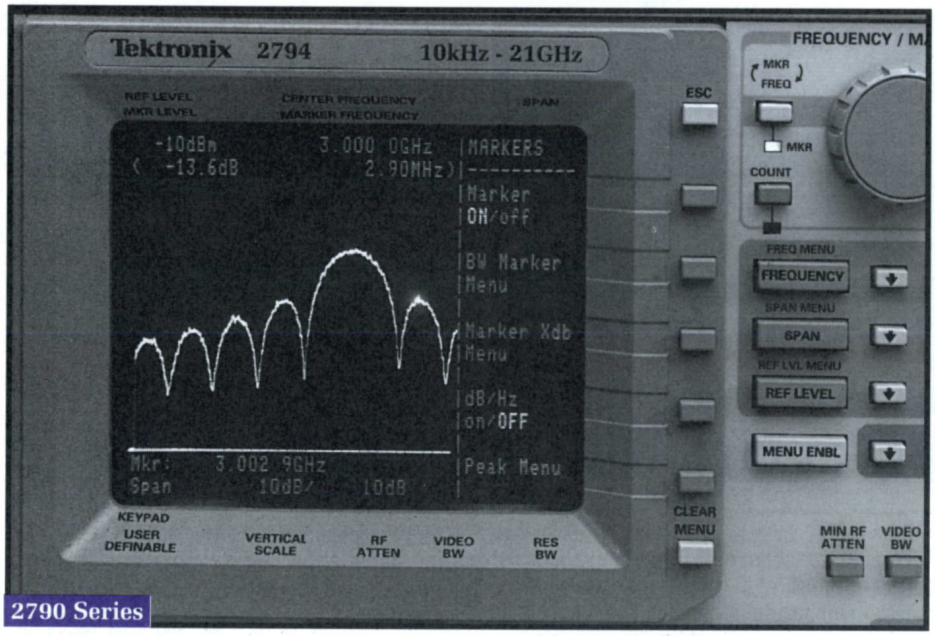
GPIB IEEE-488

The 2790 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

2794 2797
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# Spectrum Analyzers

## Portable, Rugged with Accessible Performance



2790 Series

### MENU POWER

The 2790 Series is primarily menu-driven. Pressing one of the four front-panel menu keys brings up a selection menu on the right portion of the display. Each menu selection is assigned to a bezel-mounted selection key; simply press the associated key to make a menu selection. When numeric data is required, it can be entered using the keypad. When menu selection is complete, the menu area is used by the waveform to provide a full-screen display.

Some of the common functions are performed by dedicated function keys or knobs. For example, the FREQUENCY/MARKERS knob provides frequency or marker tuning; the function is shifted between marker or frequency by alternately pressing MKR ⇔ FREQ.

A unique and powerful feature is the USER DEFINABLE knob which can be assigned to many of the front-panel functions; Span, Reference Level, Resolution Bandwidth, Sweep Speed, Minimum RF Attenuation, plus other functions. This allows you to customize the front panel for measurement convenience.

### OPERATOR CONVENIENCE

These instruments also offer operator convenience for measuring the bandwidth of filters, amplifiers, and other networks. Just enter the desired bandwidth point and select BANDWIDTH Mode, and the markers automatically update to display the new value.

Dedicated direct keypad data entry of major measurement parameters enables fast, accurate instrument setup. The unique marker keypad allows Right and Left Next, Next Higher and Lower, Marker to Ref. Level, and Peak Find and Center operations to be executed directly from the front panel. This makes signal searches much easier.

Optional switch-selectable 50 Ω and 75 Ω impedances add versatility. For applications such as baseband and CATV, 75 Ω/dBmV greatly simplifies spectrum analysis.

### PRICE/PERFORMANCE SELECTION

The performance leader is the 2794, which offers frequency coverage from 10 kHz to 21 GHz with its internal mixer, and to 325 GHz with external mixers such as the Tektronix WM780 Series (each WM780 Series mixer is individually calibrated). Signal sensitivity is an impressive –134 dBm. The 2794 is optimized for use in baseband through millimeter-wave measurements, where the ability to identify and process signal frequencies and amplitudes over wide dynamic ranges with high accuracy is critical. The 2794 offers full high-resolution and frequency coverage for RF/Microwave component design and test.

The 2792 covers the same coaxial frequency range as the 2794, and provides nearly the same set of outstanding features and state-of-the-art specifications. It is designed as a cost-effective and productive solution to engineering needs. The 2792's frequency range of 10 kHz to 21 GHz is ideal for cost-sensitive applications that still require most of the powerful features of the product family, but can get by with slightly-reduced performance specifications. The 2792 is also ideal for personal communications network testing to 26.5 GHz.

The 2795 features the same functionality and high level of performance as the 2794, but over a frequency range of 100 Hz to 1.8 GHz. It is optimized for stand-alone or automated operation in baseband through UHF measurements, where the ability to identify and process weak signals is critical. The 2795 used with the TR503 Tracking Generator forms a swept frequency system for passive and active component design and test.

The 2797 provides the same cost-effective performance as the 2794, but over a frequency range of 100 Hz to 7.1 GHz. The 2797 is well suited for land, sea, and air mobile communications system design and testing.

### REMOTE OPERATION AND COMPLETE SPECTRUM ANALYSIS PACKAGES

Full GPIB-programmability lets you automate your spectrum analysis system needs. Programming is simplified and measurement repeatability ensured. Under program control, you can operate the instrument, change front panel settings, read data from the CRT display, and send waveforms from internal memory to other GPIB devices. Tektronix' Standard Codes and Formats keep commands clear, consistent, and universally understood.

Tektronix spectrum analyzer software lets you use the 2790 Series Spectrum Analyzers as system components, controlling them with popular instrument controllers such as the PC compatibles. Coupling the computer to the Spectrum Analyzer via the IEEE 488 bus lets you take advantage of the PC's capability, as well as the power and versatility of the Spectrum Analyzer.

Tektronix' General RF Applications Software Package (GRASP) offers many different applications and utility routines, which are selected through easy menu-driven operation. Also, EMI software is available for FCC, VDE, CISPR, and MIL-STD testing.

# Spectrum Analyzers

## Portable, Rugged with Accessible Performance

**2794 2797**
**2792 2795**



### CHARACTERISTICS

| Frequency - Related | 2794 | 2792 | 2797 | 2795 |
|---|---|---|---|---|
| Frequency Range with Internal Mixers | 10 kHz to 21 GHz | 10 kHz to 21 GHz | 100 Hz to 7.1 GHz | 100 Hz to 1.8 GHz |
| Frequency Range with External Mixers | 10 kHz to 325 GHz | 26.5 GHz (Opt. 04) | NA | NA |
| Frequency Readout Accuracy (center or marker), ±[2% span + (CF x Ref) + (2N + 25) Hz] | ±20 kHz @ 1 GHz with 1 MHz span | ±30 kHz @ 1 GHz with 1 MHz span | ±21 kHz @ 1 GHz with 1 MHz span | ±20 kHz @ 1 GHz with 1 MHz span |
| Frequency Counter Accuracy, ±[(CF x Ref) + (5 + N) Hz + 1 LSD] | ±7 Hz @ 1 GHz | ±10.013 kHz @ 1 GHz, ±9 Hz @ 1 GHz (Opt. 03) | ±1 kHz @ 1 GHz, ±7 Hz @ 1 GHz (Opt. 02) | ±7 Hz @ 1 GHz |
| Delta Count Accuracy, ±[(D-F x Ref) + (10 + 2N) + 1 LSD] | ±13 Hz for 1 MHz ΔF | ±65 Hz for 1 MHz ΔF | ±14 Hz for 1 MHz ΔF | ±13 Hz for 1 MHz ΔF |
| Frequency Reference Accuracy | ≤1x10$^{-9}$/day (aging) | ≤2x10$^{-9}$/day (aging) Opt. 03 | ≤1x10$^{-9}$/day (aging) Opt. 02 | ≤1x10$^{-9}$/day (aging) |
| Frequency Stability (residual FM) | ≤3 Hz @ 1 GHz | ≤12 Hz @ 1 GHz | ≤3 Hz @ 1 GHz | ≤3 Hz @ 1 GHz |
| Frequency Stability (drift) | <50 Hz/minute | <50 Hz/minute | <50 Hz/minute | <50 Hz/minute |
| Single Sideband Phase Noise (30 kHz offset and N=1) | –105 dBc/Hz @ 1 GHz | –103 dBc/Hz @ 1 GHz | –105 dBc/Hz @ 1 GHz | –105 dBc/Hz @ 1 GHz |
| Frequency Span Range (plus 0 Hz and MAX) | 100 Hz to 150 GHz | 2 kHz to 12 GHz | 100 Hz to 4 GHz | 100 Hz to 1.7 GHz |
| Frequency Span Accuracy | ±5% | ±5% | ±5% | ±5% |
| Delta Frequency Accuracy Marker Mode | 1% of span | 1% of span | 1% of span | 1% of span |
| Resolution Bandwidth (6 dB) Range | 10 Hz to 3 MHz | 1 kHz to 3 MHz | 10 Hz to 3 MHz | 10 Hz to 3 MHz |
| Resolution Bandwidth Selectivity (–60 dB/–6 dB) | ≤7.5:1 except 15:1 @ 10 Hz | ≤7.5:1 | ≤7.5:1 except 15:1 @ 10 Hz | ≤7.5:1 except 15:1 @ 10 Hz |
| Video Bandwidth Range | 0.3 Hz to 30 kHz | 3 Hz to 30 kHz | 0.3 Hz to 30 kHz | 0.3 Hz to 30 kHz |
| **Amplitude - Related** | | | | |
| Reference Level Range | –117 to +30 dBm | –117 to +30 dBm | –117 to +30 dBm | –117 to +30 dBm |
| Maximum Safe Input Power, CW | 1 Watt (+30 dBm) | 1 Watt (+30 dBm) | 1 Watt (+30 dBm) | 1 Watt (+30 dBm) |
| Maximum Safe Input Power, Pulse | 75 W Pk (1 µS pulse, 0.1% duty factor) | 75 W Pk (1 µS pulse, 0.1% duty factor) | 75 W Pk (1 µS pulse, 0.1% duty factor) | 75 W Pk (1 µS pulse) 0.1% duty factor) |
| CRT Display Range, Log | 1 to 15 dB/div | 1 to 15 dB/div | 1 to 15 dB/div | 1 to 15 dB/div |
| CRT Display Range, Linear | 39.6 nV/div to 2.8 V/div | 39.6 nV/div to 2.8 V/div | 39.6 nV/div to 2.8 V/div | 39.6 nV/div to 2.8 V/div |
| Input Attenuator Range | 0 to 60 dB in 10 dB steps | 0 to 60 dB in 10 dB steps | 0 to 60 dB in 10 dB steps | 0 to 60 dB in 10 dB steps |
| Dynamic Range (maximums): | | | | |
| Compression to noise | 134 dB | 110 dB | 130 dB | 130 dB |
| Signal to distortion harmonic | 77 dB to 1.7 GHz<br>≥100 dB 1.7 to 21 GHz | 65 dB to 1.7 GHz<br>≥100 dB 1.7 to 21 GHz | 75 dB to 1.7 GHz<br>≥100 dB 1.7 to 21 GHz | 75 dB |
| Signal to distortion intermodulation | 93 dB to 1.7 GHz<br>≥100 dB 1.7 to 21 GHz | 76 dB to 1.7 GHz<br>≥100 dB 1.7 to 21 GHz | 90 dB to 1.7 GHz<br>≥100 dB 1.7 to 7.1 GHz | 90 dB |
| Viewable on CRT screen | 90 dB | 80 dB | 90 dB | 90 dB |
| Residual Response (no signal and zero RF attenuation) | –100 dBm (input terminated) | –95 dBm (input terminated) | –100 dBm (input terminated) | –100 dBm (input terminated) |
| Second Harmonic Distortion, RF Frequency Range | –60 dBc (mixer level –40 dBm) | –60 dBc (mixer level –40 dBm) | –60 dBc (mixer level –40 dBm) | –60 dBc (mixer level –30 dBm) |
| Second Harmonic Distortion Microwave Frequency Range | –100 dBc (mixer level –20 dBm) | –100 dBc (mixer level –20 dBm) | –100 dBc (mixer level –20 dBm) | NA |
| Third Order Intermodulation Distortion | –70 dBc (mixer level –27 dBm) | –70 dBc (mixer level –27 dBm) | –70 dBc (mixer level –27 dBm) | –70 dBc (mixer level –27 dBm) |
| Calibrator Accuracy | ±0.3 dB | ±0.3 dB | ±0.3 dB | ±0.3 dB |
| Gain Compression (1 dB) | 0 dBm | 0 dBm | 0 dBm | 0 dBm |
| Frequency Response (10 dB RF attenuation referred to cal signal): | | | | |
| Band 1 (10 kHz to 1.8 GHz) | ±2.5 dB | ±3.0 dB | ±2.5 dB | ±2.0 dB (100 Hz to 1.8 GHz) |
| Band 2 (1.7 GHz to 5.5 GHz) | ±3.5 dB | ±4.0 dB | ±3.5 dB | NA |
| Band 3 (3.0 GHz to 7.1 GHz) | ±3.5 dB | ±4.0 dB | ±3.5 dB | NA |
| Band 4 (5.4 GHz to 18 GHz) | ±4.5 dB | ±5.0 dB | NA | NA |
| Band 5 (15 GHz to 21 GHz) | ±6.5 dB | ±7.0 dB | NA | NA |
| In-band Flatness (with 10 dB RF attenuation): | | | | |
| Band 1 (10 kHz to 1.8 MHz) | ±1.5 dB | ±2.0 dB | ±1.5 dB (100 Hz to 1.8 GHz) | ±1.0 dB (100 Hz to 1.8 GHz) |
| Band 2 (1.7 GHz to 5.5 GHz) | ±2.5 dB | ±3.0 dB | ±2.5 dB | NA |
| Band 3 (3.0 GHz to 7.1 GHz) | ±2.5 dB | ±3.0 dB | ±2.5 dB (5.4 GHz to 7.1 GHz) | NA |
| Band 4 (5.4 GHz to 18 GHz) | ±3.5 dB | ±4.0 dB | NA | NA |
| Band 5 (15 GHz to 21 GHz) | ±5.0 dB | ±5.5 dB | NA | NA |

*Continued on next page.*

# 2794 2797 2792 2795 Spectrum Analyzers

## Portable, Rugged with Accessible Performance

| Amplitude - Related (continued) | 2794 | 2792 | 2797 | 2795 |
|---|---|---|---|---|
| Displayed Average Noise Level (input terminated, narrowest resolution bandwidth, and video filter): | | | | |
| Band 1 (100 Hz) | –80 dBm (typical) | NA | –75 dBm (typical) | –75 dBm (typical) |
| Band 1 (1 kHz to 10 kHz) | –90 dBm (typical) | –60 dBm (typical) | –95 dBm | –95 dBm |
| Band 1 (10 kHz to 100 kHz) | –95 dBm | –70 dBm | –115 dBm | –100 dBm |
| Band 1 (100 kHz to 1 MHz) | –115 dBm | –90 dBm | –120 dBm | –115 dBm |
| Band 1 (1 MHz to 1.8 GHz) | –134 dBm | –110 dBm | –130 dBm | –131 dBm |
| Band 2 (1.7 GHz to 5.5 GHz) | –125 dBm | –108 dBm | –127 dBm | NA |
| Band 3 (3.0 GHz to 7.1 GHz) | –125 dBm | –108 dBm | –126 dBm | NA |
| Band 4 (5.4 to 12 GHz/12 to 18 GHz) | –111/–107 dBm | –94 / –89 dBm | NA | NA |
| Band 5 (15 GHz to 21 GHz) | –106 dBm | –88 dBm | NA | NA |
| IF Gain Uncertainty | ±2 dB max over 107 dB range | ±2 dB max over 107 dB range | ±2 dB max over 107 dB range | ±2 dB max over 107 dB range |
| Scale Fidelity, Log (80 dB range/90 dB range) | ±2 dB max/ ±4 dB max | ±2 dB max | ±2 dB max/ ±4 dB max | ±2 dB max/ ±4 dB max |
| Scale Fidelity, Linear | ±5% of full scale | ±5% of full scale | ±5% of full scale | ±5% of full scale |
| Input Attenuator Switching Accuracy (20 dB to 60 dB settings): | | | | |
| 0 to 1.8 GHz | ±0.5 dB/10 dB; ±1.0 dB max | ±0.5 dB/10 dB; ±1.0 dB max | ±0.5 dB/10 dB; ±1.0 dB max | ±0.5 dB/10 dB; ±1.0 dB max |
| 1.8 to 18 GHz | ±1.5 dB/10 dB; ±3.0 dB max | ±1.5 dB/10 dB; ±3.0 dB max | ±1.5 dB/10 dB; ±3.0 dB max (1.8to 7.1 GHz) | NA |
| 18 to 21 GHz | ±3.0 dB/10 dB; ±6.0 dB max | ±3.0 dB/10 dB; ±6.0 dB max | NA | NA |
| Resolution Bandwidth Switching Uncertainty (reference BW = 3 MHz) | ±0.4 dB | ±0.4 dB | ±0.4 dB | ±0.4 dB |
| **Time - Related** | | | | |
| Sweep Time Range | 200 µsec/div to 100 sec/div | 200 µsec/div to 100 sec/div | 200 µsec/div to 100 sec/div | 200 µsec/div to 100 sec/div |
| Sweep Time Accuracy | ±5% | ±5% | ±5% | ±5% |
| Marker Time Measurement Accuracy | ±10% | ±10% | ±10% | ±10% |
| Delta Marker Time Measurement Accuracy | ±5% | ±5% | ±5% | ±5% |
| Sweep Trigger | Free Run, Line, Video, Single, Ext | Free Run, Line, Video, Single, Ext | Free Run, Line, Video, Single, Ext | Free Run, Line, Video, Single, Ext |
| **External Input** | | | | |
| RF Input Impedance | 50 Ω nominal | 50 Ω nominal | 50 Ω nominal | 50 Ω nominal |
| VSWR (10 dB input attenuation): | | | | |
| <2.5 GHz | 1.3:1 max | 1.3:1 max | 1.3:1 max | 1.3:1 max |
| 2.5 GHz to 6.0 GHz | 1.7:1 max | 1.7:1 max | 1.7:1 max | NA |
| 6.0 GHz to 18 GHz | 2.3:1 max | 2.3:1 max | NA | NA |
| 18 GHz to 21 GHz | 3.5:1 max | 3.5:1 max | NA | NA |
| Local Oscillator Emission Level (0 dB input attenuation) | ≤–70 dBm | ≤–70 dBm | ≤–70 dBm | ≤–70 dBm |
| External Mixer Input | Approx 2 GHz IF | NA | NA | NA |
| External Reference Input | 1, 2, 5, or 10 MHz | NA | 1, 2, 5, or 10 MHz | 1, 2, 5, or 10 MHz |
| Horizontal Input/Trigger Input | 0 to +10 V/1 to 50 V | 0 to +10 V/1 to 50 V | 0 to +10 V/1 to 50 V | 0 to +10 V/1 to 50 V |
| Video Input/Marker Input | 0 to +4 V/0 to –10 V | 0 to +4 V/0 to –10 V | 0 to +4 V/0 to –10 V | 0 to +4 V/0 to –10 V |
| **External Output** | | | | |
| Calibrator | 100 MHz ±10 Hz, –20 dBm ±0.3 dB | 100 MHz ±1 kHz, –20 dBm ±0.3 dB | 100 MHz ±100 Hz, –20 dBm ±0.3 dB | 100 MHz ±10 Hz, –20 dBm ±0.3 dB |
| 1st Local Oscillator | 2 to 6 GHz, +7.5 to +20 dBm | 2 to 6 GHz, +7.5 to +20 dBm | 2 to 6 GHz, +6 to +20 dBm | 2 to 4 GHz, +6 to +20 dBm |
| 2nd Local Oscillator | –12 dBm to +5 dBm | –12 dBm to +5 dBm | –12 dBm to +5 dBm | –10 dBm to +15 dBm |
| Video Output (CRT center reference) | 0.5 V of signal per div of video | 0.5 V of signal per div of video | 0.5 V of signal per div of video | 0.5 V of signal per div of video |
| Sweep Output (CRT center reference) | 0.5 V/div; ±2.5 V max | 0.5 V/div; ±2.5 V max | 0.5 V/div; ±2.5 V max | 0.5 V/div; ±2.5 V max |
| Pen Lift | +5 V nominal; TTL-compatible | +5 V nominal; TTL-compatible | +5 V nominal; TTL-compatible | +5 V nominal; TTL-compatible |

*Continued on next page.*

# Spectrum Analyzers
## Portable, Rugged with Accessible Performance

**2794** **2797**
**2792** **2795**



| External Output (continued) | 2794 | 2792 | 2797 | 2795 |
|---|---|---|---|---|
| 2nd IF Output (Opt. 42) | 110 MHz, 0 dBm; 3 dB BW is 4.5 MHz | 110 MHz, 0 dBm; 3 dB BW is 4.5 MHz | 110 MHz, 0 dBm; 3 dB BW is 4.5 MHz | 110 MHz, 0 dBm; 3 dB BW is 4.5 MHz |
| 3rd IF Output | 10 MHz, –5 dBm | 10 MHz, –5 dBm | 10 MHz, –5 dBm | 10 MHz, –5 dBm |
| Probe Power | +5 V, –15 V, +15 V; 100 mA max each | +5 V, –15 V, +15 V; 100 mA max each | +5 V, –15 V, +15 V; 100 mA max each | +5 V, –15 V, +15 V; 100 mA max each |
| **General Specifications** | | | | |
| Power Requirements:<br>Voltage<br>Frequency<br>Power | 90-132/180-250 VAC<br>47-63 Hz<br>210 W max<br>@ 115 VAC, 60 Hz | 90-132/180-250 VAC<br>47-63 Hz<br>210 W max<br>@ 115 VAC, 60 Hz | 90-132/180-250 VAC<br>47-63 Hz<br>210 W max<br>@ 115 VAC, 60 Hz | 90-132/180-250 VAC<br>47-63 Hz<br>210 W max<br>@ 115 VAC, 60 Hz |
| Weight (carrying), Nominal | 22.2 kg (48 lb.) | 21.3 kg (46 lb.) | 20.83 kg (45 lb.) | 19.44 kg (42 lb.) |
| Dimensions (without handle, feet, or cover), mm/inches | 175 x 327 x 499/ 6.9 x 12.87 x 19.65 | 175 x 327 x 499/ 6.9 x 12.87 x 19.65 | 175 x 327 x 499/ 6.9 x 12.87 x 19.65 | 175 x 327 x 499/ 6.9 x 12.87 x 19.65 |
| Digital Storage | 1000 pts horizontal, 250 pts vertical | 1000 pts horizontal, 250 pts vertical | 1000 pts horizontal, 250 pts vertical | 1000 pts horizontal, 250 pts vertical |
| Digitizing Rate | 9 µS | 9 µS | 9 µS | 9 µS |
| Macro Programming | 8K | 8K | 8K | 8K |
| Nonvolatile Memory | 9 waveforms, 10 control settings | 9 waveforms, 10 control settings | 9 waveforms, 10 control settings | 9 waveforms, 10 control settings |
| **Environmental (Per Mil-T-28800C, Type III,Class 3, Style C)** | | | | |
| Electromagnetic Compatibility (consult data sheet for compliance details) | MIL-STD-461B | MIL-STD-461B | MIL-STD-461B | MIL-STD-461B |
| Calibration Interval | 1 Year | 1 Year | 1 Year | 1 Year |
| **IEEE 488 (GPIB)** | | | | |
| Interface Functions | SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, and C0 | SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, and C0 | SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, and C0 | SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, and CO |
| Direct Plotter Output | Supports Tek HC100, HP7470A | Supports Tek HC100, HP7470A | Supports Tek HC100, HP7470A | Supports Tek HC100, HP7470A |
| Waveform Transfer Speed | 165 msec/1000 pts | 165 msec/1000 pts | 165 msec/1000 pts | 165 msec/1000 pts |
| Safety | Listed FM 3810 Certified CSA | Listed FM 3810 Certified CSA | Listed FM 3810 Certified CSA | Listed FM 3810 Certified CSA |

## ORDERING INFORMATION

**2794**
Programmable Spectrum Analyzer ..... **$32,450**
**Includes:** Operator's Manual; Programmer's Manual; 6 ft., 50 Ω coaxial cable, N-N (012-0114-00); 18 in., 50 Ω coaxial cable, BNC-BNC (012-0076-00); N male to BNC female adapter (103-0045-00); rear connector shield (337-3274-00); power cord and spare fuses.

**2792**
Programmable Spectrum Analyzer ..... **$22,000**
**Includes:** Same as 2794.

**2797**
Programmable Spectrum Analyzer ..... **$26,500**
**Includes:** Same as 2794.

**2795**
Programmable Spectrum Analyzer ..... **$22,900**
**Includes:** Same as 2794.

**Opt. 02 –** (2797) Precision Freq. Reference. 1 x $10^{-7}$/yr aging ..... **+$2,200**

**Opt. 03 –** (2792) Precision Freq. Reference. 5 x $10^{-7}$/yr aging ..... **+$1,500**

**Opt. 04 –** (2792) Freq. range extension to 26.5 GHz ..... **+$2,000**

**Opt. 07 –** 75 Ω dBmV input and calibration in addition to the normal 50 Ω dBm input and calibration. (Not combinable with Opt. 04 and Opts. 10 through 14.) Includes: 42 in., 75 Ω BNC-BNC coax cable (012-0074-00) and BNC male to "F" female adapter (013-0126-00) ..... **+$750**

**Opt. 10 –** (2794) Freq. range extension to 26.5 GHz ..... **+$2,000**

**Opt. 11 –** (2794) Freq. range extension to 40 GHz ..... **+$3,500**

**Opt. 12 –** (2794) Freq. range extension to 60 GHz ..... **+$5,500**

**Opt. 13 –** (2794) Freq. range extension to 140 GHz ..... **+$10,500**

**Opt. 14 –** (2794) Freq. range extension to 325 GHz ..... **+$14,500**

**Opt. 23 –** GRASP software (S26RF00), PC2A interface, GPIB cable. ..... **+$1,530**
**NOTE:** The PC2A is a National Instruments GPIB Interface Card.

**Opt. 30 –** Rackmount with handles for 19 in. rack ..... **+$525**

**Opt. 39 –** Non-lithium (Silver) batteries for battery-backed memory ..... **+$50**

**Opt. 41 –** (2792 and 2794) Digital Microwave Radio Measurement Enhancement Package ..... **+$450**

**Opt. 42 –** Replaces MARKER/VIDEO input port on the rear panel with a 110 MHz IF output port that provides a 3050-Series DSP System compatible 3 dB signal bandwidth ≥4.5 MHz ..... **+$750**

**INTERNATIONAL POWER PLUG OPTIONS**

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

**Opt. A2 –** United Kingdom 240 V, 50 Hz ..... **NC**

**Opt. A3 –** Australian 240 V, 50 Hz ..... **NC**

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

**Opt. A5 –** Switzerland 220 V, 50 Hz ..... **NC**

See Customer Information Section for additional description.

*Continued on next page.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The 2790 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

2794 2797
2792 2795

# Spectrum Analyzers

## Portable, Rugged with Accessible Performance

## ORDERING INFORMATION

**Opt. B1** – Service Manual ..... **+$250**
**Opt. B2** – Additional set of manuals ..... **+$350**

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M7** – Calibration Repair
2792 ..... **+$440**
2794 ..... **+$650**
2795 ..... **+$460**
2797 ..... **+$530**

**Opt. M9** – Repair Protection
2792 ..... **+$1,100**
2794 ..... **+$1,625**
2795 ..... **+$1,145**
2797 ..... **+$1,325**

**SOFTWARE**
See Pages 224-226 for complete description.
**GRASP (General RF Applications) Software** – Order S26RF00 ..... **$875**
**RSM (Host Site) Software** – Order S26RM00 ..... **$300**
**RSM (Remote Site) Software** – Order S26RM01 ..... **$750**
**EMI Prequalification Software** – Order S26EM00 ..... **$1,475**

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

**PROBES**
**FET Probe** – DC to 900 MHz. Order P6201 ..... **$1,550**
**FET Probe** – DC to 500 MHz. Order P6202A ..... **$1,025**
**50 Ω Divider Probe** – DC to 3.5 GHz, 6 ft. Order P6156 ..... **$265**
**Current Probe** – 935 Hz to 120 MHz. Order P6022 ..... **$595**

**PLOTTER**
**Plotter** – Four color. Order HC100 Opt. 01 ..... **$1,260**
**CARTS** – K218 Instrument Cart ..... **$745**

**POWER SPLITTER (6 dB)**
50 Ω, SMA, 18 GHz. Order 015-0565-00 ..... **$275**

**CABLES, PADS AND ADAPTERS**
**50 Ω Coaxial Cable** –
BNC to BNC 5.5 in. Order 012-0214-00 ..... **$60**
BNC to BNC 18 in. Order 012-0076-00 ..... **$31**
BNC to BNC 42 in. Order 012-0057-01 ..... **$28**
**75 Ω Coaxial Cable** –
BNC to BNC 42 in. Order 012-0074-00 ..... **$31**
**GPIB Cables** –
0.5 m. Order 012-1282-00 ..... **$150**
1 m. Order 012-0991-01 ..... **$170**
2 m. Order 012-0991-00 ..... **$170**
4 m. Order 012-0991-02 ..... **$260**
**75 Ω to 50 Ω Minimum Loss Attenuator** – With DC block, 5.7 dB loss. Order 011-0112-00 ..... **$85**
**75 Ω to 50 Ω Matching Attenuator** – With 11.25 dB conversion factor from dBm to dBV with DC block. Order 011-0118-00 ..... **$95**
**"F" Female to BNC Male Adapter** – Order 013-0126-00 ..... **$22**
**BNC Female to "F" Male Adapter** – Order 103-0158-00 ..... **$14**
**"N" Female to BNC Male Adapter** – Order 103-0058-00 ... **$15.50**
**75 Ω to 50 Ω Matching Transformer** – 0.5 dB loss.
50 kHz to 300 MHz. Order 120-1883-00 ..... **$170**
5 MHz to 1 GHz. Order 120-1884-00 ..... **$170**

**DC BLOCKS**
**N to N** – DC Block 015-0509-00 is rated over the coaxial frequency range of 10 kHz to 21 GHz. Its electrical characteristics, rugged construction, and type "N" connectors make it the preferred solution for EMI/RFI and other applications requiring the blocking of 2790 front ends. Characteristics – Operating Frequency: 10 kHz to 21 GHz. Insertion Loss: 1.0 dB maximum. VSWR: 1.4:1 maximum, 10 kHz to 18 GHz; 1.6:1 maximum 18 to 21 GHz. Voltage Rating: 50 VDC maximum. Impedance: 50 Ω Connectors: Type "N" male and female.
Order 015-0509-00 ..... **$430**
**BNC to BNC** – Maximum DC potential 50 V.
Order 015-0221-00 ..... **$130**

**GPIB CARDS**
**PC-GPIB Card** – IBM PC, AT, and compatibles.
Order S3FG210 ..... **$395**
**AT-GPIB Card** – IBM AT Bus (high speed card).
Order S3FG220 ..... **$495**
**MC-GPIB Card** – IBM PS/2 with Microchannel Bus.
Order S3FG230 ..... **$495**

**ADDITIONAL ACCESSORIES**
**EMI Ancillary Devices** – See Page 223.
**Service Manuals** –
2797, Volume I. Order 070-8638-00 ..... **$95**
2797, Volume II. Order 070-8642-00 ..... **$170**
2795, Volume I. Order 070-8637-00 ..... **$95**
2795, Volume II. Order 070-8641-00 ..... **$170**
2794, Volume I. Order 070-8636-00 ..... **$95**
2794, Volume II. Order 070-8640-00 ..... **$170**
2792, Volume I. Order 070-8635-00 ..... **$95**
2792, Volume II. Order 070-8639-00 ..... **$150**
**Service Kit** – Order 006-3286-01 ..... **$1,995**
**Diplexer Assembly** – For 2790 Series and WM780 Waveguide Mixers. Order 015-0385-00 ..... **$1,765**
**Diplexer Interconnecting Cable** – Required for use with Diplexer Assembly. 50 Ω, SMA-to-SMA. Order 012-0649-00 ..... **$41**
**Rack Adapter** – 19 in. Order 016-0844-01 ..... **$670**
**Rear Panel Connector Cover** – Order 337-3274-00 ..... **$5.00**
**Soft Side Case** – Order 016-0659-00 ..... **$155**
**Transit Case** – Order 016-0658-00 ..... **$990**
**TV Sideband Analyzer Adapter** – 525/60 markers. Order 1405 ..... **$7,175**
**Tracking Generator** – 100 Hz to 1800 MHz. Order TR503 ..... **$8,500**
**Microwave Comb Generator** – TM500 Series compatible. Order 067-0885-00 ..... **$2,265**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The 2790 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Waveguide Mixers





## WM780 Series Waveguide Mixers

The Tektronix WM780 Series Waveguide Mixers cover a frequency range of 18 to 325 GHz with optimum flatness. Although designed specifically for use with the Tektronix 2790 Series Spectrum Analyzers, they are also compatible with most other spectrum analyzers. 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.

### WM780 SERIES

- 18 to 325 GHz Frequency Range
- Frequency Response is ±2 dB*2
- Individual Frequency Characterization Curves Attached to Housing
- Custom Characterization Available
- Precision Gold-Plated Brass Body

### APPLICATION

- Down Conversion
- Network Analysis Measurements

*Extended spectrum analyzer measurement capability from 18 GHz to 325 GHz.*

## ELECTRICAL CHARACTERISTICS

| Tektronix Model No. | Band Desig. | Frequency Range (GHz) | Sensitivity*1 (dBm) | Frequency*2 Response (dB) | Conversion*3 Loss Typical (dB) | Low-Pass*6 Cutoff 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<br>–85 @ 75 GHz typ | ±3 *4<br>typical | 35 @ 50 GHz<br>40 @ 75 GHz | 28 GHz |
| WM780E | E | 60-90 | –80 @ 60 GHz<br>–80 @ 90 GHz typ | ±3 *4<br>typical | 35 @ 60 GHz<br>45 @ 90 GHz | 28 GHz |
| WM780W | W | 75-110 | –80 @ 75 GHz<br>–70 @ 110 GHz typ | ±3 *4<br>typical | 45 @ 75 GHz<br>55 @ 110 GHz | 30 GHz |
| WM780F | F | 90-140 | –75 @ 90 GHz<br>–65 @ 140 GHz typ | ±3 *4<br>typical | 50 @ 90 GHz<br>60 @ 140 GHz | 32 GHz |
| WM780D | D | 110-170 | –70 @ 110 GHz<br>–60 @ 170 GHz typ | ±3 *4<br>typical | 50 @ 110 GHz<br>60 @ 170 GHz | 40 GHz |
| WM780G | G | 140-220 | –65 @ 140 GHz<br>–55 @ 220 GHz typ | ±3 *4<br>typical | 55 @ 140 GHz<br>65 @ 220 GHz | 40 GHz |
| WM780J | J | 220-325 | –55 @ 220 GHz, *5<br>–45 @ 325 GHz typ | ±3 *4<br>typical | 65 @ 220 GHz<br>75 @ 325 GHz | 40 GHz |

*1 *Equivalent average noise level (using a 2790 Series Spectrum Analyzer in 1 kHz resolution bandwidth).*

*2 *Maximum amplitude variation across each waveguide mixer band (using a 2790 Series Spectrum Analyzer with peaking control optimized at each frequency in response to a –30 dBm CW input signal to the mixer).*

*3 *LO drive ±10 dBm peaking control optimized.*

*4 *Over any 5 GHz bandwidth for millimeter wave mixers above 60 GHz.*

*5 *Value estimated at 325 GHz.*

*6 *These low-pass filters are in LO/IF connector.*

## ORDERING INFORMATION

**WM780 WAVEGUIDE MIXERS AND SETS**

**18 to 26.5 GHz** – Order WM780K ..... **$1,943.50**
**26.5 to 40 GHz** – Order WM780A..... **$1,955**
**33 to 50 GHz** – Order WM780Q ..... **$2,248.50**
**40 to 60 GHz** – Order WM780U ..... **$2,673.75**
**50 to 75 GHz** – Order WM780V..... **$3,030.25**
**60 to 90 GHz** – Order WM780E ..... **$3,289**
**75 to 110 GHz** – Order WM780W..... **$3,381**
**90 to 140 GHz** – Order WM780F ..... **$3,611**
**110 to 170 GHz** – Order WM780D ..... **$5,042.75**
**140 to 220 GHz** – Order WM780G ..... **$5,163.50**
**220 to 325 GHz** – Order WM780J ..... **$6,526.25**

**18 to 40 GHz Set** – Includes WM780K, WM780A. Order WM7802 ..... **$3,622.50**
**18 to 60 GHz Set** – Includes WM780K, WM780A, WM780U. Order WM7803..... **$6,118**
**33 to 170 GHz Set** – Includes WM780Q, WM780V, WM780W, WM780D. Order WM78012..... **$13,432**

**ACCESSORIES**

**Diplexer Assembly** – Required for 2790 Series. Order 015-0385-00..... **$320**
**Diplexer Interconnecting Cable** – Required for 2790 Series. 50 Ω, SMA-to-SMA. Order 012-0649-00..... **$41**
**Case** – Order 006-7340-00..... **$60**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

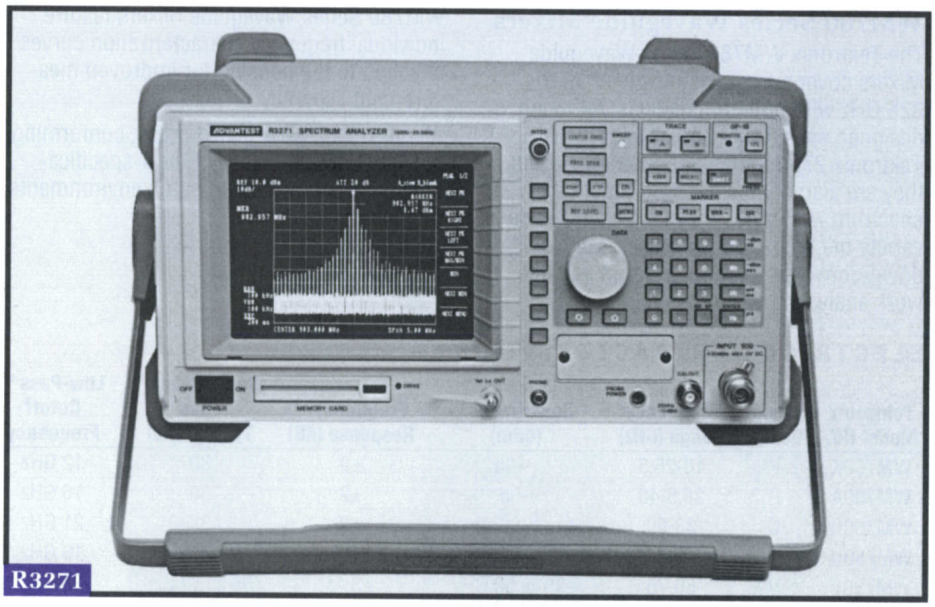
# Spectrum Analyzers



*Bench-top performance in a portable package. Ideal for analyzing signals ranging from baseband through microwave.*

**R3271**

- Excellent Spectral Purity: –110 dBc/Hz (10 kHz away from Carrier)
- Resolution Bandwidth of 10 Hz to 3 MHz
- Can Sweep the Complete Frequency Range Continuously and Repeatedly
- Built-in Frequency Counter with 1 Hz Resolution
- Audio can be Demodulated Using the Internal Speaker
- Portable System With a Large CRT Display
- Conforms to MIL-T-28800 Standards




## R3271 Spectrum Analyzer

The R3271 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 R3271 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 R3271 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.

### HIGH-PRECISION MEASUREMENTS BY SOFTWARE CALIBRATION

An internal CPU corrects not only the intermediate frequency (IF), but also the frequency response, including the attenuator, to improve the accuracy of amplitude measurement. During noise measurement, the power bandwidth is also corrected.

### PORTABLE SYSTEM WITH A LARGER CRT DISPLAY

The R3271 portable spectrum analyzer employs an eight-inch CRT display for monitoring measurement results. This provides improved display resolution for accurate measurement.

### HIGHEST SPECTRUM PURITY

Measurement of near-carrier emissions are improved by means of a high-purity synthesizer LO. SSB phase noise sidebands are a low –110 dBc/Hz up to 2.6 GHz and –98 dBc/Hz up to 23 GHz (with 10 kHz offset).

### MEASUREMENT OVER WIDE FREQUENCY AND DYNAMIC RANGES

The R3271 can repeatedly and continuously sweep a wide frequency range of 100 Hz to 26.5 GHz. The use of a low-loss harmonic mixer provides excellent sensitivity (–110 dBm at 26.5 GHz) and contributes to the large compression-to-noise dynamic range (>105 dB at 26.5 GHz).

### FREQUENCY COUNTER WITH 1 HZ RESOLUTION

A built-in frequency counter with 1 Hz resolution produces stable and precise frequency measurements by using a reference oscillator with stability of $2 \times 10^{-8}$ (or an optional $5 \times 10^{-9}$/day). This frequency counter can also precisely measure the frequency of low-amplitude signals as well as the frequency of signals hidden by stronger signals.

### RESOLUTION BANDWIDTH OF 10 HZ TO 3 MHZ

For frequency resolution, the R3271 incorporates a narrow-band (10 Hz) IF filter that can separate nearby signals from the wide IF bandwidth filter (3 MHz) to improve the measurement sensitivity to a pulsed RF signal. The R3271 can thus be used for a wide variety of measurements. The narrow-band IF filter also incorporates a digital IF filter, enabling nearby characteristic measurements with both high selectivity and high speed.

ADVANTEST

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The R3271 complies with IEEE Standard 488.1-1987.

**EIGHT-POINT MULTI-MARKER AND LIST FUNCTION**

In addition to a Δ marker and a peak marker, the R3271 can display an eight-point multi-marker. It can also display a listing of the multi-marker values. Combined with the Define function, the multi-marker listing display can greatly enhance not only the operability of the equipment, but also its measuring speed.

**GATED SWEEP**

Combined with a fast digitized sweep of 5 µs/div. in zero span, the gated sweep function can be used to analyze TDMA and video signals. This added capability provides time and frequency domain analysis for improved digital transmission performance verification.

## Characteristics

**FREQUENCY RELATED**

**Frequency Range –** 100 Hz to 26.5 GHz (extended to 325 GHz with Tektronix WM780 Series waveguide mixers – see Page 199):

| 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 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: ±3% (span >2 MHz), ±5% (span ≤2 MHz).

**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 –** $\pm 2 \times 10^{-8}$/day, $\pm 1 \times 10^{-7}$/year, $\pm 5 \times 10^{-9}$/day (Opt. 21).

**Frequency Stability –** Residual FM (zero span): <3 Hz x N p-p/0.1 s. Drift (after 1 hour warm up): 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 |

**FREQUENCY SPAN**

**Linear span –** Range: 200 Hz to 26.5 GHz, zero span. 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: +30 dBm (1 W) (Input attenuation. ≥10 dB). 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 gain compression to noise level: 130 dB – 1.55f (GHz) dB, 10 MHz to 3.6 GHz.

**Signal distortion harmonic –** >10 MHz to 3.8 GHz: 85 dB. >3.5 GHz: 110 dB.

**Third order Intermodulation –** >10 MHz: 90 dB.

**Displayed average noise level –** 10 Hz Res BW, 0 dB input attenuation, 20 times average.
1 kHz: –100 dBm.
10 kHz: –110 dBm.
100 kHz: –111 dBm.
1 MHz to 3.6 GHz: –(135 – 1.55f (GHz)) dBm.
3.5 GHz to 7.5 GHz: –130 dBm.
7.4 GHz to 15.4 GHz: –123 dBm.
15.2 GHz to 23.3 GHz: –116 dBm.
23 GHz to 26.5 GHz: –110 dBm.

**Gain compression (1 dB) –** –5 dBm mixer input level. >10 MHz.

**SPURIOUS RESPONSE**

**Second Harmonic Distortion –** <–70 dBc; Freq. Range: 10 MHz to 3.6 GHz. Mixer Level: –30 dBm. <–100 dBc; Freq. Range: >3.5 GHz. Mixer Level: –10 dBm.

**Third Order Intermodulation Distortion –** <–70 dBc; Freq. Range: 10 MHz to 3.6 GHz. Mixer Level: –30 dBm, <–75 dBc; Freq. Range: >3.6 GHz. Mixer Level: –30 dBm.

**Residual Responses –** <–100 dBm; Freq. Range: 1 MHz to 3.6 GHz. <–90 dBm; Freq. Range: 300 kHz to 26.5 GHz.

**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. 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 –** ±5 dB.

**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 19 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.

# Spectrum Analyzers



**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 –** With Opt. 71. Trigger signal source: External trigger signal (input from the external trigger input connector). 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).

**Gated sweep specifications –** Trigger signal source: Produce a gate signal. Input from the external trigger input connector or gate input connector. Frequency domain analysis: External trigger input and gate input. Time domain analysis: External trigger input, gate input, VIDEO and TV-V

**Gate position –** 300 ns to 100 ms with resolution of 100 ns.

**Gate width –** 1 µs to 1.5 s with resolution of 100 ns.

**INPUTS/OUTPUTS**

**RF Input –** Connector type: N type (adaptable to SMA type). Impedance: 50 Ω (nominal). VSWR (input attenuation ≥10 dB, at tuned frequency): ≤3.6 GHz (nominal): <1.5 : 1. >3.6 GHz (nominal): <2.5 : 1. 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: +15V, –15 V. Current: 150 mA max., each.

**Demodulated Audio Output –** Connector: Subminiature monophonic jack, front panel. Power output: 0.2 watt 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 Opt. 01, HP7470A, HP7475A, HP7440A, and HP7550A, or other HPGL plotters.

**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.

**POWER REQUIREMENTS**

**Operating voltage –** Automatically selects between 100 VAC and 220 VAC. 100 VAC: 90 V to 132 V. 220 VAC: 198 V to 250 V.

**Power consumption –** Max. 400 VA.

**Frequency –** 100 VAC: 48 to 440 Hz. 200 VAC: 48 to 66 Hz.

## PHYSICAL CHARACTERISTICS

**Dimensions (without handle, feet, and front cover)**

| | mm | in. |
|---|---|---|
| **Height** | 177 | 7.0 |
| **Width** | 353 | 13.9 |
| **Depth** | 450 | 17.7 |
| **Weight** | **kg** | **lb.** |
| **Nominal** | 22 | 48.5 |

## ORDERING INFORMATION

**R3271**
Spectrum Analyzer ..... **$34,000**
**Includes:** Power Cord, BNC-to-BNC Cable, N-Type BNC-to-BNC Input Cable, N-to-BNC Adapter, 32k Memory Card, Front Cover, Instruction Manual.
**Opt. 15 –** Add controller function ..... **+$2,900**
**Opt. 21 –** Add 5 x $10^{-9}$/day crystal ..... **+$600**
**Opt. 71 –** Add delayed and gated sweep ..... **+$2,300**
**Opt. 73 –** GPIB Expansion ..... **+$1,000**
**Waveguide Mixers –** Tektronix WM780 Series. (See page 199)

**RECOMMENDED ACCESSORIES**
See Page 424 for complete selection information.

**PROBES**
**FET Probe –** DC to 900 MHz (Requires 1101A). Order P6201 ..... **$1,550**
**FET Probe –** DC to 500 MHz. Order P6202A ..... **$1,025**
**50Ω Divider Probe –** DC to 3.5 GHz, 6 ft. Order P6156 ..... **$265**
**Current Probe –** 935 Hz to 120 MHz. Order P6022 ..... **$595**
**Plotter –** Order Tektronix HC100 Opt. 01 ..... **$1,260**
**Preamplifier –** 9 kHz to 1 GHz, ≥ 25 dB. Order R14601 ..... **$995**
**Memory Card –** Set of five 32 KB cards.Order A09505 ..... **$500**
**Memory Card –** Set of five 128 KB cards. Order A09506 ..... **$1,400**
**Aluminum Transit Case –** Order R16059 ..... **$1,000**
**Rackmount Adapter –** Order A02459 ..... **$300**

ADVANTEST

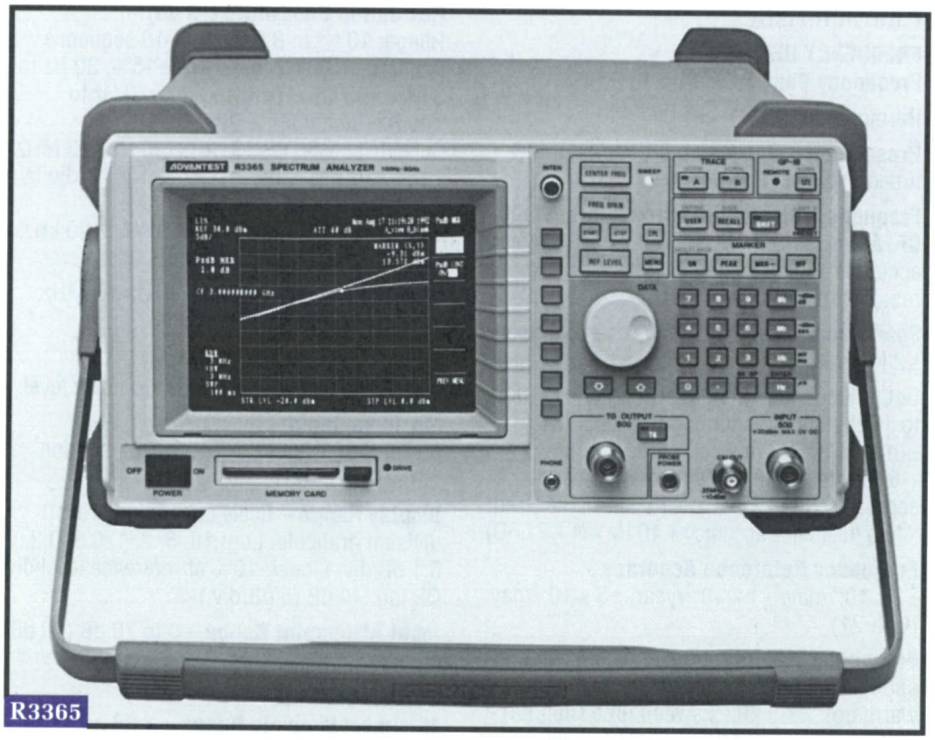
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The R3271 complies with IEEE Standard 488.1-1987.

# Spectrum Analyzers

**R3265**
**R3365**





R3365

## R3265/R3365 Spectrum Analyzer

The R3265/R3365 is a quasi-microwave spectrum analyzer designed to meet user needs and to ensure easy operations. The R3265/R3365 incorporates a time domain function so it can be used for both digital and analog mobile communication. The R3265/R3365 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 R3265/R3365 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 R3265/R3365 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.

The R3265 and R3365 are identical except that the R3365 includes a built-in tracking generator to facilitate frequency response measurements, and provides scalar network analyzer capability (with an external SWR bridge).

### HIGH-PRECISION MEASUREMENT BY SOFTWARE CALIBRATION

An internal CPU corrects not only the intermediate frequency (IF), but also the frequency response, including the attenuator, to improve the accuracy of amplitude measurements. During noise measurement, the power bandwidth is also corrected.

### RESOLUTION BANDWIDTH OF 10 HZ TO 3 MHZ

For frequency resolution, the R3265/R3365 incorporates a narrow-band (10 Hz) IF bandwidth filter that can separate nearby signals from the wide IF bandwidth filter (3 MHz) to improve the measurement sensitivity to a pulsed RF signal. This allows the R3265/R3365 to be used for a wide variety of measurements.

The narrowband IF bandwidth filter also incorporates a digital IF filter, thus enabling nearby measurements with both high selectivity and high-speed measurements.

### PORTABLE SYSTEM WITH A LARGE CRT DISPLAY

The R3265/R3365 portable spectrum analyzer employs an eight-inch CRT that displays measurement results, thus ensuring accurate monitoring and easy operation.

**R3265/R3365**

- 100 Hz to 8 GHz Frequency Range
- –145 dBm Sensitivity to 3.6 GHz (–135 dBm to 8 GHz)
- High-Speed 5 µs/div. Sweep and Digital Read Output
- Built-in 100 kHz to 3.6 GHz Tracking Generator (R3365)
- TDMA Signal Analysis
- Memory Card Function
- Multi-Marker with up to Eight Points
- Extensive EMC Measurement Functions
- Confirms to MIL-T-28800 Standards

*High performance quasi-microwave spectrum analyzer. R3365 includes built-in tracking generator.*

ADVANTEST

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The R3265 complies with IEEE Standard 488.1-1987.

# Spectrum Analyzers



### BURST SIGNAL ANALYSIS FUNCTIONS

- **Fast Digitized Sweep.** The R3265/R3365 uses 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 R3265/R3365 includes a burst signal (TDMA and video signals) analysis function as a standard feature. When combined with the high-speed sweep, this function 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. Opt. 71 incorporates this signal, which facilitates operations considerably.
- **Delayed Sweep.** The delayed sweep (Opt. 71) can be used to analyze the frequency of only the portion specified in the zero-span mode (time domain) and to expand the portion specified in the zero-span mode. Any gate signal is internally produced from a trigger signal source. This gate signal enables the portion you wish to analyze to be gated, the frequency to be analyzed partially, and the time domain waveform to be expanded.

### MEASUREMENT OF OCCUPIED FREQUENCY BANDWIDTHS AND ADJACENT-CHANNEL LEAKAGE POWER

By calculating the measured spectrum data, the R3265/R3365 can easily measure the occupied frequency bandwidth of a radio transmission characteristic and the leakage power of an adjacent channel. 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 R3365 includes 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.

## Characteristics

### FREQUENCY RELATED

**Frequency Range –** 100 Hz to 8 GHz.

**Harmonic Mode (N) –** =1.

**Preselector –** 3.5 GHz to 8 GHz 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 –** ±2 x $10^{-5}$/day, ±1 x $10^{-7}$/year, ±5 x $10^{-9}$/day (Opt. 21).

**Frequency Stability –** Residual FM (zero span): <3 Hz p-p/0.1s. Drift (after 1 hour warm up): <2.5 kHz x sweep time (minute). 50 kHz < span ≤2 MHz . <60 Hz x sweep time (minute). Span ≤50 kHz.

**Spectral Purity –** Noise sidebands

| Offset | f ≤2.6 GHz | f >2.6 GHz |
|---|---|---|
| 1 kHz | <–100 dBc/Hz | –95 dBc/Hz |
| 10 kHz | <–110 dBc/Hz | –108 dBc/Hz |
| 20 kHz | <–110 dBc/Hz | –108 dBc/Hz |
| 100 kHz | <–114 dBc/Hz | –110 dBc/Hz |

**Frequency Span –**
Linear span: Range: 200 Hz to 8 GHz, zero span. 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: +30 dBm (1 W) (Input attenuation ≥10 dB). DC: 0 W.

**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 gain compression to noise level: 200 MHz to 3.6 GHz: 135 dB –1.55 f (GHz) dB. 10 MHz to 3.6 GHz: 130 dB –1.55f (GHz) dB.
Signal distortion harmonic: 100 MHz to 1.8 GHz: 87 dB. 10 MHz to 3.6 GHz: 82.5 dB. >3.5 GHz: 112 dB
Third order Intermodulation: >200 MHz: 93 dB. >10 MHz: 90 dB.

**Displayed average noise level (10 Hz res. BW, 0 dB input attenuation, 20 times average.) –** 1 kHz: –100 dBm.
10 kHz: –110 dBm. 100 kHz: –111 dBm.
1 MHz: –135 dBm. 10 MHz to 3.6 GHz (low noise mode): –(145 –1.55f (GHz)) dBm. 3.5 GHz to 8 GHz: –135 dBm.

### SPURIOUS RESPONSE

| | | Freq. Range | Mixer Level |
|---|---|---|---|
| Second Harmonic Distortion | <–70 dBc | 100 MHz to 3.6 GHz | –30 dBm |
| | <–60 dBc | 10 MHz to 3.6 GHz | –30 dBm |
| | <–100 dBc | >3.5 GHz | –10 dBm |
| Third Order Intermodulation Distortion | <–70 dBc | 200 MHz to 3.6 GHz | –30 dBm |
| | <–60 dBc | 10 MHz to 3.6 GHz | –30 dBm |
| | <–75 dBc | >3.5 GHz | –30 dBm |
| Residual Responses (no signal at input, 0 dB RF attenuation) | <–100 dBm | 1 MHz to 3.6 GHz | |
| | <–90 dBm | 300 kHz to 8 GHz | |

# Spectrum Analyzers

**R3265**
**R3365**



**AMPLITUDE ACCURACY**
**Frequency response –** In band flatness (10 dB input attenuation): 100 Hz to 3.6 GHz: ±1.5 dB. 50 MHz to 2.8 GHz: ±1.0 dB. 3.5 GHz to 7.5 GHz: ±1.5 dB. 7.4 GHz to 8 GHz: ±1.5 dB. Additional uncertainly due to band switching: ±0.5 dB. Frequency response referenced to CAL signal (10 dB input attenuation): 100 Hz to 8 GHz, ±3 dB.

**Calibrator accuracy –** –10 dBm ±0.3 dB.

**IF gain uncertainty (after automatic calibration) –** ±0.5 dB: 0 dBm to –50 dBm. ±0.7 dB: 0 dBm to –80 dBm.

**Scale fidelity –** Log: ±0.2 dB/1 dB, ±1 dB/10 dB, ±1.5 dB/90 dBm. 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 8 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) p-p –** Log: 1.2 dB (RBW ≤1 MHz), 3 dB (RBW =3 MHz). Linear: 4% of ref. level (RBW ≤1 MHz), 12% of ref. level (RBW 3 MHz).

**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 – WITH OPT. 71.**
**Trigger signal source –** External trigger signal (input from the external trigger input connector). 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 (the resolution is the same as that set in the sweep time).

**Gated sweep specifications –**
Trigger signal source: Produces a gate signal. Input from the external trigger input connector or gate input connector.
Frequency domain analysis: External trigger input and gate input.
Time domain analysis: External trigger input, gate input.

**Gate position –** 300 ns to 100 ns with resolution of 100 ns.

**Gate width –** 1 µs to 1.5 s with a resolution of 100 ns.

**TRACKING GENERATOR (R3365)**
**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). Impedance: 50 Ω (nominal). VSWR (input attenuation ≥10 dB, at tuned frequency): ≤3.6 GHz: <1.5:1 (nominal). >3.6 GHz: <2.0:1 (nominal).
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.

**Phone Output –** Demodulated audio. Connector: Subminiature monophonic jack, front panel. Power output: 0.2 watt, 8 Ω (nominal).

**GPIB Interface –** Enables remote operation and data input/output.
Connector: IEEE-488 bus connector.
Direct plotter output: Supports Tektronix HC100 Opt. 01, HP7470A, HP7475A, HP7440A, HP7550A, or other HPGL plotters.

**GENERAL SPECIFICATIONS**
**Environmental –** Operating temperature: 0° C to +50° C. Nonoperating temperature: –20° C to +60° C. Humidity: RH 85%.

**Safety –** This product has been safety tested by Advantest to IEC 348 specifications.

**Power Requirements –** Operating voltage: Automatically selects between 100 VAC and 220 VAC. 100 VAC: 90 V to 132 V. 220 VAC: 198 V to 250 V. Power Consumption: Max. 400 VA. Max. 400 VA. Frequency: 48 Hz to 440 Hz

**PHYSICAL CHARACTERISTICS**

| Dimensions | mm | in. |
|---|---|---|
| Height | 177 | 7.0 |
| Width | 353 | 13.9 |
| Depth | 450 | 17.7 |
| **Weight** | **kg** | **lb.** |
| Nominal | 22 | 48.5 |

## ORDERING INFORMATION

**R3265**
Spectrum Analyzer ..... **$28,500**

**R3365**
Spectrum Analyzer ..... **$38,000**
**Includes:** Power Cord, BNC-BNC Input Cable, N Type-BNC Input Cable, N-BNC Adapter, Memory Card, Front Cover, Instruction Manual.

**Opt. 15 –** Add controller function ..... **+$2,900**
**Opt. 21 –** Add 5 x $10^{-9}$/day crystal ..... **+$600**
**Opt. 71 –** Add delayed sweep ..... **+$2,300**

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

**PROBES**
**FET Probe –** DC to 900 MHz (Requires 1101A). Order P6201 ..... **$1,550**
**FET Probe –** DC to 500 MHz. Order P6202A ..... **$1,025**
**50 Ω Divider Probe –** DC to 3.5 GHz, 6 ft. Order P6156 ..... **$265**
**Current Probe –** 935 Hz to 120 MHz. Order P6022 ..... **$595**
**Plotter –** Order Tektronix HC100 Opt. 01 ..... **$1,260**
**Memory Card –** Set of five 32 KB cards. Order A09505 ..... **$500**
**Memory Card –** Set of five 128 KB cards. Order A09506 ..... **$1,400**
**Preamplifier –** 9 kHz to 1 GHz, ≥ 25 dB. Order R14601 ..... **$995**
**SWR Bridge –** 50 MHz to 2 GHz, 50Ω, Type N connectors. Order 60NF50 ..... **$4,275**
**Aluminum Transit Case –** Order R16059 ..... **$1,000**
**Rackmount Adapter –** Order A02459 ..... **$300**

**ADVANTEST**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The R3265 complies with IEEE Standard 488.1-1987.

# TV Sideband Adapter



*Use with compatible spectrum analyzers to display the frequency response characteristics of RF and IF circuits in TV transmission systems.*

**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/TV Sideband Adapter

The 1405 Sideband Adapter works with 279X, 275X, 271X, and 49X 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 display frequency characteristics of RF and IF circuits with frequencies to 1 GHz. Video circuits can also be analyzed.

Corrected frequency/channel dials for the 1405 are provided by Option 02 (for use with the 279X Series) and Option 03 (for use with the 271X Family).

Call your local sales engineer for additional information.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

## ORDERING INFORMATION

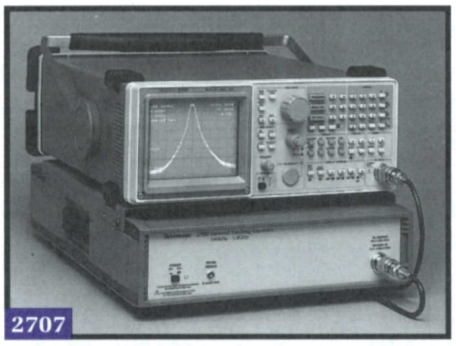
**1405**
TV Sideband Adapter 525/60 Markers ..... **$7,175**
**Includes:** Instruction Manual (070-2078-00).
**Opt. 01** – TV Sideband Adapter (625/50 Markers) ..... **+$200**
**Opt. 02** – Dial Readout for 2790 Series Spectrum Analyzers ..... **NC**
**Opt. 03** – Dial Readout for 271X Series Spectrum Analyzers ..... **NC**

**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1** – Universal Euro 220 V, 50 Hz ..... **NC**
**Opt. A2** – United Kingdom 240 V, 50 Hz ..... **NC**
**Opt. A3** – Australian 240 V, 50 Hz ..... **NC**
**Opt. A4** – North American 240 V, 60 Hz ..... **NC**
**Opt. A5** – Switzerland 220 V, 50 Hz ..... **NC**
See Customer Information Section for additional description.
**Rackmount Conversion Kit** – Standard 19 in. Rack. Order 016-0489-00 ..... **$735**

# Tracking Generators

**2711/2712 OPT. 04** | **TR503 2707**






## Characteristics (w/271X Series)

2711/2712 Opt. 04 Internal Tracking Generator. 2707 External Tracking Generator.

**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.

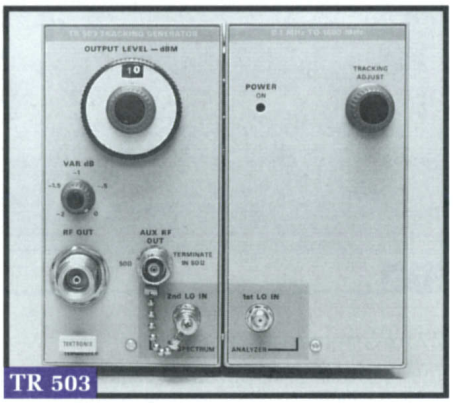
**Dynamic Range (System) –** ≥100 dB typical.

**Spurious Responses (harmonically related) –** ≤–20 dBc at ≥100 kHz.

**Spurious Responses (non-harmonically related) –** ≤–30 dBc at ≥100 kHz.

Request Data Sheet 2EW-8875-0 (External Tracking Generator) or 2EW-8451-0 (Internal Tracking Generator) for full characteristics.

Characterize filters, check duplexers or cables, make frequency response, SWR measurements (with a return-loss bridge), EMI site attenuation tests, and much more. The 271X and 279X Spectrum Analyzer/tracking generator systems provide at least 100 dB dynamic range to see filter ultimate rejection or circuit isolation characteristics.




## TR 503 Characteristics (w/2790 Series)

**Frequency Range –** 100 kHz to 1.8 GHz.

**Output Level –** (Max) 0 dBm ±0.5 dB.

**Range –** 0 to –59 dBm in 10 dB and 1 dB steps.

**Flatness –** Within ±2.25 dB Max from 100 kHz to 1.8 GHz (Typically ±1.5 dB).

**Dynamic Range –** ≥110 dB.

**Residual FM –** 10 Hz p-p.

**Output Impedance –** 50 Ω Nominal, VSWR 2:1 or less to 1.8 GHz.

**Auxiliary Output –** 0.1 V RMS into 50 Ω load. 7 dBm minimum.

**2711/2712 OPT. 04/2707**

- Internal Tracking Generator for 2711 and 2712 (Opt. 04)
- 2707 External Tracking Generator For 2711, 2712, and 2714 (Must Be Used For Tracking Generator Capability with 2712 Opt. 12 or 14 and 2714)
- Swept Measurements 100 kHz – 1.8 GHz
- Output from –48 dBm to 0 dBm (–1.2 dBmV to 46.8 dBmV) in 0.1 dB steps

**TR 503**

- Swept Measurements to 1.8 GHz
- Enhances Dynamic Range to Better than 110 dB
- Very Stable – Useful as a CW Signal Source
- Auxiliary, Constant Level Output Provides for Frequency Counter Measurement Even of Signals at the Noise Floor
- UL Listed 1244

*2707 External Tracking Generator for the 2711, 2712, and 2714 Spectrum Analyzers.*

*2711, 2712 Opt. 04 Internal Tracking Generator*

*TR 503 Tracking generator for 490, 2750, and 2790 Series Spectrum Analyzers.*

## ORDERING INFORMATION

**2707**
External Tracking Generator ..... TD **$3,950**
May also be ordered as part of 2711, 2712 or 2714 Spectrum Analyzers. Specify 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.

**2711/2712 INTERNAL TRACKING GENERATOR.**
Order 2711 Opt. 04 or 2712 Opt. 04 ..... **$3,150**
See page 210 for more information.

**Opt. 01 –** 75 Ω output..... **NC**
**Includes:** Type F-to-BNC adapter and Type F-to-F adapter, plus standard accessories noted above except Type N-to-BNC adapter.

**2707 COMPATIBILITY KITS**
2711, 2712, and 2714 with Opt. 15 (1st LO output) installed.
Order 040-1406-00..... **$345**
2711, 2712, and 2714 without Opt. 15 installed.
Order 040-1407-00..... **$525**
2711, 2712 and 2714 1st LO Output. Order 040-1408-00..... **$280**

**TR 503**
Tracking Generator..... **$8,500**
**Includes:** Two 50 Ω coax cables (012-0649-00); N male to BNC female adapter (103-0045-00); Retainer Plug-in (343-0604-00); Instruction Manual (070-3526-00).

**ACCESSORIES**
**Power Module –** Order TM 503B ..... **$495**
**Power Module –** Order TM 504..... **$780**
**Blank Panel –** Order 016-0195-05..... **$47**
**Rackmount Conversion Kit –** Standard 19 in. Rack.
Order 016-0489-00..... **$735**

**INTERNATIONAL POWER PLUG OPTIONS**
Opt. A1 - Opt. A5 available. See Customer Information Section for additional description.

TD
2707 available within 24 hours through TekDirect
Call 1-800-426-2200.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

2712
2711

# Spectrum Analyzers
## Versatile, Low-Cost

*Lightweight, portable spectrum analyzers – packed with affordable measurement power.*

**2712**

- High Value, Low Cost
- 5 x $10^{-7}$ Frequency Accuracy
- Sensitivity to –139 dBm (–92 dBmV) with Built-in Preamp
- Internal Frequency Counter
- Full Programmability
- Real Time Clock
- 124K 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

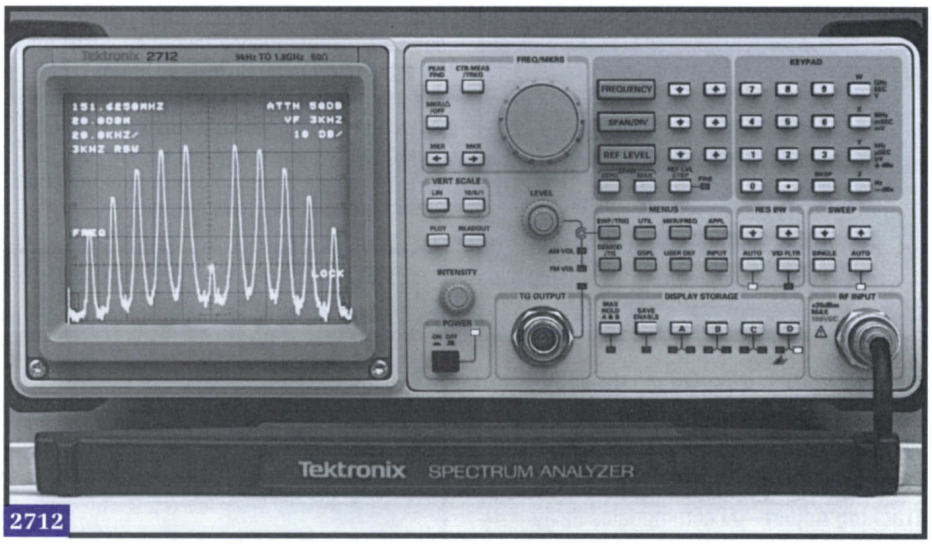
**2711**

- Economical, Can Be Configured to Meet Most Budgets
- High Portability
- Internal or External Tracking Generator Option
- Video Monitor Mode Option
- GPIB or RS-232 Interface Option
- Excellent Frequency Accuracy and Sensitivity
- 3-Control Operation for Most Measurements
- UL Listed 1244, CSA Bulletin 556B

TD
2712 and 2711 available within 24 hours through TekDirect
Call 1-800-426-2200.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488
The 2712 and 2711 comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.



2712

### 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 nonvolatile 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 radio measurements.

The optional internal or external tracking generator provides high dynamic range swept measurements to 1.8 GHz.

**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 |
| Nonvolatile Memory | 124K | 28K (124K 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 |

*Continued on next page.*

# Spectrum Analyzers
## Versatile, Low-Cost

**2712**
**2711**



**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 pages 220 to 223.

### 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. Compact size, light weight (9.5 kg, about 21 lb.). Both instruments can also be quickly converted to rack operation with optional rackmount 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 troubleshooting 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.

### Characteristics

The following characteristics apply to both the 2712 and 2711 after a 15-minute warmup period, unless otherwise noted.

**FREQUENCY RELATED**

**Frequency Range –** 9 kHz to 1800 MHz.

**Center Frequency Accuracy –** 2712: 5x$10^{-7}$ of CF ±700 Hz; 2711: 1x$10^{-5}$ of CF ±5 kHz.

**Frequency Counter Accuracy** (Std 2712, Opt 02 2711) **–** 2712: 5x$10^{-7}$ of CF ±10 Hz, ±1 LSB. 2711: 1x$10^{-5}$ 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 w/Opt. 14: Add 1 MHz, 100 kHz, 10 kHz, and 1 kHz; 2712 w/Opt. 12: add 1 MHz, 120 kHz, 9 kHz, 1 kHz to 200 Hz replaces 300 Hz filter.

**Resolution Bandwidth Shape Factor** (60 dB/6 dB) **–** ≤7:1

**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 2 significant digits via menu.

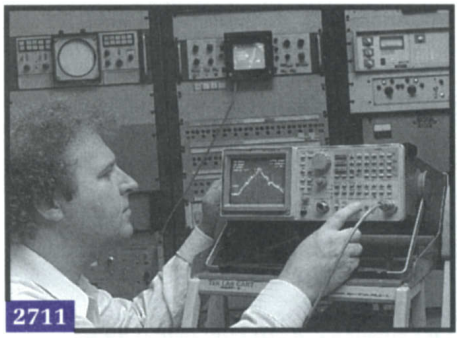
**Span Accuracy –** ±3% over the center eight divisions.

**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 down 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



**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 VDC (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 eighteen shocks.

**Radiated and Conducted Emissions –** Meets FCC Part 15, Sub-part J, Class A and VDE 0871, Class B.

**GENERAL CHARACTERISTICS**
**Power Requirements –** 90 W max. (1.2 A) at 115 V, 60 Hz. Operates 48 Hz to 440 Hz, 90 to 132 VAC, or 48 Hz to 63 Hz to 250 VAC. Battery power (Opt. 07) available.

**Weight –** 9.5 kg (<21 lb.) nominal for basic configuration.

**Dimensions (H,W,D) with Feet, Handle, and Front Panel Cover –** 137 x 361 x 445 mm (5.4 x 14.2 x 17.5 in.).

**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.

**Nonvolatile 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 4 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 w/ Opt. 02.

**Signal Track –** Drifting signal is kept at display center with correct frequency and peak amplitude displayed.

**Graticule Illumination –** For CRT photography.

**Direct Plot/Print –** Supports Epson FX and LQ Series Printers and Tektronix HC100 Printer/Plotter via built-in GPIB interface (std 2712, 2711 Opt. 03), RS-232C interface (Opt. 08, 2712 and 2711).

*1 *Typical but nonwarranted performance parameters.*

*2 *Up to 108 saved displays, 36 front-panel setups available with Opt. 03 or 08.*

TD
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The 2712 and 2711 comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

## ORDERING INFORMATION

**2712**
Spectrum Analyzer ..... TD **$11,950**
**Includes:** Power cord (U.S. 115 V/60 Hz), Operator's Manual, Pocket Reference Guide, Programmers Manual, front cover, and N-to-BNC adapter.

**2711**
Spectrum Analyzer. ..... TD **$8,750**
**Includes:** Power cord (U.S.115 V/60 Hz), Operator's Manual, front cover, and N-to-BNC adapter.

**Opt. 02 –** (2711 only) Add internal frequency counter with selectable 1 kHz/1 Hz readout resolution. ..... **+$820**

**Opt. 03 –** (2711 only) GPIB Interface. Full programmability, direct print, additional NV RAM, and real time clock. Cannot combine with Opt. 08 ..... **+$790**

**Opt. 04 –** Add internal tracking generator, 100 kHz-1800 MHz, 0 dBm to –48 dBm in 0.1 dB steps (Not compatible with Opt. 12 or 14/2712 only – order external tracking generator Opt. 05 instead.). ..... **+$3,150**

**Opt. 05 –** External tracking generator with active probe power jack. Not compatible with Opt. 04 ..... **+$3,950**

*Continued on next page.*

# Spectrum Analyzers
## Versatile, Low-Cost





## ORDERING INFORMATION

**Opt. 08 –** (2712 only) Replace GPIB with RS-232C interface. ..... **NC**

**Opt. 08 –** (2711 only, Not compatible with Opt. 03.) RS-232 Interface, full programmability, direct print, additional NV RAM, and real time clock ..... **+$790**

**Opt. 10 –** Video monitor mode. ..... TD **+$650**

**Opt. 12 –** (2712 only) Add Quasi-peak Detector (built-in). **Includes:** 200 Hz, 9 kHz, and 120 kHz EMC filters; 1 kHz and 1 MHz RBW filters. Not compatible with Opt. 04 or 14. ..... TD **+$1,480**

**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. ..... **+$600**

**Opt. 15 –** 1st LO output for use with Tektronix 1405 TV Sideband Adapter interface ..... TD **+$280**

**Opt. 20 –** EMC antenna set plus tripod and coax suitable for tests to 1 GHz (contact Tektronix Sales Engineer for more information) ..... **+$3,290**

**Opt. 21 –** Add 2706 Stepping RF Preselector ..... **+$4,250**

**Opt. 30 –** Rackmount for 19 in. rack width, 5.25 in. height. ... **+$250**

**Opt. 33 –** Travel Line Package. Includes: accessory pouch, carrying strap, vinyl rain cover ..... **+$100**

**Opt. 34 –** Portable-to-Rackmount Adapter for 19 in. rack width, 7 in. height ..... **+$590**

### INTERNATIONAL POWER PLUG OPTIONS

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

**Opt. A2 –** United Kingdom 240 V, 50 Hz ..... **NC**

**Opt. A3 –** Australian 240 V, 50 Hz ..... **NC**

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

**Opt. A5 –** Switzerland 220 V, 50 Hz ..... **NC**

See Customer Information Section for additional description.

**Opt. B1 –** Service Manual ..... **+$135**

**Opt. B2 –** Additional Set of Manuals ..... **+$215**

### WARRANTY-PLUS SERVICE OPTIONS

**OPT. M7 – CALIBRATION SERVICE**

2711 ..... **+$245**
2712 ..... **+$335**

**OPT. M9 – REPAIR PROTECTION**

2711 ..... **+$490**
2712 ..... **+$670**

### SOFTWARE

See Pages 221 and 226 for additional information.

**271x PC Utility Software –** Order S26UT10 ..... **$575**

**EMI Commercial Test Software –** Order S26EMI2 ..... **$1,750**

**EMI Ancillary Devices –** See Page 223.

### RECOMMENDED ACCESSORIES

See Page 424 for complete Selection Information.

### PROBES

**Active –** All require 1103 Power Supply
4 GHz, 0.4 pF/100 kΩ, 1 M. Order P6217 ..... **$3,495**
750 MHz, 2 pF/1 MΩ, 1.5 M. Order P6205 ..... **$495**
TEKPROBE® Power Supply. Order 1103 ..... **$600**

**Camera –** Low cost. Order C-9 Opt. 1A & Opt. 20 ..... **$875**

**Plotter –** Four color. (GPIB) Order HC100 Opt. 01 ..... **$1,260**
(RS-232). Order HC100 Opt. 03 ..... **$1,145**

**CART –** K218 Instrument Cart ..... **$745**

**POWER SPLITTER –** 75 Ω/50 Ω BNC Output, 50 Ω BNC Input.
Order 067-1232-00 ..... **$275**

### CABLES, PADS, AND ADAPTERS

**50 Ω Coaxial Cable –**
BNC to BNC 5.5 in. Order 012-0214-00 ..... **$60**
BNC to BNC, 18 in. Order 012-0076-00 ..... **$33**
BNC to BNC, 42 in. Order 012-0057-01 ..... **$30**

**75 Ω Coaxial Cable –** BNC to BNC, 42 in.
Order 012-0074-00 ..... **$33**

**GPIB Cables –**
0.5 m. Order 012-1282-00 ..... **$150**
1 m. Order 012-0991-01 ..... **$170**
2 m. Order 012-0991-00 ..... **$170**
4 m. Order 012-0991-02 ..... **$260**

**RS-232 Modem Cables –**
9-Pin female to 25-Pin male. Order 012-1241-00 ..... **$70**
9-Pin female to 9-Pin female. Order 012-1379-00 ..... **$65**
9-Pin female to 25-Pin female. Order 012-1380-00 ..... **$60**

**75 Ω to 50 Ω Minimum Loss Adapter –** With DC block, 5.7 dB loss. Order 011-0112-00 ..... **$105**

**75 Ω BNC to 50 Ω Type N Minimum Loss Attenuator –**
Order 131-4199-00 ..... **$55**

**75 Ω to 50 Ω Matching Attenuator –** With 11.25 dB conversion factor from dBm to dBV with DC block.
Order 011-0118-00 ..... **$95**

**"F" Female to BNC Male Adapter –** Order 013-0126-00 ..... **$24**

**BNC Female to "F" Male Adapter –** Order 103-0158-00 ... **$15.50**

**"N" Female to BNC Male Adapter –** Order 103-0058-00 ... **$18.75**

**75 Ω to 50 Ω Matching Transformer –** 0.5 dB loss.
50 kHz to 300 MHz. Order 120-1883-00 ..... **$170**
5 MHz to 1 GHz. Order 120-1884-00 ..... **$170**

### GPIB CARDS

**PC-GPIB Card –** IBM PC, AT, and compatibles.
Order S3FG210 ..... **$395**

**AT-GPIB Card –** IBM AT Bus (high speed card).
Order S3FG220 ..... **$495**

**MC-GPIB Card –** IBM PS/2 with Microchannel Bus.
Order S3FG230 ..... **$495**

### ADDITIONAL ACCESSORIES

**Service Manual –**
2712. Order 070-8130-01 ..... **$135**
2711. Order 070-8130-01 ..... **$135**

**Front Panel Cover –** Order 200-2520-00 ..... **$12.25**

**Transit Case –** Order 016-0792-02 ..... **$460**

**Soft Side Case –** Order 016-1158-00 ..... **$120**

**Rain Cover –** Order 200-2500-00 ..... **$12.25**

**Accessory Pouch –** Mounts on top. Order 016-0617-03 ..... **$75**

**Carrying Strap –** Order 346-0199-00. ..... **$22**

**Viewing Hoods –**
Collapsible. Order 016-0592-00 ..... **$20**
Binocular. Order 016-0566-00 ..... **$30**
Polarized. Order 016-0180-00 ..... **$100**

**CRT Filter –** Smoke Gray. Order 337-2775-02 ..... **$11**

TD
Product available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488
The 2712 and 2711 comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Spectrum Analyzer
## Cable TV



*Cable ready RF testing from Tektronix. Highly portable with Selectable Digital and True Analog Display.*

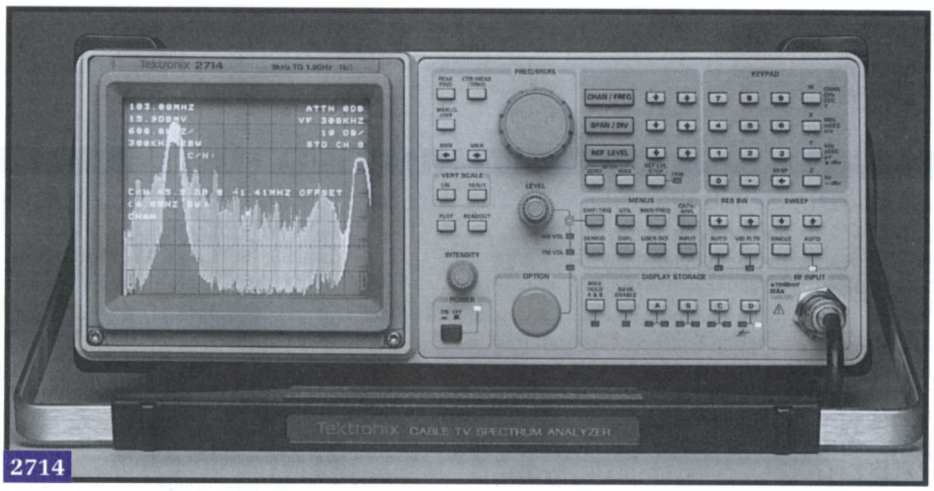
**2714**

- 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

TD
Product available within 24 hours through TekDirect.
Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488
The 2714 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.




*The 2714 simplifies 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.

**BUILT-IN, AUTOMATIC MEASUREMENTS**

The 2714 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
- Survey of system visual and aural carrier levels and frequencies
- Depth of modulation
- Aural carrier deviation measurement
- 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

*Continued on next page.*

# Spectrum Analyzer
## Cable TV



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.

Measurement results can be output to a printer or plotter connected directly to the 2714's interface port. Results can also be automatically stored in the 2714's nonvolatile memory for later transfer to a PC. This, along with high portability, makes the 2714 ideal as an automatic data collection tool in the field for engineers and technicians alike.

**THE 2714 CAPITALIZES ON PC POWER**

The PC-based software package that accompanies the 2714 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 2714's built-in measurements. Creating a test sequence is a simple matter of indicating the desired tests in an on-screen setup matrix.

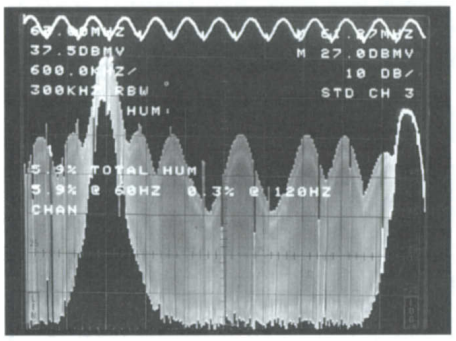
**Report Generator –** You can generate test and measurement reports that can be in any of several forms. These reports are directly usable for presentation of proof-of-performance data.

**Historical Database –** Data storage, archiving, and analysis for creating and comparing histories of previous measurements are provided.

**Remote Control –** Your PC can execute tests and measurements on a remotely located 2714 and receive results at the PC. Communication between the computer and the 2714 is through the RS-232 interface.

**GENERAL PURPOSE CAPABILITIES**

In addition to its special cable TV features, the 2714 also doubles as a highly capable, general-purpose spectrum analyzer. You get excellent RF performance, a built-in frequency counter, full programmability, enough nonvolatile 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.




*Measurement conditions and results are clearly displayed on-screen. Text can even be added, to describe measurement location for example.*

The 2714 can also be used to characterize filters, cable trunk amplifiers, line extenders, and other 2-port devices when used with the Opt. 05 External Tracking Generator.

## Characteristics

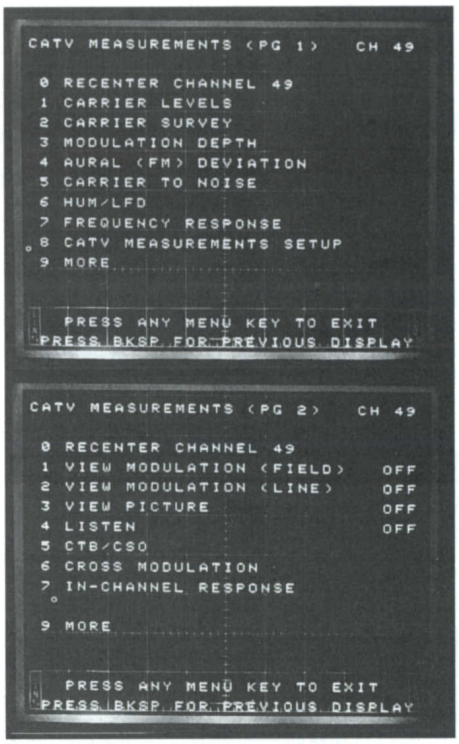
**CABLE TV MEASUREMENTS**

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 2714 PC software.
Channel Number Range: 0 to 999; configured using 2714 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.




*Pressing the CATV/APPL front-panel button provides easy access to the CATV Measurement Mode menu display*

**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: 0-30 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.

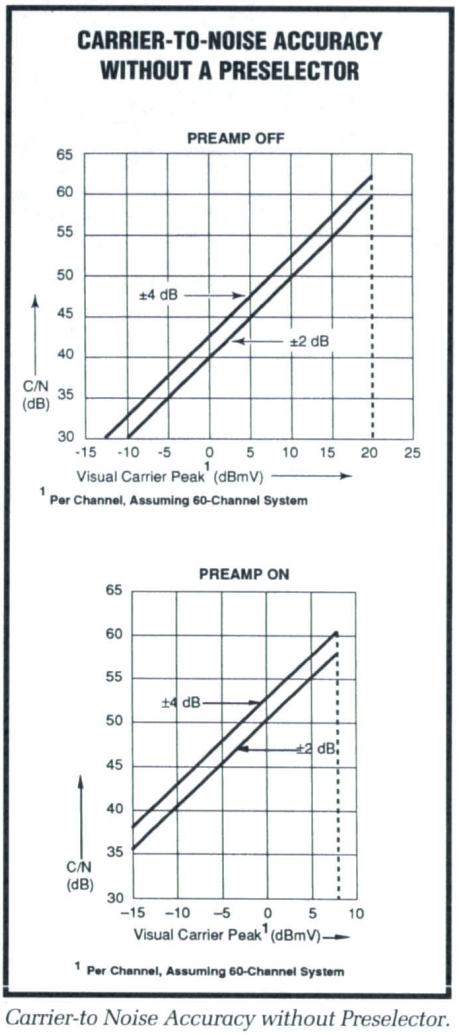
**Modulation Depth –** % AM measured from sync tip to lowest white level in 10 sweeps (VITS line used if defined in channel table).
AM Range: 50% to 95%.
Resolution: 0.1%.
Accuracy: ±2% for visual carrier to noise ≥40 dB (300 kHz RBW).

# Spectrum Analyzer
## Cable TV



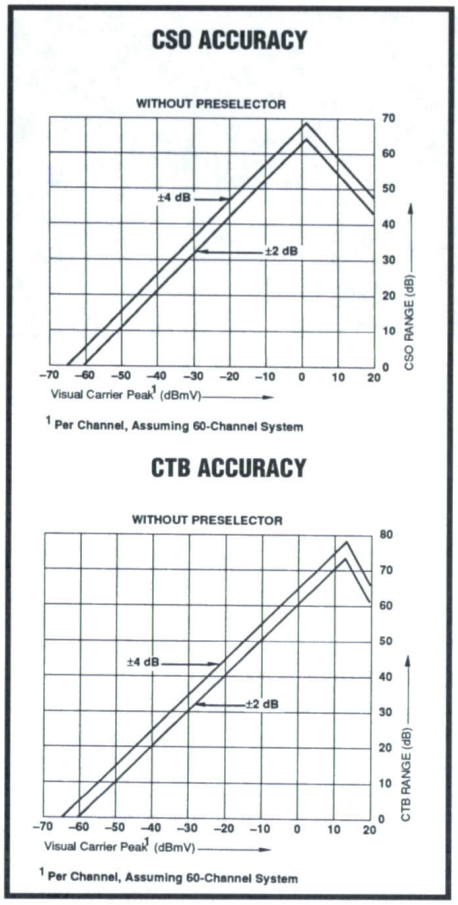
**Hum/Low-Frequency Disturbance –** Power line frequency measured on an unmodulated visual carrier and low frequency disturbance measured on the modulated carrier.
AM Range: 1% to 10% peak-to-peak.
Resolution: 0.1%.
Accuracy: ±1% for hum ≤5% and visual carrier to noise ≥25 dB (300 kHz RBW); ±2% for hum, <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: See figure below.
Resolution: 0.3 dB.




*Carrier-to Noise Accuracy without Preselector.*

**CTB/CSO –** Measured relative to visual carrier peak according to NCTA recommendations.
Range and Accuracy: See following figure.
Resolution: 0.3 dB.




*CTB/CSO Accuracy without Preselector.*

**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.
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 FAST SURVEY is DISABLED.
**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: 52 dB; usable to 65 dB.
Resolution: 0.1 dB.
Accuracy: ±2 dB for cross modulation <40 dB; ±3 dB for cross modulation <52 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 –** NTSC or PAL visual carrier is demodulated and displayed.

**View Modulation** (Field) **–** One video field of the selected channel's video is displayed.

**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 or PAL.
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 –** $5 \times 10^{-7}$ of center frequency ±700 Hz.

**Frequency Counter Accuracy –** $5 \times 10^{-7}$ 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).

*Continued on next page.*

# Spectrum Analyzer
## Cable TV



**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 VDC 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, Method 514, Procedure X (modified).

**Shock –** Operating and nonoperating: Three guillotine-type shocks of 30 g, one-half sine, 11 ms duration each direction along each major axis; total of 18 shocks.

**Altitude –** Operating: 15,000 ft. Nonoperating: 50,000 ft.

**Radiated and Conducted Emissions –** Meets FCC Part 15, Subpart B, Class A and VDE 0871, Class B.

**GENERAL CHARACTERISTICS**

**Power Requirements –** 105 W maximum (1.4 A) at 115 V, 60 Hz: operates 48 Hz to 440 Hz, 90 to 132 VAC, or 48 Hz to 63 Hz, 90 VAC to 250 VAC.

**Weight –** <10.2 kg (22.5 lb.) nominal for basic configuration.

**Dimensions (H,W,D with Feet, Handle, and Front-Panel Cover) –** 137 x 361 x 445 mm (5.4 x 14.2 x 17.5 in.).

**Note:** Full specifications are available in the 2714 Cable TV Spectrum Analyzer Data Sheet, Tektronix Literature number 2EW-8705-1.

## ORDERING INFORMATION

**2714**
Cable TV Spectrum Analyzer ..... TD **$14,200**
**Includes:** PC Software, power cord (U.S. 115 V/60 Hz), User 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). ..... **NC**

**Opt. 05 –** 100 kHz to 1.8 GHz External Tracking Generator with mechanical mating kit (includes Opt. 15). ..... **+$3,950**

**Opt. 08 –** Provides an RS-232 port as a no-cost option (not compatible with Opt. 03) ..... **NC**

**Opt. 15 –** Add 1st local oscillator output for a 1405 TV Sideband Analyzer ..... TD **+$280**

**Opt. 30 –** Rackmount adapter for 19 x 5.25 in. ..... **+$250**

**Opt. 33 –** Travel Line package; includes: rain cover, accessory pouch, gray CRT filter, and carrying strap ..... **+$100**

**Opt. 34 –** Portable-to-rackmount adapter for 19 x 7 in. ..... **+$590**

**Opt. B1 –** Service Manual ..... **+$135**

**Opt. B2 –** Additional set of manuals ..... **+$240**

**INTERNATIONAL POWER PLUG OPTIONS**

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

**Opt. A2 –** United Kingdom 240 V, 50 Hz ..... **NC**

**Opt. A3 –** Australian 240 V, 50 Hz ..... **NC**

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

**Opt. A5 –** Switzerland 220 V, 50 Hz ..... **NC**

See Customer Information Section for additional description.

**WARRANTY-PLUS SERVICE OPTIONS**

**Opt. M7 –** Calibration Service ..... **+$400**

**Opt. M9 –** Repair Protection ..... **+$795**

**SOFTWARE**

See Page 226 for additional information.

**271x PC Utility Software –** Order S26UT10 ..... **$575**

**RECOMMENDED ACCESSORIES**

See Accessories section page 424 for complete selection information.

**Camera –** Low cost. Order C-9 Opt. 1A and Opt. 20 ..... **$875**

**Plotter –** Four color. Order HC100 Opt. 01 ..... **$1,260**

**CART –** K218 Instrument Cart ..... **$745**

**CABLES, PADS, AND ADAPTERS**

**75 Ω Coaxial Cable –**
BNC to BNC 42 in. Order 012-0074-00 ..... **$33**
BNC to BNC 24 in. Order 012-1339-00 ..... **$45**

**F Series Input Adapter/Connector Replacement –**
Order 103-0301-00 ..... **$20**

**BNC Input Adapter/Connector Replacement –**
Order 103-0310-00 ..... **$36**

**GPIB Cables –** 0.5 m. Order 012-1282-00 ..... **$150**
1 m. Order 012-0991-01 ..... **$170**
2 m. Order 012-0991-00 ..... **$170**
4 m. Order 012-0991-02 ..... **$260**

**RS-232 Modem Cables –**
9-Pin female to 25-Pin male. Order 012-1241-00 ..... **$70**
9-Pin female to 9-Pin female. Order 012-1379-00 ..... **$65**
9-Pin female to 25-Pin female. Order 012-1380-00 ..... **$60**
25-Pin male to 36-Pin male. Order 012-1250-00 ..... **$50**

**"F" Female to BNC Male Adapter –** Order 013-0126-00 ..... **$24**

**BNC Female to "F" Male Adapter –** Order 103-0158-00 ... **$15.50**

**"N" Female to BNC Male Adapter –** Order 103-0058-00 ..... **$18.75**

**GPIB CARDS**

**PC-GPIB Card –** IBM PC, AT, and compatibles.
Order S3FG210 ..... **$395**

**AT-GPIB Card –** IBM AT Bus (high speed card).
Order S3FG220 ..... **$495**

**MC-GPIB Card –** IBM PS/2 with Microchannel Bus.
Order S3FG230 ..... **$495**

**ADDITIONAL ACCESSORIES**

**Service Manual –** Order 070-8534-00 ..... **$145**

**Front Panel Cover –** Order 200-2520-00 ..... **$12.25**

**Transit Case –** Order 016-0792-02 ..... **$460**

**Soft Side Case –** Order 016-1158-00 ..... **$120**

**Rain Cover –** Order 200-2500-00 ..... **$12.25**

**Accessory Pouch –** Mounts on top. Order 016-0617-03 ..... **$75**

**Carrying Strap –** Order 346-0199-00. ..... **$28**

**Viewing Hoods –** Collapsible. Order 016-0592-00 ..... **$20**
Binocular. Order 016-0566-00 ..... **$30**
Polarized. Order 016-0180-00 ..... **$100**

**CRT Filter –** Smoke Gray. Order 337-2775-02 ..... **$11**

TD
Product available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

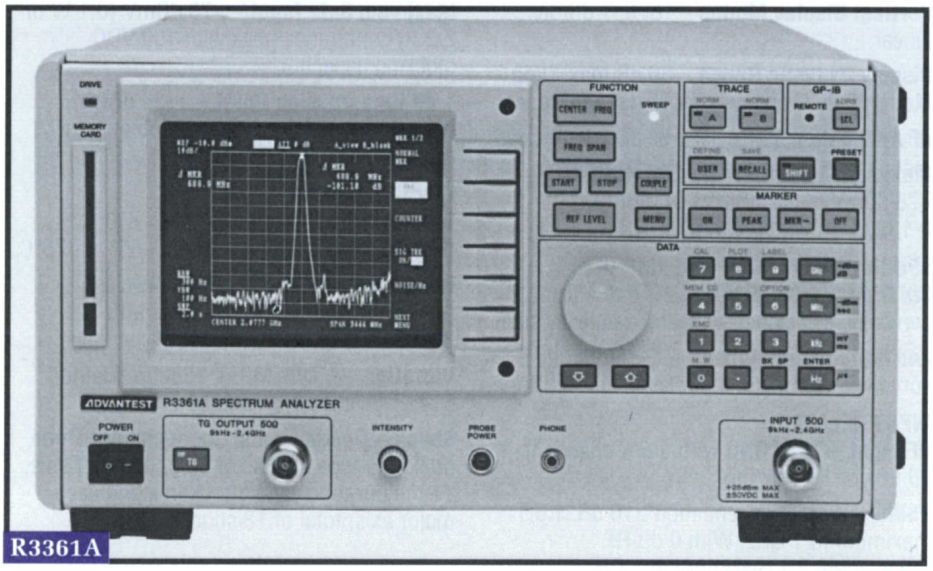
GPIB IEEE-488
The 2714 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# R3261A R3261AN R3261B R3361A R3361AN R3361B Spectrum Analyzers

*Easy-to-use portable spectrum analyzers offering high performance and unique functions.*

**R3261A, R3261AN, R3261B, R3361A, R3361AN, R3361B**

- Total Level Accuracy of 1 dB (typical)
- User-Defined Functions
- Measuring Window Function
- 120 dB Display Range
- Built-in Tracking Generator (R3361A, R3361AN, R3361B)



R3361A

## 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 (R3261A/R3361A) or 9 kHz to 3.6 GHz (R3261B/3361B). 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 (Opt. 15), parallel I/0, and GPIB interface for line connection and automatic measurement, so the user can create the ideal system configuration.

### 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.

### 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.

| | R3261A | R3261AN | R3261B | R3361A | R3361AN | R3361B |
|---|---|---|---|---|---|---|
| **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** | Opt. 04 | Opt. 04 | Opt. 04 | Opt. 04 | Opt. 04 | Opt. 04 |
| **Burst Signal Analysis** | Opt. 12 | Opt. 12 | Opt. 12 | Opt. 12 | Opt. 12 | Opt. 12 |

ADVANTEST

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488

The R3261A, R3261AN, R3261B, R3361A, R3361AN, R3361B comply with IEEE Standard 488.1-1987.

# Spectrum Analyzers

**R3261A R3361A**
**R3261AN R3361AN**
**R3261B R3361B**



**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, yet 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.** If the user defines 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.

**INTERNAL TRACKING GENERATOR AND 120 dB DISPLAY RANGE**
The R3361A/R3361AN/R3361B have 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.

The wide frequency range (R3361A: 9 kHz to 2.6 GHz, R3361B: 9 kHz to 3.6 GHz) enables the passing characteristic of sub-microwave filters for the new mobile communication systems and their reflection characteristics using bridges to be measured with high precision. A log sweep is also available.

**CONTROLLER FUNCTION FOR AUTOMATIC MEASUREMENT (OPTIONAL)**
An optional controller function can be installed in the R3261/R3361 Series. The function understands the easy-to-use BASIC language and controls not only itself but also other GBIB equipment connected through the GPIB interface. When creating a program, you can use your own terminal or personal computer in the terminal mode. The parallel I/O controls parallel I/O equipment including small jigs for automatic measurement, according to instructions from the controller function. This function works efficiently in a small space at low cost, so it is ideal for small systems. The created program, measuring conditions, and waveform data can be stored in the IC memory so that the program can be run using this unit alone.

## Characteristics

**FREQUENCY RELATED**

**Measuring Frequency Range –** R3261A, R3261AN, R3361A, R3361AN: 9 kHz to 2.6 GHz. R3261B, R3361B: 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: R3261A/AN/, R3361A/AN: 1 kHz to 2.6 GHz and zero. R3261B/R3361B: 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.

# R3261A R3261AN R3261B R3361A R3361AN R3361B Spectrum Analyzers

**AMPLITUDE RELATED**

**Amplitude Measuring Range –** R3261A, R3261B, R3361A, R3361B: –130 dBm to +25 dBm. R3261AN, R3361AN: –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 –** R3261A, R3261B, R3361A, R3361B: –109.9 dBm to +40.0 dBm, 0.715 µV to 22.4 V. R3261AN, R3361AN: +0.1 dBµV to +150 dBµV, 1.01 µV to 31.6 V.

**Reference Level Accuracy (after automatic calibration) –**

| | R3261A/R3261B R3361A/R3361B | R3261AN R3361AN |
|---|---|---|
| <±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): R3261A, R3261B, R3361A, R3361B: –120 dBm + 1.55 f (GHz) dB. R3261AN, R3361AN: –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.

**Frequency response –**

| | R3261A/R3261B R3361A/R3361B | R3261AN R3361AN |
|---|---|---|
| 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 –** R3261A, R3261B, R3361A, R3361B: ≤–100 dBm; Termination: 50 Ω. R3261AN, R3361AN: ≤–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 (R3361A, R3361AN, R3361B)**

**Frequency Range –** R3361A/R3361AN: 9 kHz to 2.6 GHz. R3361B: 9 kHz to 3.6 GHz.

**Output Level Range –** R3361A, R3361B: 0 dBm to –50 dBm. R3361AN: +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 –**

| | R3361A/R3361B (at –10 dBm output) | R3361AN (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 –**
R3361A/R3361B: Frequency ≤3.0 GHz: ≤–110 dBm. Frequency ≤3.6 GHz: ≤–100 dBm. R3361AN: ≤+1 dBµV.

**Output Impedance –** R3361A, R3361B: Approximately 50 Ω.
R3361AN: 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.

# Spectrum Analyzers

**R3261A**
**R3261AN**
**R3261B**

**R3361A**
**R3361AN**
**R3361B**



**INPUT RELATED**

**Input Impedance –** R3261A, R3261B, R3361A, R3361B: 50 Ω. R3261AN, R3361AN: 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 –** R3261A, R3261B, R3361A, R3361B: +25 dBm (attenuator ≥30 dB), 50 VDC max. R3261AN, R3361AN: +132 dBm (attenuator ≥30 dB), ±50 VDC 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 –** Hard copy output of all display data to Tektronix HC100 Opt. 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 Volts. Opt. 40: 198 to 250 Volts.

**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.** |
| R3261A, R3261AN, R3261B | 15 | 33 |
| R3361A, R3361AN, R3361B | 17 | 37.5 |

## ORDERING INFORMATION

**R3261A**
Spectrum Analyzer ..... **$12,900**
**Includes:** Power Cord, BNC-to-BNC Cable, N-Type BNC Cable, N-to-BNC Adapter, N-Type N-to-BNC Adapter, Memory Card, Instruction Manual.

**R3261AN**
Spectrum Analyzer ..... **$12,900**
**Includes:** Power Cord, BNC-to-BNC Cable, N-Type BNC Cable, N-to-BNC Adapter, N-Type N-to-BNC Adapter, Memory Card, Instruction Manual.

**R3261B**
Spectrum Analyzer ..... **$18,200**
**Includes:** Power Cord, BNC-to-BNC Cable, N-Type BNC Cable, N-to-BNC Adapter, N-Type N-to-BNC Adapter, Memory Card, Instruction Manual.

**R3361A**
Spectrum Analyzer ..... **$18,500**
**Includes:** Power Cord, BNC-to-BNC Cable, N-Type BNC Cable, N-to-BNC Adapter, N-Type N-to-BNC Adapter, Memory Card, Instruction Manual.

**R3361AN**
Spectrum Analyzer ..... **$18,500**
**Includes:** Power Cord, BNC-to-BNC Cable, N-Type BNC Cable, N-to-BNC Adapter, N-Type N-to-BNC Adapter, Memory Card, Instruction Manual.

**R3361B**
Spectrum Analyzer ..... **$23,500**
**Includes:** Power Cord, BNC-to-BNC Cable, N-Type BNC Cable, N-to-BNC Adapter, N-Type N-to-BNC Adapter, Memory Card, Instruction Manual.

**Opt. 04 –** Occupied bandwidth measurement/ adjacent-channel leakage power measurement ..... **+$900**
**Opt. 12 –** Gated sweep ..... **+$1,950**
**Opt. 15 –** Controller function (including parallel I/O and serial I/0) ..... **+$1,950**
**Opt. 40 –** 198 to 250 VAC operation ..... **NC**
**Opt. 70 –** Multi-marker option Max. ..... **+$500**

**RECOMMENDED ACCESSORIES**

See Page 424 for complete selection information.

**PROBES**

**FET Probe –** DC to 900 MHz (Requires 1101A). Order P6201 ..... **$1,550**
**FET Probe –** DC to 500 MHz. Order P6202A ..... **$1,025**
**50 Ω Divider Probe P6156 –** DC to 3.5 GHz, 6 ft. Order P6156 ..... **$265**
**Current Probe –** 935 Hz to 120 MHz. Order P6022 ..... **$595**
**Plotter –** Order Tektronix HC100 Opt. 01 ..... **$1,260**
**Carrying Case –** Order R16211A ..... **$500**
**Front Cover –** Order A02804 ..... **$200**
**Transit Case –** Order R16056A ..... **$1,000**
**Memory Card –** Set of five 32 KB cards. Order A09505 ..... **$500**
**Memory Card –** Set of five 128 KB cards. Order A09506 ..... **$1,400**
**Preamplifier –** 9 kHz to 1 GHz, ≥ 25 dB. Order R14601 ..... **$995**
**SWR Bridge –** 50 MHz to 2 GHz, 50Ω, Type N connectors. Order 60NF50 ..... **$4,275**
**Rackmount Set –** Conforms to EIA standards. Order A02455 ..... **$300**

**ADVANTEST**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488

The R3261A, R3261AN, R3261B, R3361A, R3361AN, R3361B comply with IEEE Standard 488.1-1987.

# EMC Solutions

## Measurement Systems



*Measurement tools designed to meet your EMC testing needs. Available as a complete system or separate components.*

**27120**

**DIAGNOSTIC AND PRE-/POST-CERTIFICATION MEASUREMENTS**

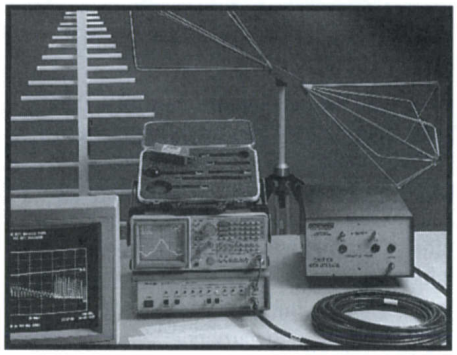
- Detect Potential Problems Early In the Design Phase
- Diagnose and Correct "Hot Spots" Prior to Building Production Prototypes
- Verify Performance Before Purchasing Expensive and Difficult-to-Schedule Certification Testing

**COMPLIANCE MAINTENANCE**

- Establish On-going 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
- EC '92 Generic Immunity Source



### 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 time and lower your cost 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 outstanding 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/'92, VDE, VCCI, and other EMI testing. The easy-to-use 9 kHz – 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 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 pages 208 to 211. Components of the 27120 Measurement System are also available separately.

For additional information on EMC measurements using Tektronix Spectrum Analyzers, software, and associated equipment, ask your local Tektronix Sales Office for a copy of *EMC Measurement Solutions*, 2EW-8793-0.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The 27120 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

## ORDERING INFORMATION

**27120**

EMC Pre-/Post-Certification Measurement System ..... **$25,980**
**Opt. 05** – Add External Tracking Generator ..... **+$3,950**
**Opt. 10** – Add Television Demodulator ..... **+$650**
**Opt. 11** – Delete Antennas, Tripod, Cable ..... **–$3,290**
**Opt. 16** – Delete LISN and Transient Limiter ..... **–$2,870**

**INTERNATIONAL POWER PLUG OPTIONS**

**Opt. A1** – Universal Euro 220 V, 50 Hz ..... **NC**
**Opt. A2** – United Kingdom 240 V, 50 Hz ..... **NC**
**Opt. A3** – Australian 240 V, 50 Hz ..... **NC**
**Opt. A4** – North American 240 V, 60 Hz ..... **NC**
**Opt. A5** – Switzerland 220 V, 50 Hz ..... **NC**

See Customer Information Section for additional description.

# EMC Solutions





## S26EM00
## EMI Prequalification Software

Tektronix' EMI Prequalification Software provides a low-cost, time-saving approach to EMI conducted and radiated emissions testing using Tektronix' 490P, 2750P, and 2790 Series Spectrum Analyzers. It is particularly designed for engineers who require a compact system for measuring and documenting MIL STD EMI levels during the various design stages.

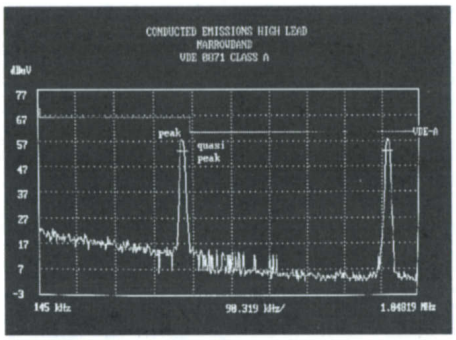
When used with a Tektronix 490P, 2750P, and 2790 programmable spectrum analyzer and an IBM or compatible PC (equipped with a National Instruments IEEE-488 interface card), this software enables a cost-effective approach for integrated EMI testing. This software package includes test routines for FCC Part 15 Subpart B, VDE 0871, and MIL-STD 461B/462 RE02 and CE03. Routines are accessed through menu-driven operation. For each class of test, routines are provided for acquiring data, graphing results (semilog plot with selected limits superimposed), and creating printouts of frequencies approaching or exceeding limits. Capability is also included for updating and displaying antenna factors.

For information about ordering antennas and other EMC test equipment, see Ancillary Devices or contact your Tektronix sales engineer.

## S26EM12 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.




*Graphic display of peak and quasi-peak measurement.*

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 flexible 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. Additionally, tabular test results can be printed on an Epson-FX or compatible line printer.

A free demo disk is available by calling the Tektronix National Marketing Center at 1-800-426-2200, Ext. 99.

**S26EM00**

EMI Software

- Cost-Effective Approach to Automated EMI Testing
- Runs on IBM or Compatible PC
- Easy, Menu-Driven Operation
- Pre-Certification Testing for FCC/VDE, MIL-STD 461B/462 CE03 and RE02.

**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

*Tektronix PC-based software automates tedious EMI measurements, reports results, and archives data.*

Free S26EM12 demo disk available. Call the number below.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

## ORDERING INFORMATION

**S26EM00**
EMI Prequalification Software ..... **$1,475**
**Includes:** Software on DS/DD diskettes, license agreement, and User's Manual.
**Opt. 10** – GPIB Interface for PC ..... **+$495**

**S26EM12**
Commercial EMI Test Software ..... **$1,750**
**Includes:** 5.25 in., 3.5 in. media and documentation.
**Opt. 10** – GPIB Interface for PC ..... **+$495**
**EMI Ancillary Devices** – See Page 223.

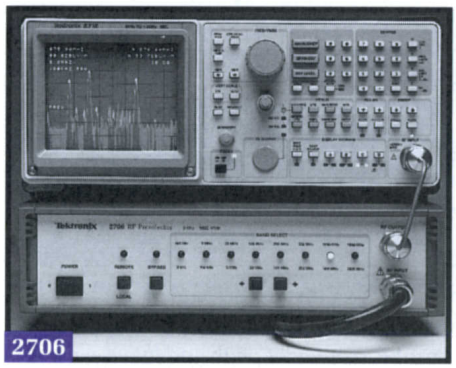
# EMC Solutions

## 2706 Stepping RF Preselector

*Affordable preselection for use with any spectrum analyzer.*

**2706**

- Low Investment
- Easy to Use
- Part of Automated Measurement System Using Tektronix S26EM12 EMI Software
- By-Pass Mode Facilitates Measurement Without Preselection
- Can be Easily Taken to Remote Measurement Sites
- Can be Used as a Stand-Alone Filter in Many Other Applications
- 9 kHz to 1800 MHz Overall Range (By-Pass Mode)
- Continuous Bandpass Filtering from 9 kHz to 1800 MHz in Eight Selectable Bands
- Compact, Light-Weight Design
- Attaches to the Tektronix 271X Spectrum Analyzers to Form Integrated Unit
- UL Listed 1244, Certified CSA C22.2 No. 231-M89




### 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 (max): 2.0 dB.

**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 VDC

**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 VAC, 48 to 63 Hz, 10 W maximum.

**Weight** – 5.9 kg (13 lb.).

**Dimensions (H, W, D)** – 8.8 x 32.7 x 43.1 cm (3.46 x 12.87 x 16.97 in.).

TD Product available within 24 hours through TekDirect Call 1-800-426-2200.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The 2706 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

## ORDERING INFORMATION

**2706**

Stepping RF Preselector ..... TD **$4,450**

**Includes:** Power Cord (U.S. 115 V, 60 Hz), Operator's Manual.

**Opt. 01** – 271X Spectrum Analyzer Mounting Hardware and RF Interconnect Cable ..... **+$300**

**NOTE:** The 2706 Opt. 01 Stepping RF Preselector is available at a reduced price when ordered as an option to the 2711 or 2712 Spectrum Analyzers (see page 211).

**INTERNATIONAL POWER PLUG OPTIONS**

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

**Opt. A2** – United Kingdom 240 V, 50 Hz ..... **NC**

**Opt. A3** – Australian 240 V, 50 Hz ..... **NC**

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

**Opt. A5** – Switzerland 220 V, 50 Hz ..... **NC**

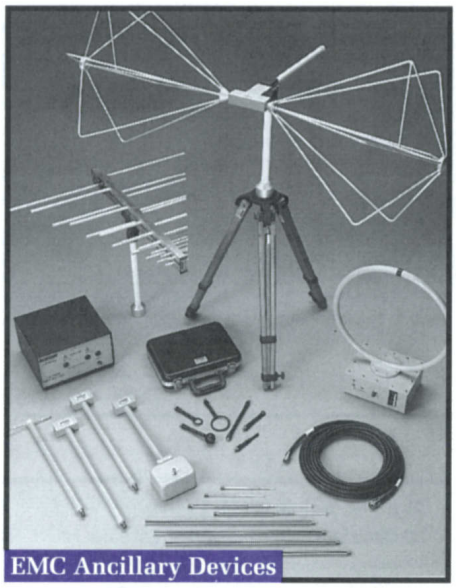
See Customer Information Section for additional description.

**SOFTWARE**

See Page 221 for complete description.

**Commercial EMI Test Software** – Order S26EM12 ..... **$1,750**

# EMC Solutions
## Ancillary Devices


EMC Ancillary Devices

*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, 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 table below.

**EMC ANCILLARY DEVICES**

- Active Loop Antenna
- Adjustable-Length Dipole
- Biconical Antenna
- Log-Periodic Antenna
- RF Near-Field Probe Set
- LISN
- Transient Limiter
- 10m Low-Loss Coaxial Cable
- Adjustable Tripod

*Antennas, transducers, and other devices for EMI testing.*

### EMC ANCILLARY DEVICE SELECTION GUIDE/ORDERING INFORMATION

| Device | Frequency Range | Application Information | Order No. | Price |
|---|---|---|---|---|
| **Loop Antenna** | 9 kHz to 30 MHz | Radiated H-field (magnetic) emissions. Active loop provides gain and low-frequency sensitivity. | 119-4144-00 | TD **$2,495** |
| **Adjustable-length Dipole** | 28 MHz to 1 GHz | Radiated E-field emissions/CATV leakage. Ideal for EMI testing and site attenuation measurements. Includes four baluns. | 119-4145-00 | TD **$2,695** |
| **Biconical Antenna** | 30 MHz to 300 MHz | Radiated E-field emissions. Broadband frequency capability eliminates need for band switching, element extension, or external tuning. | 119-4148-00 | TD **$1,295** |
| **Log-periodic Antenna** | 200 MHz to 1 GHz | Radiated E-field (electric) emissions. Linearly polarized design permits separate measurement of horizontal and vertical fields. Broadband frequency. | 119-4142-00 | TD **$1,550** |
| **RF Probe Set** | 9 kHz to 1.8 GHz | Locate RF "Hot Spots." Useful in diagnostic testing phase in EMI compliance investigation. Includes five probes plus extension. | 119-4146-00 | TD **$520** |
| **LISN** | 10 kHz to 100 MHz | Facilitates measurement of conducted emissions on power line from equipment under test. Filters undesired signals imported on mains supply. | 119-4147-00 | **$2,395** |
| **Transient Limiter** | 9 kHz to 100 MHz | Use with LISN to prevent inadvertent damage to spectrum analyzer input | 011-0164-00 | **$475** |
| **10 m Coaxial Cable** | NA | Couple antenna to spectrum analyzer (male fittings). | 012-1291-00 | **$150** |
| **Adjustable Tripod** | NA | Mounting for all above antennas. Wooden frame reduces field disturbance. | 016-1102-00 | **$295** |

TD
Products available within 24 hours through TekDirect
Call 1-800-426-2200.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

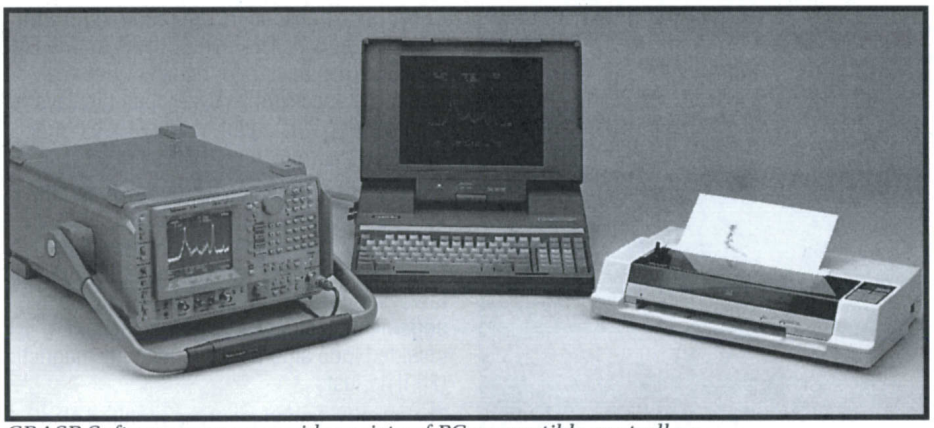
# Spectrum Analyzers
## Software



*Automate your measurements with Tektronix Spectrum Analyzer Software.*

**S26RF00**
GRASP Software

- Performs Automated Spectrum Analysis on PC-compatible Computers
- Select Applications Through Easy, Menu-driven Operation
- Supports VGA, EGA, and CGA Graphics



*GRASP Software runs on a wide variety of PC-compatible controllers.*

### S26RF00 — GRASP Software

GRASP (General RF Applications Software Package) combines the power of Tektronix' 490P-/2750P-/2790-series programmable spectrum analyzers and PC-compatible controllers.

This comprehensive software offers many applications/utility routines that are selected through easy, menu-driven operation. It provides immediate access to operations such as swept-frequency measurements, waveform storage and recall, and performing various types of signal analysis. Measurements such as harmonic distortion, amplitude modulation, and signal-to-noise ratio are performed with a minimum of effort.

From the GRASP main menu, a user selects among any of the submenus for Measurements, Filter Tests, Signal Search routines, Waveform Operations, and Utilities. Selections are made by pressing the appropriate function key shown on screen. Prompts guide you through each measurement task.

For example, users can use a Cursors routine which displays the instrument CRT on their terminal screen. It calculates and displays both the absolute amplitude and frequency of one or two marked signals, plus the relative (delta) amplitude and frequency difference between the two markers.

Complete source code is provided with GRASP, thereby simplifying the task of integrating user-written routines into GRASP.

GRASP works on most MS-DOS compatible computers that are equipped with a National Instruments GPIB card.

**MAIN MENU MAP**

**MEASUREMENTS**
- Harmonic Distortion
- Amplitude Modulation
- Signal-to-Noise
- Frequency Response
- Cursors

**SIGNAL SEARCH**
- Fast Search
- Precise Search
- Spur Search
- Automatic Identify

**UTILITIES**
- Talk/Listen
- Sensitivity Test
- Resolution Filter Test
- Calibration Assistance
- Select Instrument
- Select Disk

**FILTER TESTS**
- Band-pass Filters
- Low-pass Filter
- High-pass Filter

**WAVEFORM OPERATION**
- Acquire AVIEW Waveform
- Acquire BView Waveform
- Send to Instrument
- Redraw Waveform
- Store on Disk
- Load from Disk
- Graph Waveform
- Overlay Waveform
- Normalize Waveform

*The GRASP main menu lists all submenus and their routines.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

**ORDERING INFORMATION**

**S26RF00**
General RF Applications Software ..... **$875**
**Includes:** Software on 5.25 in. HD diskettes.

**Opt. 1A** – Substitute 5.25 in. DSDD diskettes ..... **NC**
**Opt. 1B** – Substitute 3.5 in. DD diskettes ..... **NC**
**Opt. 10** – GPIB interface for PC ..... **+$495**

# Spectrum Analyzer
## Software

**S26RM00**
**S26RM01**



### S26RM00/S26RM01 Remote Site Monitoring PC Software

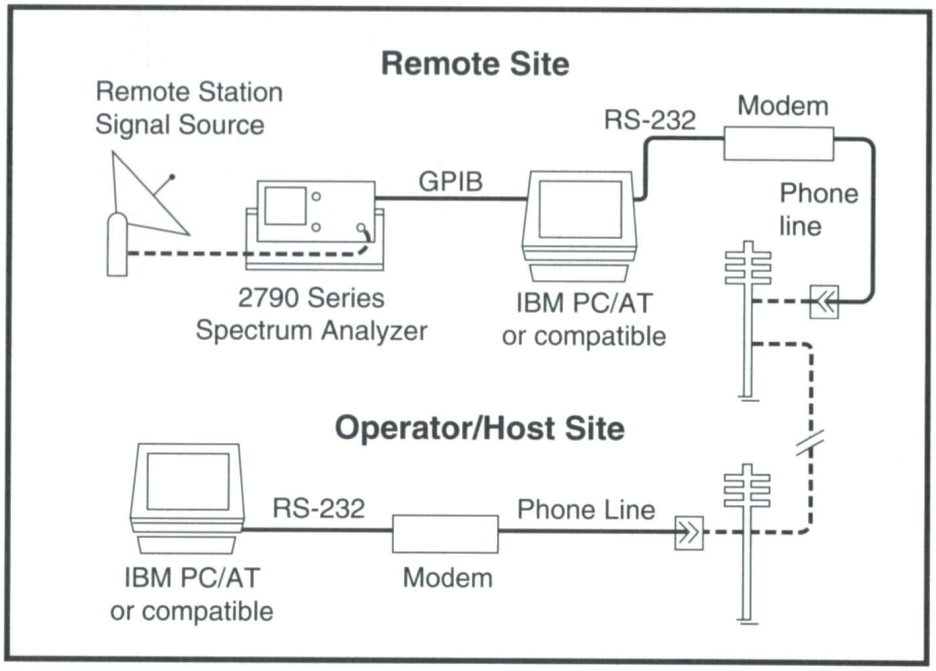
RSM (Remote Site Monitoring) software simplifies the control and data analysis of instruments at remote sites or in hostile environments. RSM merges the power and precision of Tektronix' 490P, 2750P, and 2790 Series Spectrum Analyzers with the economy of PC-based controllers to provide cost effective, remote-site monitoring and control.

RSM provides the ability to connect, via telephone, a pair of PCs. The remote-site PC is connected to the remote Tektronix 490P, 2750P, and 2790 Series Spectrum Analyzer, and perhaps to other Tektronix programmable instruments, via the IEEE 488 interface. This remote PC includes a National Instruments GPIB card.

The host-site PC is located at a convenient location such as an office or lab. At the host site, the user has complete control over the operations of the remote-site PC, and all screen displays seen are identical to those currently appearing at the remote site, including full color.

From RSM's main menu, a user selects any of the submenus for Monitor, Waveform Operations, Utilities, Measurements, and Signal Search. Each of these submenus and the included routines are accessed through a pop-up menu structure.

The Monitor menu contains several routines that control the operation of the Independent Automated Signal Monitoring mode. RSM continually checks the RF input signals to the remote spectrum analyzer and compares them to a user-defined frequency/amplitude tolerance window. The user can define all monitoring parameters, verify pass/fail conditions of the current setup, initiate monitoring, and report all current and logged errors.




*Equipment setup for remote site signal monitoring.*

**MONITOR**
- Enter Parameters
- Take A Measurement
- Report Errors
- Hang-up/Monitor
- Immediate Call Back
- Show Parameters

**MEASUREMENTS**
- Harmonic Distortion
- Amplitude Modulation
- Signal-to-Noise

**SIGNAL SEARCH**
- Fast Search
- Precise Search
- Spur Search

**WAVEFORM OPERATIONS**
- Acquire A View Waveform
- Acquire B View Waveform
- Send to Instrument
- Store on Disk
- Load from Disk
- Graph Waveform
- Acquire Mode: Norm

**UTILITIES**
- Talk/listen (Command)
- Sensitivity Test
- Resolution Filters Test
- Calibration Assistance
- Select Instrument
- Select Disk
- User Program

The Monitor menu includes a Hang-Up/Monitor routine which terminates any existing phone connection between the host and remote sites and initiates the signal monitoring routine as specified. If the signal drops out of the previously defined amplitude/frequency window, an automatic telephone call is placed to the host site to alert the operator to the error condition.

The Waveform Operations menu provides several routines, such as acquiring and graphing one or more signals, storing and loading waveforms to disk, and sending waveforms back to the analyzer for display.

The Utilities menu includes a Talk/Listen routine that sends commands and queries to the spectrum analyzer or other Tektronix instruments at the remote site. This menu also allows inclusion of a user-written program to perform tasks such as automated signal surveillance of a set of communication channels.

The Measurements and Signal Search menus provide a variety of routines for performing tasks such as measuring harmonic distortion and amplitude modulation, as well as performing a precise signal search over a specified frequency range.

For maximum flexibility, the RSM system is offered in two packages: a host-site module (S26RM00) and a remote-site module (S26RM01). At least one of each module is required to comprise a working remote monitoring system. Both modules are provided with source code.

## ORDERING INFORMATION

**RSM Host Site** – Order S26RM00 ..... **$300**
**Includes:** Software on DS/DD diskettes, license agreement, and Users Manual.

**RSM Remote-Site** – Order S26RM01 ..... **$750**
**Includes:** Software on DS/DD diskettes, license agreement, and User's Manual.

**Opt. 10** – GPIB interface for PC ..... **+$495**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# Spectrum Analyzer
## Software



*Software to automate your spectrum analyzer measurements.*

**S26UT00**
2782/PC Utility Software

- 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


S26UT10

### S26UT00 — 2782/PC Utility Software

The Tektronix 2782/PC Utility Software is designed to capitalize on the power of the Tektronix 2782 and 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.

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.

### 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.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

## ORDERING INFORMATION

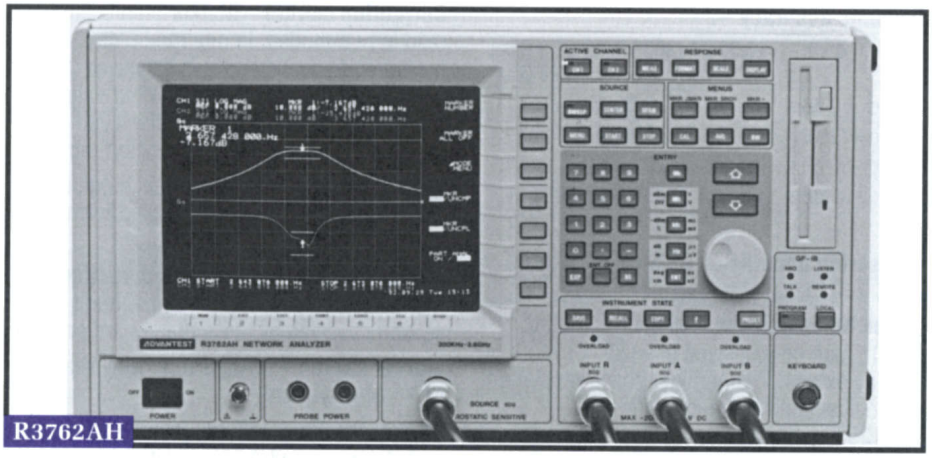
**S26UT00**
2782 Utility Software ..... **$1,400**
**Includes:** Software on 5.25 in. DS/DD diskettes, license agreement, and users manual.

**S26UT10**
2710 Series PC Utility Software ..... **$575**
**Includes:** Software on 5.25 in. and 3.5 in. diskettes.
**Opt. 09** – Source Code ..... **+$1,000**
**Opt. 10** – GPIB interface for PC ..... **+$495**

# Network Analyzers
# S-Parameter Test Set

**R3762AH**
**R3961B**
**R3961BN**




R3762AH

*High-throughput network analyzer with built-in controller function for automatic testing.*

**R3762AH, R3961B, R3961BN**

- 300 kHz to 3.6 GHz Frequency Range with 1 Hz Resolution
- High-Accuracy, High-Resolution Measurements
- High-Speed Measurement: 0.5 ms/point
- Powerful Analytical and Marker Functions
- Built-in BASIC Controller Functions

**APPLICATIONS**

- Crystal Filters
- SAW Devices
- Amplifiers
- Antennas
- High Frequency Packages

## R3762AH Network Analyzer

The R3762AH quasi-microwave vector network analyzer can quickly and accurately measure amplitude, phase, group delay, and impedance in the frequency range of 300 kHz to 3.6 GHz. In addition to its 0.5 ms/point high-speed measurement capability, the R3762AH provides high measurement accuracy due to unique RF analog and digital signal processing technologies. These analyzers also feature numerous useful functions such as measuring amplitude ripple and group-delay ripple values in a given interval, measuring filter bandwidths, and Q = Δf/fo measurements at an XdB-down point. These functions are not only easy to use, but also greatly improve the throughput of measurements.

### HIGH-RESOLUTION, HIGH ACCURACY MEASUREMENTS

The R3762AH incorporates a 1 Hz high-resolution signal source using a high-speed synthesizer to provide an absolute amplitude accuracy of ±1 dB. In addition, for relative value measurements, it provides such superior performance capabilities as an amplitude measurement accuracy of 0.05 dB with 0.001 dB resolution and phase measurement accuracy of 0.3° with 0.01° resolution. All this has been made possible by unique analog circuit technology and powerful digital signal processing.

### PHASE/GROUP DELAY MEASUREMENT FUNCTION OPENS NEW HORIZONS IN ANALYSIS

The R3762AH enables precise, phase characteristic measurements with a phase-measurement accuracy of 0.3° and resolution of 0.01°. In addition, because the electrical length can be compensated for by a simple, one-touch operation, the phase reference plane can be matched to the measurement device to accurately measure the electrical length of wires and coaxial cables.

Group delay aperture can be very conveniently set with span % for optimum measurements based on the measurement frequency and band.

One unique function of the R3762AH is the phase-zero search function. Since this function automatically searches the frequency at phase zero, it is very convenient for analyzing crystal oscillators.

## R3762AH Characteristics

### MEASURING FUNCTIONS

**Display Channels –** Two channels.

**Display Parameters –** A/R, B/R, A/B. Includes conversion of impedance, admittance, S-parameters. Characteristic impedance (Zo) input also possible.

**Format –** Orthogonal display: Log/linear amplitude, phase, group delay, real number and imaginary number parts of complex parameters. I Z I, R, X (for impedance conversion measurement). I Y I, G, B (for admittance conversion measurement).
Phase extension display function.
Smith chart: Marker readout is log/linear amplitude, phase, real number part + imaginary number part, R+jX, G+jB.
Polar coordinate display: Marker readout is log/linear amplitude, phase, real number part + imaginary number part.

### SIGNAL SOURCE CHARACTERISTICS

**Measurement Frequency –** Range: 300 kHz to 3.6 GHz. Resolution: 1 Hz. Accuracy: +10 ppm (25°C + 5°C).

**Output Level –** Range: +20 dBm to –5 dBm. Resolution: 0.01 dB. Accuracy: ±0.5 dB at 0 dBm, 50 MHz, 25°C ± 5°C). Output level linearity (0 dBm referenced, 25°C ± 5°C): –5 dBm to +15 dBm: ±0.4 dB. +15 dBm to +20 dBm: ±0.7 dB. Flatness (at 25°C ± 5°C): 2.0 dB p-p.

**Output –** Single. Connector: N type (F), 50 Ω.

ADVANTEST

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The R3762AH, R3961B, R3961BN comply with IEEE Standard 488.1-1987.

**R3762AH**
**R3961B**
**R3961BN**

# Network Analyzers S-Parameter Test Set

**Signal Purity –** Harmonic distortion: ≤–20 dBc (at maximum output). Non-harmonic spurious; ≤25 dBc (at maximum output). Phase noise: At 10 kHz offset, 1 Hz bandwidth: 300 kHz ≤f <3 MHz: –75 dBc. 3 MHz ≤f <40 MHz: –85 dBc. f ≥40 MHz: –85 dBc +20 log (f/40 MHz).

**SWEEP FUNCTIONS**

**Sweep parameters –** Frequency, level.

**Maximum sweep range –** Frequency: 300 kHz to 3.5 GHz. Signal level: –5 dBm to +20 dBm.

**Setting range –** Start/stop or center/span.

**Sweep type –** Can be selected from linear or logarithmic frequency, sweep, partial and given frequency sweep, level sweep, and CW (single frequency).

**Sweep time –** 0.5 ms/point, Note that the minimum sweep time varies depending upon the measurement format, type of error compensation, sweep width per point, number of measuring points, and the IF bandwidth of the measurement.

**Measuring points –** 3, 6, 11, 21, 51, 101, 201, 301, 601, 1201 points. However, the maximum displayed number of points is 801.

**Sweep trigger –** Continuous, hold, single sweep, or set by either line trigger or external trigger.

**Sweep mode –** Dual sweep: Two channels are swept in the same frequency range. Alternate sweep: Two channels can be swept by different sweep types in different frequency ranges.

**INPUT CHARACTERISTICS**

**Input terminals –** 3-CH (Rch, Ach, Bch).

**Dynamic range –** 100 dB (CH A, CH B), 30 dB (CH R).

**Noise level –** –90 dBm (1 kHz bandwidth on CH A, B). –100 dBm (10 Hz bandwidth on CH A, B).

**Minimum input to Rch –** –30 dBm (Minimum required level to ensure correct operation).

**Maximum input level –** 0 dBm.

**Input breakdown level –** +20 dBm.

**Input impedance –** 50 Ω.

**Return loss –** 20 dB (at 25°C ± 5°C).

**Connector –** N-type (F) 50 Ω.

**Input crosstalk –** –100 dB (300 kHz to 1 GHz). –90 dB (1 GHz to 3.6 GHz).

**Resolution bandwidth –** 1 kHz to 10 Hz (Variable in 1-3 steps).

**Amplitude Characteristics –** Measuring range: 0 ±100 dB (amplitude ratio). Amplitude resolution: 0.001 dB.

**Dynamic accuracy –**

| | |
|---|---|
| 0 to –10 dBm | ±0.30 dB (300 kHz ≤f ≤1.3 GHz)<br>±0.50 dB (1.3 GHz ≤f ≤3.6 GHz) |
| –10 to –60 dBm | ±0.05 dB |
| –60 to –70 dBm | ±0.15 dB |
| –70 to –80 dBm | ±0.40 dB |
| –80 to –90 dBm | ±1.00 dB (f ≥19 MHz) |

**Measuring accuracy –** ±0.5 dB (–10 dBm, 25°C ± 5°C), calibrated by normalizing.

**Phase Measurement –** Measuring range: ±180° (Can be displayed in ±180° or more by display extension function). Phase resolution: 0.01°. Frequency characteristics: ±5° (25°C ± 5°C).

**Dynamic accuracy –**

| | |
|---|---|
| 0 to –10 dBm | ±5.0° |
| –10 to –50 dBm | ±0.3° |
| –50 to –60 dBm | ±0.4° |
| –60 to –70 dBm | ±1.5° |
| –70 to –80 dBm | ±4.0° |
| –80 to –90 dBm | ±8.0° (f ≥19 MHz) |

**GROUP DELAY TIME CHARACTERISTICS**

**Linear/Logarithmic Frequency Sweeps and Sweeps with Arbitrary Frequency –** Range: Derived from the following equation:

$$t = \frac{\Delta\phi}{360 \times \Delta f}$$

where: $\Delta\phi$ = Phase
$\Delta f$ = Aperture frequency (Hz)

**Measurement Range –** 1 ps to 250 s.

**Group Delay Time Resolution –** 1 ps.

**Aperture Frequency –** Equivalent to Δf. Can be set to any desired frequencies up to 20% of frequency span.

$$\text{Accuracy} = \frac{\text{Phase accuracy}}{360 \times \text{aperture frequency (Hz)}}$$

**MARKER FUNCTIONS**

**Marker display –** Marker readout can be converted to display values corresponding to each measurement format.

**Multi-marker –** Ten independent markers can be set for each channel.

**Delta marker –** Any of ten markers can be specified for the reference marker, making it possible to measure delta values between moved markers.

**Fixed marker –** The fixed marker can be assigned a marker value off the measurement display tube surface, making it possible to measure delta values with the reference marker.

**Correction marker –** Marker points can be read in two modes. In one mode, data at the measured frequency point is displayed directly; in the other mode, a measurement value at the appropriate frequency is displayed after obtaining the value by the insertion method.

**Marker couple –** Markers in each channel can be set either in a two-coupled form or entirely independent form.

**Analysis in arbitrary specified section –** Marker search and ripple measurement in the section specified by the Δ marker are possible.

**Marker search –** MAX search, MIN search, NEXT MAX search.

**Marker tracking –** Marker search based on sweep-by-sweep tracking is possible.

**Target search –** Bandwidth, center frequency, and Q at the X dB down point can be calculated. In addition, the frequency value with phase 0° and frequency width at ±X° can also be searched.

**Marker → –** MKR → reference value, MKR → Start, MKR → Stop, MKR → Center, MKR → / Span, MKR → Center scale. Furthermore, markers can be moved from a data waveform to a memory waveform or vice versa.

**Auto zoom –** Can be set to the span specified by Auto Zoom Span through automatic functioning of MAX search and MKR → Center.

**ERROR CORRECTION FUNCTIONS**

**Normalize –** Corrects for frequency response errors (both amplitude and phase) during transmission measurement are compensated.

**1-port calibration –** Corrects errors due to bridge directivity, frequency response, and source match during reflection measurements. Short, open, and load are required for error correction.

**2-Port calibration –** Corrects errors caused by the directivity, frequency response, source match, reflection frequency response, and crosstalk in ports 1 and 2.

**Data averaging –** Data (vector values) are averaged for every sweep. The average factor can be set to any value between 2 to 126.

**Auto offset compensation –** Electrical length compensation: Equivalent electrical length or delay time are added to the measured phase and group delay time. Range: 3 x 108 m to +3 x108 m or +1 sec. to –1 sec.

**INSTRUMENT STATE FUNCTIONS**

**Save –** The set conditions are stored in an internal register by pressing the Save Register key. In addition, when the power is turned on, the unit is set to state held immediately before power-off by the Power Off Save function. Measurement data, calibration data, and set conditions are saved on floppy disk (standard) by pressing the Store key.

# Network Analyzers
# S-Parameter Test Set

**R3762AH**
**R3961B**
**R3961BN**



**Recall –** The set conditions stored in the internal register are recalled by pressing the Recall key. The measurement data, calibration data, and set conditions saved on floppy disk (standard) are recalled by pressing the Load key.

**Limit line function –** The limit line for GO/NO-GO tests (standard value line) is defined on the CRT screen.

**PROGRAMMING FUNCTIONS**

**BASIC controller function –** Enables the unit to control itself and other measuring instruments equipped with a GPIB interface.

**Built-in arithmetic functions –** Provide high-speed analysis of measured data.

**Floppy disk drive functions –** Disk capacity: 750 kB (formatted). Type of media: 3.5 inch, double-sided, double-density floppy.

**CONNECTION WITH EXTERNAL EQUIPMENT**

**Copy –** Graphs displayed on the CRT and data lists can be output to a GPIB compatible plotter or printer without requiring an external controller.

**Video plotter output signals –** Separate signal (DIN 8-Pin), Composite signal (BNC).

**GPIB data output and remote control –** Based on IEEE-488.

**S-parameter test set control –** 14-Pin.

**Parallel I/O output –** TTL level, 8-Bit output (2 ports), 4-Bit input/output (2 ports).

**RS-232C –** Serial output based on RS-232C standards.

**External trigger –** BNC female connector, TTL level, LOW enable.

**External reference frequency input –** Frequency 1, 2, 5, 10 MHz. Connector: BNC female connector.

**GENERAL SPECIFICATIONS**

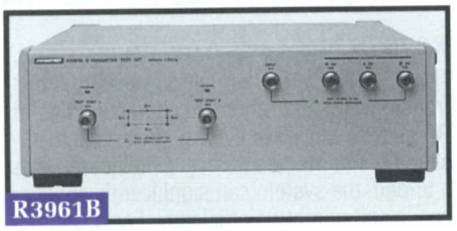
**Operating Environment –** Temperature: When using floppy disk drive: +5°C to +40°C, relative humidity 85% or less. When not using floppy disk drive: 0°C to +40°C, relative humidity 85% or less.

**Safety –** This product has been safety tested by Advantest to IEC 348 specifications.

**Power Requirements –** Operating voltage: Standard: 90 to 132 V. Opt. 40: 198 to 250 V. Power consumption: 280 VA or less. Frequency: 48 Hz to 63 Hz

**PHYSICAL CHARACTERISTICS**

| Dimensions (approx.) | mm | in. |
|---|---|---|
| Height | 221 | 8.7 |
| Width | 424 | 16.7 |
| Depth | 450 | 17.7 |
| | kg | lb. |
| Weight | 23 | 50.7 |




### R3961B/R3961BN S-Parameter Test Set

The R3961B/R3961BN S-Parameter test set is connected to the R3762AH network analyzer to measure the transmission/reflection characteristics for frequencies of 300 kHz to 3.6 GHz (for R3961B) and 300 kHz to 2 GHz (for R3961BN). The R3961B/R3961BN contain the devices necessary for measurement, such as the SWR bridge, power splitter, and switches. They can measure all S-Parameters of S11, S12, S21, and S22, without having to disconnect the device-under-test.

**R3961B/R3961BN TEST SET**

**Frequency Range –** R3961B: 300 kHz to 3.6 GHz. R3961BN: 300 kHz to 2 GHz.

**Test Port Impedance –** R3961B: 50 Ω. R3961BN: 75 Ω.

**Directivity –** R3961B: ≥25 dB, 300 kHz to 5 MHz, (≥30 dB at 25°C ± 5°C). ≥35 dB, 5 MHz to 1.3 GHz. ≥30 dB, 1.3 GHz to 3.6 GHz. R3961BN: ≥25 dB, 300 kHz to 5 MHz (≥30 dB at 25°C ± 5°C). ≥30 dB, 5 MHz to 2 GHz.

**Input Port Return Loss –** R3961B: ≥17 dB, 300 kHz to 1.3 GHz, ≥12 dB, 1.3 GHz to 3 GHz, ≥10 dB, 3 GHz to 3.6 GHz. R3961BN: ≥17 dB, 300 kHz to 1.3 GHz, ≥12 dB, 1.3 GHz to 2 GHz.

**Test Port Return Loss –** R3961B: ≥20 dB, 300 kHz to 1.3 GHz. ≥16 dB, 1.3 GHz to 3 GHz. ≥14 dB, 3 GHz to 3.6 GHz. R3961BN: ≥17 dB.

**RF destructive level –** +27 dBm max.

**Test ports 1 and 2 isolation –** 90 dB or more.

**Coaxial switch reproducibility –** ±0.03 dB (at the tenth changeover).

**FREQUENCY CHARACTERISTICS**

**Transmission Amplitude –** R3961B: 1.5 dB p-p typical. R3961BN: 3 dB p-p typical.

**Transmission Phase –** R3961B: 10° p-p typical. R3961BN: 20° p-p typical.

**Reflection Amplitude –** R3961B: 1.5 dB p-p typical. R3961BN: 3 dB p-p typical.

**Reflection Phase –** R3961B: 10° p-p typical. R3961BN: 3° p-p typical.

**Insertion Loss –**
RF IN to PORT 1, 2: R3961B: 6 dB typical. R3961BN: 12 dB typical
RF IN to OUTPUT R: R3961B: 21 dB typical. R3961BN: 21 dB typical
RF IN to OUTPUT A & B: R3961B: 22 dB typical. R3961BN: 34 dB typical.

**PHYSICAL CHARACTERISTICS**

| Dimensions (approx.) | mm | in. |
|---|---|---|
| Height | 132 | 5.2 |
| Width | 424 | 16.7 |
| Depth | 450 | 17.7 |
| | kg | lb. |
| Weight | 8 | 17.6 |

**ORDERING INFORMATION**

**R3762AH**
Network Analyzer ..... **$24,000**
**Includes:** Power Cord, NP-to-NP Input Cable, Limit Line Editor on Floppy Disk, Instruction Manual.
**Opt. 40 –** 198 to 250 VAC operation ..... **NC**
**Keyboard –** Order TR45103 ..... **$1,300**

**R3961B**
50 Ω S-Parameter Test Set ..... **$8,000**
**Includes:** R3762AH Interconnect Cable.

**R3961BN**
75 Ω S-Parameter Test Set ..... **$8,000**
**Includes:** R3762AH Interconnect Cable.

**CALIBRATION KITS**
**Type N, 50 Ω –** Order 9617C3 ..... **$2,300**
**3.5 mm, 50 Ω –** Order 9617H3 ..... **$3,000**
**BNC, 50 Ω –** Order 9617K3 ..... **$2,100**
**Type N 75 Ω –** Order 9617R3 ..... **$3,500**
**BNC, 75 Ω –** Order 9617S3 ..... **$3,100**

ADVANTEST

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The R3762AH, R3961B, R3961BN comply with IEEE Standard 488.1-1987.

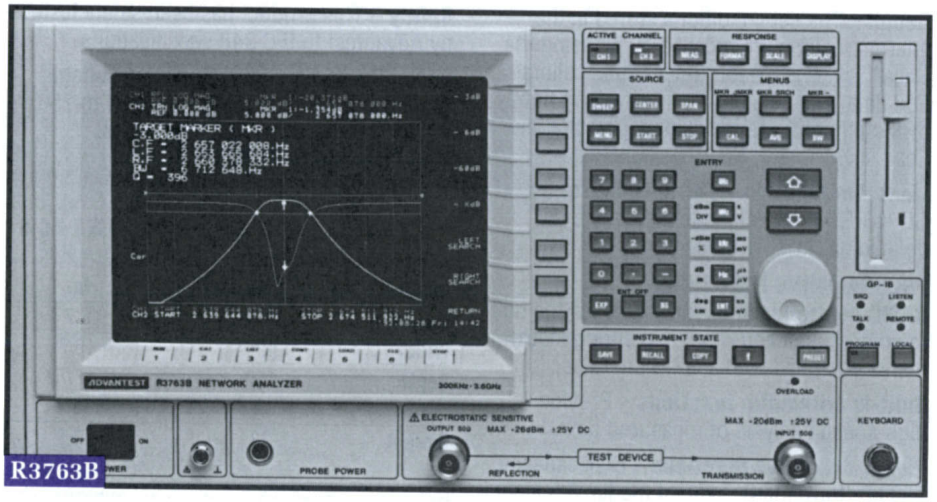
# Network Analyzers



*High-throughput network analyzer with built-in controller and internal test set.*

**R3763B**
**NETWORK ANALYZER**

- Significantly Greater Space and Operation Efficiency
- Reflection Characteristic Measurement with a High Repeatability
- High-speed Measurement: 0.5 ms/point
- Built-in Parallel I/O Functions
- Built-in BASIC Controller Functions




## R3763B Network Analyzer

The R3763B Network Analyzer measures the transmission and reflection characteristics of RF/quasi-microwave electronic parts at a speed of 0.5 ms/point. Because it incorporates a bridge, the system can significantly enhance space and operation efficiency. For measurement and analytical functions, the system is provided with an innovative user sweep function, a limit line display function, a beep function, and a tracking search function in the partial analysis mode. These functions enable the system to be the best for use in production and inspection. The built-in BASIC controller contained in the system function uses its own editor to create the measurement, analysis, and data processing programs for automatic measurement and processing. This enables fast ATE construction as well as measurement with turn-key operation, without the need to use an external computer.

### SPACE AND OPERATION EFFICIENCY

It has been difficult to fully automate the testing and inspection of RF/quasi-microwave electronic parts. Because of the high frequencies of these devices, setup reproducibility is difficult to achieve even with special jigs. As a result, testing and inspection are often manual processes. In addition, testing for transmission and reflection characteristics has required a separate power splitter as well as a SWR bridge and cabling to connect these parts. This configuration makes the work area more complicated and degrades the operational efficiency. Because these units are incorporated into the R3763B, the workplace remains clear and uncluttered, thereby improving efficiency. The BASIC controller contained in the system allows for easy manipulation of complicated measurements through a turn-key operation.

### HIGH-THROUGHPUT MEASUREMENT

The R3763B provides a number of functions which enhance the measurement throughput, including the following features.

- Fast measurement at 0.5 ms/point by the high-speed settling signal source and a fast vector operation.
- High throughput for automatic measurements implemented by the BASIC controller using built-in functions.
- Increased measurement speed through the user sweep function.
- SAVE/RECALL functions to store up to ten system states.

### DIGITAL PROCESSING FOR HIGHLY ACCURATE MEASUREMENTS

Digital processing is used in all stages of the receiver after the IF (Intermediate Frequency) stage. Using this function in conjunction with the calibration function will provide highly accurate measurements with:

- Amplitude characteristic measurement accuracy of ±0.5 dB/0.01 dB resolution
- Phase characteristic measurement accuracy of ±0.3°/0.01° resolution

### TURN-KEY OPERATION THROUGH THE BASIC CONTROLLER FUNCTIONS

You can automate the processes from data processing to analysis by creating a sequential program through the BASIC controller functions built into the system. Executing the program allows automation of your measurement processes.

ADVANTEST

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The R3763B complies with IEEE Standard 488.1-1987.

**LIMIT LINE FUNCTION USEFUL FOR ADJUSTMENT AND JUDGMENT**

The limit line display can specify the upper and lower limits at the point frequency and the upper and lower limits in a line (continuous frequency area). In addition, it can mix these limits and specify up to 30 segments. Also, it can specify a point in the basic data at which a pass or fail is decided, and set the limit values of ±X dB for up to 30 segments. The pass or fail result may be output through the GPIB. The limit line may be used to indicate a display circle as the pass/fail decision function on the polar coordinate display.

**MARKER TRACKING FUNCTION BEST SUITED FOR ADJUSTMENT AND TEMPERATURE/TIME VARIANCE CHARACTERISTICS MEASUREMENTS**

The resonant frequency of the inductive resonator (TEM mode) is adjusted in real time by trimming in the order of a few tens of microns. Using the marker tracking function provides continuous realtime measurements of the maximum value for transmission characteristics, the 3 dB bandwidth, and the minimum value for the reflection characteristics of each sweep.

**FILTER ANALYSIS FUNCTION USEFUL FOR MEASURING FILTER CHARACTERISTICS**

A special function called the Filter Analysis mode has been prepared to take a filter measurement. By using only one key, this versatile function can calculate and display the center frequency, 3 dB bandwidth, left/right frequencies, Q, and SF (Shape Factor) value of the filter to be measured.

**MULTI-MARKER (TEN MARKERS) FUNCTION FOR THE BEST ADJUSTMENT**

The R3763B can specify ten multi-markers for each channel. In addition, the delta from the active marker related to the specified marker (the frequency or level difference) can be determined by just pressing one key.

**USER SWEEP FUNCTION TO ENHANCE THROUGHPUT**

The measuring speed depends upon the number of frequency points required by the device to be measured. As the number of points decrease, the measurement throughput increases. Partial measurement may be sufficient for some devices to be measured. With the R3763B, you can set the number of points from 3 to 1201 and use the user sweep function to divide the frequency band needed for the measurements into as many as 15 segments for a data sweep. In particular, the user sweep function specifies only those parts required by the measurement. With the user sweep function, a single action is sufficient to carry out a high-resolution measurement which otherwise would require separate measurements in two or three different frequency bands.

## Characteristics

**MEASUREMENT FUNCTIONS**

**Display Channels –** Two channels.

**Display Parameters –** REFILL (reflection, S11), RNs (transmission, S21). Includes conversion of impedance and admittance. Characteristic impedance (Zo) can be input.

**Format –** Orthogonal display: Log/linear amplitude, phase, group delay, real and imaginary parts of complex parameters. I Z I, R, X (at impedance conversion measurement). I Y I, G, B (admittance conversion measurement). Phase extension display function. Smith chart: Marker readout for log/linear amplitude, phase, real + imaginary parts, R+jX, G+jB. Polar coordinate display: Marker readout for log/linear amplitude, phase, real + imaginary parts.

**SIGNAL SOURCE CHARACTERISTICS**

**Measurement Function –** Range: 300 kHz to 3.6 GHz (RNS), 20 MHz to 2.0 GHz (REFILL). Resolution: 1 Hz. Accuracy: ±10 ppm (25°C ± 5°C).

**Output Level –** Range: +5 dBm to –18 dBm. Accuracy: ±0.5 dB (–14 dBm, 50 MHz, 25°C ± 5°C). Output level linearity: –14 dBm (reference). ±0.7 dB (–14 dBm to +5 dBm). ±1.0 dB (–18 dBm to –14 dBm). Flatness: 2.0 dB p-p (–14 dBm, 25°C ± 5°C). Output impedance: 50 Ω.

**Output Form –** Output: Single. Connector: 50 Ω, N type, female.

**Signal Purity –** Harmonic distortion: –20 dBc (at max. output, 25°C ± 5°C). Non-harmonic spurious: Value related to mixer ≤–25 dBc (at max. output, 25°C ± 5°C).
Phase noise: 10 kHz offset, 1 Hz bandwidth. 300 kHz ≤f <3 MHz: –75 dBc. 3 MHz ≤f <40 MHz: –85 dBc. f ≥40 MHz: –85 dBc + 20log (f/40 MHz).

# Network Analyzers



**SWEEP FUNCTIONS**

**Sweep Parameters –** Frequency and signal level.

**Max. Sweep Range –** Frequency: 300 kHz to 3.6 GHz. Signal level: –18 dBm to + 5 dBm.

**Range Setting –** Start/stop or center/span.

**Sweep Time –** 0.5 ms/point min. Sweep time depends upon measurement format, type of error correction, sweep width per point, number of measurement points, and IF bandwidth for measurement.

**Number of Measurement Points –** 3, 6, 11, 21, 51, 101, 201, 301, 601, 1201 (max. number of display points is 601).

**Sweep Mode –** Dual sweep: Two channels swept in the same frequency range. Alternate Sweep: Two channels can be swept using two different types of sweep in different frequency ranges.

**RECEIVE/TRANSMISSION CHARACTERISTICS**

**Input Characteristics –** Frequency range: 300 kHz to 3.6 GHz. Resolution bandwidth: 10 Hz to 1 kHz (variable in 1 or 3 steps).
Dynamic range: 100 dB.
Noise level: –90 dBm (in 1 kHz bandwidth). –100 dBm (in 10 Hz bandwidth ≥20 MHz).
Max. input level: 0 dBm.
Max. breakdown level: +20 dB, ±25 VDC.
Return loss: 20 dB or more (25°C ± 5°C).
Input crosstalk: –100 dB (20 MHz ± 1 GHz). –90 dB (300 kHz ± 3.6 GHz).

**Amplitude Characteristics –** Measurement range: 0 ± 100 dB (amplitude ratio).
Amplitude resolution: 0.001 dB.
Dynamic accuracy: 0 to –10 dBm ± 0.30 dB, f ≤1.3 GHz. 0 to –10 dBm ± 0.5 dB, f >1.3 GHz. –10 to –60 dBm ± 0.05 dB. –60 to –70 dBm ± 0.15 dB. –70 to –80 dBm ± 0.40 dB. –80 to –90 dBm ± 1.00 dB.

**Phase Measurement –** Measurement range: ±180° (Measurement range exceeding ±180° are enabled by using the display extension function). Phase resolution: 0.01°. Dynamic accuracy (at f ≥19 MHz): 0 to –10 dBm ±5.0°. –10 to –50 dBm ±0.3°. –50 to –60 dBm ±0.4°. –60 to –70 dBm ±1.5°. –70 to –80 dBm ±4.0°. –80 to –90 dBm ±8.0°.

**GROUP DELAY TIME CHARACTERISTICS**

**Linear/Logarithmic Frequency Sweeps and Over Sweeps All Frequencies –** Range: Derived from the following equation:

$$t = \frac{\Delta\phi}{360 \times \Delta f}$$

where: $\Delta\phi$ = Phase
$\Delta f$ = Aperture frequency (Hz)

**Measurement Range –** 1 ps to 250 ps.
**Aperture Frequency –** Corresponds to f; can be set to any value up to 100% of frequency span.

$$\text{Accuracy} = \frac{\text{Phase accuracy}}{360 \times \text{aperture frequency (Hz)}}$$

**RECEIVE/REFLECTION CHARACTERISTICS**

**Input Characteristics –** Frequency range: 20 MHz to 2.0 GHz. Resolution bandwidth: 1 kHz to 10 Hz. Max. input level: +6 dBm. Max. breakdown level: +26 dBm, 0 VDC. Directivity: 35 dB or more (20 MHz to 2.0 GHz, 25°C ± 5°C). Test port source match: 16 dB or more (20 MHz to 2.0 GHz, 25°C ± 5°C).

**Amplitude Characteristics –** Measurement range: 0 ± 100 dB (amplitude ratio). Amplitude resolution: 0.001 dB. Amplitude tracking: ±0.5 dB (–14 dBm, 20 MHz to 3.6 GHz, 25°C ± 5°C).

**Phase Characteristics –** Measurement range: ±180° (Measurements exceeding ±180° can be displayed continuously by using the display extension function). Phase resolution: 0.01°. Phase tracking: ±5° (–14 dBm, 20 MHz to 3.6 GHz< 25°C ±5°C).

**GROUP DELAY TIME CHARACTERISTICS**

**Linear/Logarithmic Frequency Sweeps And Sweeps Over All Frequencies –** Range: Derived from the following equation

$$t = \frac{\Delta\phi}{360 \times \Delta f}$$

where: $\Delta\phi$ = Phase
$\Delta f$ = Aperture frequency (Hz)

**Measurement Range –** 1 ps to 250 ps.
Group delay time resolution: 1 ps.
Aperture frequency: Corresponds to $\Delta f$ and can be set to any value to 100% of frequency span.

**MARKER FUNCTION**

**Multiple Markers –** Up to ten independent markers can be set for each channel.

**Fixed Marker –** Normal markers overlap the measurement waveform, but fixed marker values can be specified outside the measurement display area and can be measured for delta values against the reference marker.

**Correction Marker –** Two modes are available for reading marker points: one displays data at the measured frequency point without further processing, and the other displays the value between measurement points by interpolation.

**Marker Coupling –** Coupled or independent markers may be set for each channel.

**Analysis of Any Freely Specified Section –** Marker search and ripple measurement can be performed in a section specified with the marker.

**MKR Search –** MAX search, MIN search, and NEXT MAX search.

**Marker Tracking –** Marker search activation tracking function can be performed for each sweep.

**Target Search –** Bandwidth, center frequency, and Q at the X dB DOWN point can be calculated. The frequency of phase 0° and the frequency width at ±X° can be searched for.

**AUTO ZOOM –** MAX search and MKR→CENTER automatically set the value to the SPAN specified by AUTO ZOOM SPAN.

# Network Analyzers





### ERROR CORRECTION FUNCTIONS

**Normalize –** Corrects for frequency response errors (both amplitude and phase) during transmission measurement.

**1-port Calibration –** Corrects for errors due to bridge directivity, frequency response, and source match during reflection measurements. Short, open, and load are required for error correction.

**Data Averaging –** Data (vector values) are averaged for every sweep. The average factor can be set to any value between 2 to 126.

**Auto Offset Compensation –** Electrical length compensation: Equivalent electrical length or delay time are added to the measured phase and group delay time. Range: 3 x 108 m to +3 x108 m or +1 sec. to –1 sec.

### INSTRUMENT STATE FUNCTIONS

**Save –** The set conditions are stored in an internal register by pressing the Save Register key. In addition, when the power is turned on, the unit is set to state held immediately before power-off by the Power Off Save function. Measurement data, calibration data, and set conditions are saved on built-in floppy disk by pressing the Store key.

**Recall –** The set conditions stored in the internal register are recalled by pressing the Recall key. The measurement data, calibration data, and set conditions saved on built-in floppy disk are recalled by pressing the Load key.

**Limit Line Function –** The limit line for GO/NO-GO tests (standard value line) is defined on the CRT screen.

### PROGRAMMING FUNCTIONS

**BASIC Controller Function –** The standard controller function in the analyzer controls the analyzer itself and other instruments with the GPIB interface. This control is executed by programs created on the analyzer.

**Built-in Functions –** The built-in functions contained in the analyzer provide fast analysis of measurement data.

**Floppy Disk Drive (FDD) Function –** Disk capacity: 750 kB (formatted). Media type: 3.5 in., double-sided, double density.

### CONNECTIONS TO EXTERNAL EQUIPMENT

**Copy –** Produces hard copies of graphs and printouts of data lists displayed on the CRT by using the GPIB-compatible plotter and printer, without the need for an external controller.

**Video Plotter Output Signal –** Separate signal (8-Pin DIN socket) and Composite signal (BNC connector).

**GPIB Data Output and Remote Control –** Conforms to IEEE 488.

**Parallel I/O –** TTL level (38 pins), 8-Bit output (2 ports) and 4-Bit I/O (2 ports).

**EIA-232-D –** Serial output conforms with EIA-232-D.

**External Trigger –** TTL level, LOW enable. Connector, BNC female.

**External Reference Frequency Input –** Frequency: 1, 2, 5, 10 MHz. Connector: BNC female.

### DISPLAY

**CRT Format –** Single channel, 2-CH overlay, 2-CH separation, and enlarged scale.

**Display Data –** Data being measured is displayed, or both the data being measured and the data in memory are displayed simultaneously.

**Reference Line Position –** Between the top (100%) and bottom (0%) of the vertical axis scale.

**Time Display –** The calendar date (year/month/day) and time of day (hour/minute/second) can be set and displayed.

**Label –** Up to 45 characters can be entered.

### GENERAL SPECIFICATIONS

**Operating Environment –** Temperature (when FDD is used): +5 to +40°C, relative humidity 85% or less.

**Safety –** This product has been tested by Advantest to IEC 348 specifications.

**Power Requirements –** Operating voltage: Standard: 90 to 132. Opt. 40: 195 to 250 Power consumption: 280 VA or less. Frequency: 48 Hz to 86 Hz

### PHYSICAL CHARACTERISTICS

| Dimensions (approx.) | mm | in. |
|---|---|---|
| Height | 221 | 8.7 |
| Width | 424 | 16.7 |
| Depth | 450 | 17.7 |
| | **kg** | **lb.** |
| Weight | 25 | 55.1 |

### ORDERING INFORMATION

**R3763B**
Network Analyzer ..... **$28,500**
**Includes:** Power Cord, Limit Line Editor on Floppy Disk, Instruction Manual.
**Opt. 10 –** Attenuation down to –88 dBm ..... **+$2,900**
**Opt. 40 –** 195 to 250 V operation ..... **NC**
**Keyboard –** Order TR45103 ..... **$1,300**

**CALIBRATION KITS**
**Type N, 50 Ω –** Order 9617C3 ..... **$2,300**
**3.5 mm, 50 Ω –** Order 9617H3 ..... **$3,000**
**BNC, 50 Ω –** Order 9617K3 ..... **$2,100**
**Type N 75 Ω –** Order 9617R3 ..... **$3,500**
**BNC, 75 Ω –** Order 9617S3 ..... **$3,100**
**Plotter –** HC100 Opt. 01 ..... **$1,260**

ADVANTEST

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The R3763B complies with IEEE Standard 488.1-1987.

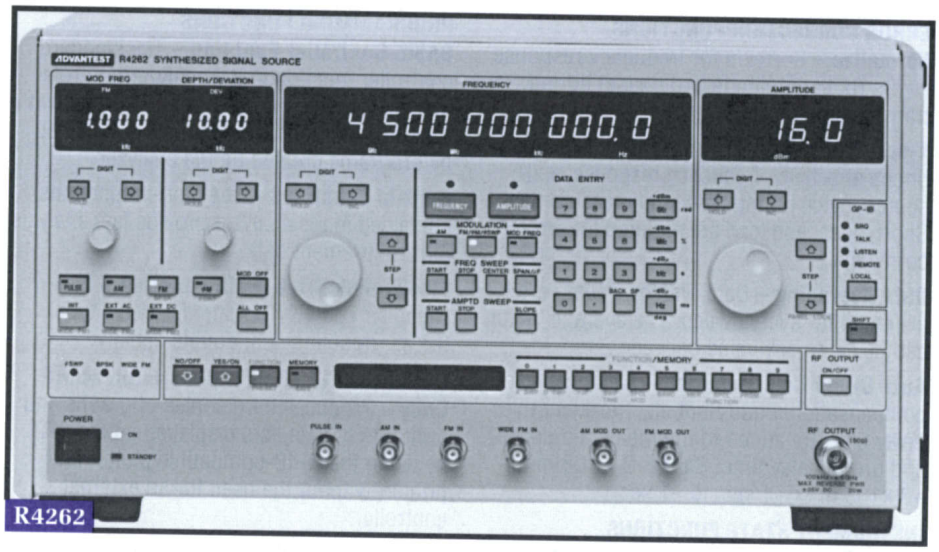
# Signal Sources



*4.5 GHz Synthesized Signal Generator offering outstanding signal purity and performance.*

**R4262 SYNTHESIZED SIGNAL SOURCE**

- 100 kHz to 4.5 GHz with 0.1 Hz Resolution
- High Purity of –137 dBc/Hz at 1 GHz (10 kHz offset)
- Capable of Digital Modulation
- High Output of More Than +16 dBm




## R4262 Synthesized Signal Source

The R4262 Synthesized Signal Source covers a wide frequency range from the RF band to the quasi-microwave band. It allows frequency settings with a 0.1 Hz resolution over the 100 kHz to 4.5 GHz frequency range, and provides extremely low phase-noise characteristics (–137 dBc/Hz at 1 GHz carrier frequency and 10 kHz offset). It incorporates two-train audio signal sources (one for amplitude modulation, one for angle modulation), and provides versatile ways to modulate signals, including simultaneous modulation, AM, FM, øM (phase modulation), PM (pulse modulation), BPSK, and wide FM.

The R4262 provides ideal signal sources for testing amateur radios, cordless telephones, radio pagers, MCA, and car telephones, as well as sub-microwave-based mobile communications, satellite communications, satellite broadcasting, and GPS (global positioning system) equipment.

### HIGH SPECTRUM PURITY

Based on low-noise YTO (YIG Tuned Oscillator) synthesizer technology, the R4262 makes it possible to reduce phase-noise in the S-band to as low as –126 dBc/Hz (10 kHz offset frequency). Its extremely low phase-noise characteristics of –137 dBc/Hz or less (10 kHz offset frequency) at 1 GHz provides an ideal signal source for testing such signal interferences as adjacent channel interference in RF-band receivers.

### HIGH ACCURACY AND HIGH OUTPUT LEVEL

The R4262 produces a maximum output of +16 dBm in the 100 kHz to 4.5 GHz frequency range (+13 dBm at 4 GHz to 4.5 GHz). You can set power levels down to –120 dBm with ±1 dB accuracy.

### UNIQUE SSB PHASE-NOISE CHARACTERISTIC CONTROL FUNCTION

Two modes of phase-noise characteristics are provided; a normal mode featuring extremely low phase-noise characteristics in frequencies very close to the carrier, and a special mode featuring extremely low phase-noise characteristics in frequencies far away from the carrier (offset 100 kHz or more). Therefore, you can select the phase-noise characteristic that best suits your intended test.

### VERSATILE MODULATING FUNCTIONS

A wide variety of modulating functions are provided, including AM, PM, FM, øM, wide FM, AM-FM-øM, PM-FM, PM-øM, AM-AM, FM-FM, øM-øM, AM-wide FM, PM-wide FM, and analog sweep-wide FM simultaneous modulation.

### VERSATILE SWEEP MODES

The R4262 can generate amplitude and frequency sweeps in specified times.

### BUILT-IN LOW-DISTORTION AUDIO SIGNAL SOURCES

Two trains of low-distortion audio signal sources (one for amplitude modulation and one for angle modulation at 20 Hz to 10 kHz) are built in.

### REVERSE POWER PROTECTION

The R4262 is designed to withstand reverse power of up to 20 W.

ADVANTEST

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The R4262 complies with IEEE Standard 488.1-1987.

## Characteristics

**FREQUENCY RELATED**

**Frequency Characteristics –** RF output frequency range: 100 kHz to 4.5 GHz.

**Carrier frequency –**

| Band | Frequency Range |
|---|---|
| 1 | 0.1000000 to 69.9999999 MHz |
| 2 | 62.5000000 to 131.1999999 MHz |
| 3 | 125.0000001 to 262.4999999 MHz |
| 4 | 250.0000001 to 524.9999999 MHz |
| 5 | 500.0000001 to 1049.9999999 MHz |
| 6 | 1000.0000001 to 2000.0000000 MHz |
| 7 | 2000.0000001 to 4500.0000000 MHz |
| HET | 10.0000000 to 2000.0000000 MHz |
| 1ex | 0.1000000 to 120.0000000 MHz |

**Resolution –** Normal mode: 0.1 Hz. Fast mode: 1 Hz.

**Stability –** Same as internal reference oscillator or external reference input.

**Internal reference quartz oscillator –**

| | Standard | Opt. 23 |
|---|---|---|
| Aging Rate | $2 \times 10^{-8}$/day<br>$8 \times 10^{-8}$/month | $5 \times 10^{-10}$/day<br>$1 \times 10^{-8}$/month |
| Long-term Stability | $1 \times 10^{-7}$/year | $2 \times 10^{-8}$/year |
| Temperature Characteristics (+25°C ± 25°C) | $\pm 5 \times 10^{-8}$ | $\pm 5 \times 10^{-9}$ |

**SPECTRAL PURITY**

**SSB Phase-Noise –** In normal-band CW and AM modes with 10 kHz offset: –138 dBc/Hz (band 4). –137 dBc/Hz (band 5). –132 dBc/Hz (band 6). –126 dBc/Hz (band 7 ≤4 GHz). –124 dBc/Hz (band 7 >4 GHz).

**Residual FM –** <2 Hz RMS (in CW mode at 0.3 to 3 kHz demodulation bandwidth).

**Residual AM –** <0.01% AM RMS (in CW mode at 0. to 3 kHz demodulation bandwidth).

**Spurious –** In normal-band CW and FM modes (10 kHz frequency deviation) at output level ≤10 dBm.

Harmonics: –30 dBc.

Non-harmonics: With off carrier of 10 kHz or more: –90 dBc (bands 2 to 5). –84 dBc (band 6). –78 dBc (bands 1 and 7).

**OUTPUT**

**Output level range –**

–140.0 dBm to +16.0 dBm (bands 1 to 5).
–133.0 dBm to +16.0 dBm (band 6, HET).
–120.0 dBm to +16.0 dBm (band 7 ≤4 GHz).
–120.0 dBm to +13.0 dBm (band 7 >4 GHz).

**Resolution –** 0.1 dB.

**Absolute accuracy (at 25°C ± 10°C, except for analog sweep) –** ±1 dB output level at ≥–120 dBm. ±2 dB output level at –120 to –133 dBm (bands 1 to 6, HET).

**Output level flatness –** <±0.8 dB (at 0.1 to 4.5 GHz, output level of +5 dBm). <±0.5 dB (at 0.1 to 1 GHz, output level of +5 dBm).

**Output impedance –** 50 Ω nominal.

**SWR –** <1.5 at output level <0 dBm. <2.0 at output level ≤+5 dBm.

**Reverse power protection –** 20 W, ±25 VDC.

**Units –** dBm, dBμ, dBμV, V, mV, μV, nV.

**Output level switching time –** <50 ms from when last command is issued to when output stabilizes.

**AMPLITUDE MODULATION (AM)**

**Modulation Range –** 0 to 99% at output level ≤+7 dBm, bands 1 to 5, INT, EXT AC. 0 to 95% at output level ≤+7 dBm, band 6, INT, EXT AC. 0 to 90% at output level ≤+7 dBm, EXT DC in bands 1 to 6 and INT, EXT AC in band 7 (<4 GHz).

**Setting resolution –** 0.1%.

**Indicated AM accuracy –** ±(set value x 6%) ±1% (at modulation frequency 1 kHz, modulation degree ≤90%).

**FREQUENCY MODULATION (FM)**

**Maximum frequency deviation –** 800 kHz (at 1 kHz modulation frequency, band 7, HET). 400 kHz (at 1 kHz modulation frequency, band 6). 200 kHz (at 1 kHz modulation frequency, bands 5, 1, and 1ex). 100 kHz (at 1 kHz modulation frequency, band 4). 50 kHz (at 1 kHz modulation frequency, band 3). 25 kHz (at 1 kHz modulation frequency, band 2).

**Indicated FM accuracy –** ±7% of setting ±10 Hz (at modulation frequency 1 kHz, frequency deviation <400 kHz).

**FM distortion –** At 20 Hz to 20 kHz modulation frequency. EXT DC. 1% or less at maximum frequency deviation. 0.5% or less at 1/2 the maximum frequency deviation.

**PHASE MODULATION (Ø M)**

**Modulation accuracy –** 10% of setting at 1 kHz modulation frequency.

**Binary Phase Shift Keying (BPSK) –** Carrier null: >30 dB (at ambient temperature 20°C to 35°C, 100 kHz rectangular wave).

**PULSE MODULATION**

(at band 7, HET when output level ≤+15 dBm)

**ON/OFF ratio –** >35 dB (band HET: 10 to 2.0 GHz). >50 dB (band 7: 2.0 to 4.5 GHz).

**Rise/fall time –** <2.5 μs (10 to 90%). Minimum pulse width: 5 μs.

**Repetition frequency –** 30 Hz to 50 kHz.

**Input threshold level –** 1.5 V (nominal).

**INTERNAL MODULATION OSCILLATOR**

(2 trains built-in; one for amplitude modulation, one for angle modulation)

**Modulation frequency –** 20 Hz to 100 kHz.

**Frequency resolution –** 1% of setting.

**Frequency accuracy –** ±3% of setting.

**Output amplitude range –** 1 V p-p (600 Ω load).

**Output amplitude resolution –** 1 mV p-p.

**Distortion –** <0.04% (20 Hz to 10 kHz). <1% (output amplitude 0.2 V peak, >10 kHz).

**Output amplitude accuracy –** ±4% of setting.

**Output impedance –** 600 Ω ±10%.

**BROADBAND ANALOG SWEEP**

**Center frequency range –** 100 kHz to 120 MHz, 10 MHz to 4.5 GHz.

**Span –** 8 MHz to 2.5 GHz (less than 8 MHz also possible). The full sweep mode must be set when sweeping across 2.0 GHz.

**Start/stop frequency range –** 100 kHz to 120 MHz, 10 MHz to 4.5 GHz. The full sweep mode must be set when sweeping across 2.0 GHz.

**Setting resolution –** Approx. 6.25 kHz.

**Accuracy –** ±1% of set span ±1 MHz (after automatic calibration). Center frequency accuracy when zero span: <±1 MHz (after automatic calibration).

**Sweep modes –** AUTO (INT, EXT, LINE), SINGLE, MANUAL.

**Sweep time –** Approx. 50 ms to 100 s.

# Signal Sources



**NARROWBAND ANALOG SWEEP ±ΔF**

**Center frequency range –** 100 kHz to 4.5 GHz.

**Maximum span (2ΔF) –** ≤8 MHz (depends upon center frequency).

**Setting resolution –** 1 kHz (range 1) at ΔF ≤4.0 MHz: 0.1 kHz (range 2) at ΔF ≤400 kHz. 0.01 kHz (range 3) at ΔF ≤40 kHz.

**Indicated span accuracy –** ±2% of set span.

**Center frequency accuracy –**

| Band | Range 1 | Range 2 | Range 3 |
|---|---|---|---|
| 7, HET | 40 kHz | 20 kHz | 10 kHz |
| 6 | 4 kHz | 2 kHz | 1 kHz |
| 1 to 5 | 0.4 kHz | 0.2 kHz | 0.1 kHz |

**Sweep modes –** AUTO (INT, EXT, LINE), SINGLE, MANUAL.

**Sweep time –** Approx. 50 ms to 100 s.

**DIGITAL FREQUENCY SWEEP**

**Frequency range –** 100 kHz to 4.5 GHz. However, when swept across 2.0 GHz, a band-cross wait time is added, resulting in a SINGLE sweep.

**Linear sweep –** Linearly swept between set start and stop frequencies or between center frequency and span with the set sweep time, step frequency, and number of steps. The sweep time, step frequency, and number of steps can be set to any desired value.

**Log sweep –** The step frequency is incremented at the ratio of 1:0.1 (1% log) and 1.1 (10% LOG).

**Number of steps –** Manually set: 1 to 3999. Automatically set: 1 to 9999.

**Sweep modes –** AUTO (INT), SINGLE.

**Sweep time –** Approx. 40 ms to 100 s per sweep (manually set). Approx. 40 ms to 100 s per step (manually set).

**ANALOG LEVEL SWEEP**

**Range –** 15 dB log sweep.

**Sweep time –** 50 ms to 100 s.

**Sweep modes –** AUTO (INT, EXT, LINE) SINGLE, MANUAL.

**Analog Phase Sweep –** Maximum span: 600° (at band 7, HET). Sweep modes: AUTO (INT, EXT, LINE) SINGLE, MANUAL. Sweep time: Approx. 50 ms to 100 s.

**Phase Shift –** Maximum offset range: 600° (at band 7, HET).

**INPUT/OUTPUT**

**FRONT PANEL**

**RF signal output –** 100 kHz to 4.5 GHz RF signal output terminal (equipped with reverse power protection). Connector: N-type.

**Modulation signal input –** AM, FM, øM, BPSK, wide FM, pulse modulation input terminals. Connectors: BNC.

**Modulation signal output –** Internal modulation oscillator (AM, FM) output terminals. Connectors: BNC.

**REAR PANEL**

**REFERENCE EXT IN –** External reference frequency input terminal. Frequency: 10 MHz. Level: ≥1 V p-p. Impedance: 1 kΩ. Connector: BNC.

**REFERENCE 10 MHz OUT –** Internal reference frequency output terminal. Frequency: 10 MHz. Level: ≥1 V p-p. Impedance: 50 Ω. Connector: BNC.

**SWEEP IN/OUT –** Sweep voltage input/output terminals. Level: 0 V to 8 V or –4 V to +4 V. Connector: BNC.

**STOP SWEEP –** Sweep stop signal input terminal. Level: TTL level (Low = stop, High = sweep). Connector: BNC.

**BLANK OUT –** Sweep blanking signal output. Level: 0 V to +5 V or 0 V to –5 V (0 V = sweeping, ±5 V = blanking). Connector: BNC.

**MARKER OUT –** Marker signal output. Level: –5 V to +5 V (–5 V = marker frequency, 0 V = sweeping, +5 V = blanking). Connector: BNC.

**AUX MOD IN –** External modulation signal auxiliary input terminal. Connector: BNC.

**GPIB interface –** Based on IEEE-488-1978. Function control: All functions (except power on/off) can be controlled in the same way as from the front panel.

**GENERAL SPECIFICATIONS**

**Memory Function –** Total of 50 items – 10 items from all conditions set on the front panel and 40 items of carrier frequencies and output levels – can be stored in the built-in memory. The memory contents are retained by a backup circuit when the power is off.

**Radiation Interference –** <1 μV as measured at a position 1 inch apart from the panel surface by using a 1 inch, 2-turn, 50 Ω terminated coil.

**Temperature –** 0°C to +40°C, relative humidity 85% or less.

**Safety –** This product has been safety tested by Advantest to IEC 348 specifications.

**POWER REQUIREMENTS**

**Operating voltage –** Standard: 90 to 110 V. Opt. 32: 98 to 132 V. Opt. 42: 198 to 242 V. Opt. 44: 216 to 250 V.

**Power consumption –** 440 VA max.

**PHYSICAL CHARACTERISTICS**

| Dimensions | mm | in. |
|---|---|---|
| Height | 221 | 8.7 |
| Width | 424 | 16.7 |
| Depth | 550 | 21.7 |
| | kg | lb. |
| Weight | 45 | 99.2 |

**ORDERING INFORMATION**

ADVANTEST

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The R4262 complies with IEEE Standard 488.1-1987.

**R4262 OPT. 32 (FOR U.S. OPERATION)**
Synthesized Signal Source ..... **$51,400**
**Includes:** Power Cord, BNC-to-BNC Input Cable, N-to-N Output Cable, N-to-BNC Adapter, Instruction Manual.

**Opt. 23 –** Internal reference quartz oscillator. ..... **+$1,500**
Aging rate: 5 x $10^{-10}$/day, 1 x $10^{-8}$/month
Long-term stability: 2 x $10^{-8}$/year
Temperature characteristics: ±5 x $10^{-9}$ (+25°C ± 25°C)

**Opt. 32 –** 98 to 132 V operation
(must be specified on U.S. orders) ..... **NC**

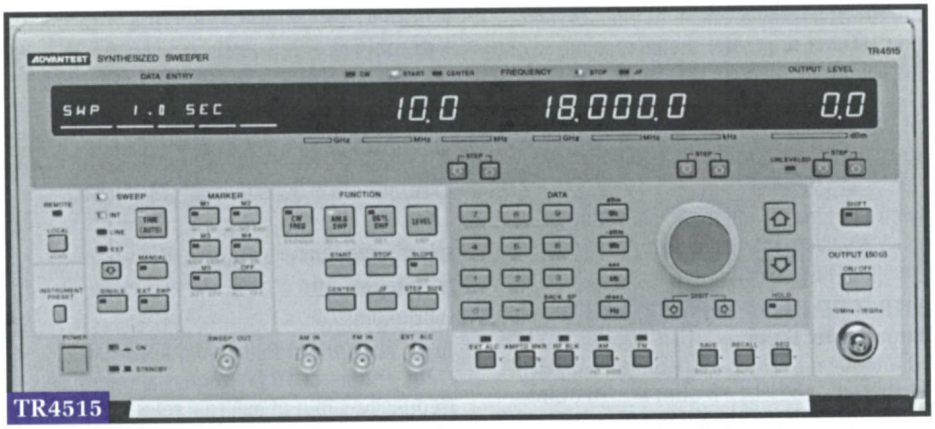
**Opt. 42 –** 196 to 242 V operation ..... **NC**

**Opt. 44 –** 216 to 250 V operation ..... **NC**

**Rackmount Kit –**
Conforms to EIA standards, with front handle.
Order A02712 ..... **$300**

**Rackmount Kit –**
Conforms to EIA standards, without front handle.
Order A02722 ..... **$100**

**Transit Case –** Order R16060 ..... **$1,050**



TR4515

## TR4515 Synthesized Sweeper

The TR4515 is a synthesized sweeper with a wide frequency range. Features include: the ability to sweep continuously from 10 MHz to 18 GHz in a variety of modes including digital sweep modes; an extremely pure output signal due to the use of a YTO (YIG Tuned Oscillator); and the high accuracy and resolution with which its synthesized frequency can be set. The output has low residual FM and excellent level repeatability in the CW mode, making it ideal for device gain and loss measurements.

Sweep width, output level, sweep time, and other sweep parameters can be input from the keyboard, data knob, and step keys, with the input values visible on the front-panel LED display. Then the sweep pattern set by these parameters can be saved to the internal memory. Up to 10 different patterns can be stored in memory for instant recall at a press of the RECALL or SEQ key. The SEQ (sequence) mode is particularly useful on production lines, because it can program a continuous series of measurements incorporating up to 10 patterns.

Also provided are five independent intensified markers, each continuously variable. The frequency assigned to each marker is shown on the LED display when the marker button is pressed.

### WIDEBAND SWEEP: 10 MHZ TO 18 GHZ

A single sweep covers the entire band from 10 MHz to 18 GHz. Additional capabilities include start-stop sweep, marker-to-marker sweep, ΔF sweep, and digital sweep.

### HIGH ACCURACY AND RESOLUTION IN FREQUENCY SETTING

The TR4515 uses a synthesized sweep that provides the same stability as the internal reference frequency (aging rate 2 x $10^{-7}$) or an externally input reference frequency. In an analog sweep, the frequency is calibrated at the start and stop points, enabling measurements with an accuracy of ±2 MHz or better. In CW mode, frequency can be set in minimum steps of 1 kHz, while the CW high-resolution mode can interpolate frequency settings with 10 Hz resolution.

### DIGITAL SWEEP IN PRECISE FREQUENCY OR LEVEL STEPS

In addition to its analog sweep functions, the TR4515 can perform digital sweeps of frequency or level. The digital frequency sweep provides precise frequency steps with 1 kHz resolution. The digital level sweep offers 0.01 dB resolution and a variable sweep range of up to 90 dB (+10 dBm to –80 dBm, including the output attenuator option), providing even greater dynamic range than the analog level sweep.

### TR4515 SYNTHESIZED SWEEPER

- High-Purity Signal Output: –95 dBc (at 8 GHz with 10 kHz Offset)
- Accurate Frequency Setting with High Resolution
- Digital Frequency and Level Sweeps
- Sequence Function

*A synthesized sweeper with high signal purity. Also usable as a signal generator.*

ADVANTEST

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The TR4515 complies with IEEE Standard 488.1-1987.

# Signal Sources



## Characteristics

**FREQUENCY RELATED**

**Continuous Wave Mode –** Frequency range: 10 MHz to 18 GHz with over-range to 18.1999 GHz.

**Frequency setting resolution –** Normal mode: 10 MHz ≤f ≤8 GHz: 1 kHz. 8 GHz <f ≤16 GHz: 2 kHz. f>16 GHz: 3 kHz. High-resolution mode: 10 Hz.

**Frequency setting accuracy –** Normal mode: Depends upon the internal reference frequency and external input frequency.

**High-resolution mode –** Display accuracy: ±10 Hz + internal reference frequency accuracy ±1 count x n. Setting accuracy: ±100 Hz + internal reference frequency accuracy. Drift: n x 70 Hz/minute.

**Reference frequency –** Internal reference frequency: 10 MHz, 3 x $10^{-8}$/day, 2 x $10^{-7}$/week, 1x $10^{-6}$/year. External input frequency: 5 MHz or 10 MHz, 0 dBm to +10 dBm.

**Residual FM –** n x 30 Hz RMS (demodulation bandwidth 50 Hz to 15 kHz). n = 1: f ≤8 GHz. n = 2: 8 GHz <f ≤16 GHz. n = 3: f >16 GHz.

**Switching time –** f ≤8 GHz: Max. 100 ms. f >8 GHz: Max. 150 ms.

**ANALOG SWEEP MODE**

**Frequency range –** 10 MHz to 18 GHz with over-range to 18.1999 GHz.

**Setting resolution (start and stop) –** 100 kHz.

**Setting accuracy (start and stop) –** Normal mode: f ≤8 GHz: ±20 MHz or less. f >8 GHz: ±30 MHz or less.

**Residual FM –** ±300 kHz peak.

**Sweep time –** 10 ms to 100 s (two variable digits). 50 ms to 100 s with full sweep.

**Sweep time accuracy –** ±50%.

**Manual sweep resolution –** ΔF x 0.1%.

**Markers –** 5 points.

**Marker accuracy –** Active marker: Sweep time 100 ms or greater. Equal to accuracy of normal marker at ±30 MHz of band switch-over points. ΔF <200 MHz: ±1 MHz. ΔF <2 GHz: ±2 MHz. Normal marker: Δf ≤8 GHz: ±20 MHz. f >8 GHz: ±30 MHz.

**Sweep modes –** Center/ΔF, start/stop, M1-M2 sweep, manual sweep, external sweep, single sweep.

**OUTPUT RELATED CHARACTERISTICS**

**Output Level Range –** +15°C to +35°C: 10 MHz ≤f ≤14 GHz: +10 dBm to –10 dBm. 14 GHz <f ≤18 GHz: +8 dBm to –10 dBm. +15°C to +35°C, with option 10: 10 MHz ≤f <14 GHz: +8 dBm to –80 dBm. 14 GHz ≤f <18 GHz: +5 dBm to –80 dBm.

**Setting Resolution –** 0.01 dB.

**Display Resolution –** 0.01 dB for data entry display, 0.1 dB for level display.

**Output Level Accuracy –** +15°C to +35°C: ±1.5 dB. +15°C to +35°C with Opt. 10: 1.7 dB ±0.4 dB/step.

**Output Impedance –** Approx. 50 Ω.

**VSWR (at SMA output connector) –** 2.0. Max. With Opt. 10: 2.2. Output connector: SMA connector, convertible to type N. Residual AM> 50 dBc (20 Hz to 20 kHz demodulation band). Level Sweep: Max. 13 dB.

**SIGNAL PURITY**

**Harmonics –** f ≤2 GHz: >25 dBc. 2 GHz <f ≤8 GHz: >40 dBc.

**Non-harmonics –** f ≤3.7 GHz: >40 dBc. f >3.7 GHz: >60 dBc.

**SSB phase noise –** In CW mode when f ≤8 GHz: 95 dBc/Hz with 10 kHz offset. 105 dBc/Hz with 100 kHz offset. In CW mode when f ≤16 GHz: 88 dBc/Hz with 10 kHz offset. 98 dBc/Hz with 100 kHz offset. In CW mode when f ≤18 GHz: 83 dBc/Hz with 10 kHz offset. 93 dBc/Hz with 100 kHz offset.

**MODULATION CHARACTERISTICS**

**External FM –** Sensitivity: –6 MHz/V.

**Input impedance –** Approx. 10 kΩ.

**Deviation –** Max. ±10 MHz.

**3 dB bandwidth –** DC to 100 kHz.

**External AM –** Sensitivity: 1 dB/V, Max. 13 dB.

**Input impedance –** Approx. 10 kΩ.

**3 dB bandwidth –** DC to 40 kHz (typical) with 0 dBm output.

**Input and Output Functions –** Standard GPIB. Output of 10 MHz internal reference frequency. Input of external reference frequency. Sweep voltage output (0 V to +10 V). External sweep voltage input (0 V to +10 V). Blanking output, pen lift output, sweep trigger input, sweep stop input.

**GENERAL SPECIFICATIONS**

**Internal Memory –** 10 sets of front-panel settings.

**Sequence Operation –** Automatic measurement by recall of up to 10 patterns stored in internal memory.

**Operating Temperature –** 0°C to +40°C, Max. 85% RH.

**Safety –** This product has been safety tested by Advantest to IEC 348 specifications.

**POWER REQUIREMENTS**

**Operating voltage –** Standard: 90 V to 110 V. Opt. 32: 108 V to 132V. Opt. 42: 198 V to 242 V. Opt. 44: 216 V to 250 V.

**Power consumption –** 360 VA max.

**Frequency –** 48 Hz to 66 Hz.

**PHYSICAL CHARACTERISTICS**

| Dimensions (approx.) | mm | in. |
|---|---|---|
| Height | 178 | 7.0 |
| Width | 425 | 16.7 |
| Depth | 550 | 21.7 |
| | **kg** | **lb.** |
| Weight | 29 | 63.8 |

ADVANTEST

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The TR4515 complies with IEEE Standard 488.1-1987.

## ORDERING INFORMATION

**TR4515 OPT. 32 (FOR U.S. OPERATION)**
Synthesized Sweeper ..... **$46,500**
**Includes:** Power Cord, Instruction Manual.

**Opt. 10 –** Output attenuator (70 dB in 10 dB steps) ..... **+$3,800**

**Opt. 32 –** 98 to 132 V operation (must be specified on U.S. orders) ..... **NC**

**Opt. 42 –** 196 to 242 V operation ..... **NC**

**Opt. 44 –** 216 to 250 V operation ..... **NC**

**Rackmount Kit –**
Conforms to EIA standards. Order A02603 ..... **$100**

# Fourier Analyzers

**2622**
**2630**
**2642A**



## Fourier Analyzers

### PC INTEGRATED

Fourier Analyzers from Tektronix provide the most advanced architecture in bench-top instrumentation available today. From their inception, Fourier Analyzers have been designed to carefully integrate the advancing technology of personal computers with the precision and speed of dedicated measurement hardware. The result is a continuously evolving, high-quality measurement system dedicated to the analysis of analog signals and the properties they represent.

Within each Tek Fourier Analyzer is a combination of precision signal-acquisition hardware and microprocessors specifically designed for high-performance signal processing. Connected to a PC, the Fourier Analyzer's internal processors have access to the PC's display, I/O ports, mass storage, and keyboard. In short, the PC becomes the terminal for a powerful Fourier analysis system.

### FLEXIBLE

The Instrument Program (IP) supplied with the Fourier Analyzer is the critical link between the analyzer and the PC. When it is executed from the PC, all of the Fourier Analyzer's instructions are downloaded into the analyzer's internal RAM, providing the latest features and capabilities. IP then uses the PC's display to generate the Fourier Analyzer's user interface – complete with high resolution graphics and easy-to-learn pull-down menus.

From the keyboard, or using a mouse, you have access to a wide variety of analysis functions and data presentations. Standard functions include:

- Time Record (Waveform)
- Orbits (Lissajous)
- Auto- and Cross-Correlation
- Power Spectrum for each Channel
- Frequency Response Functions Between any Two Channels
- Impulse Response
- Real, Imaginary, Magnitude, Phase, and Nyquist Displays
- Advanced Data Cursors




*2642A Shown with Desktop PC*

**2622/2630/2642A**

### FEATURES:

- Easy-to-Learn Pull-Down Menus
- Up To Four Input Channels
- Optional Built-in Signal Generator with Periodic, Random, and Arbitrary Analog Signal Generation
- UL Listed 1244 Certified CSA C22.2 No. 231-M89

### BENEFITS:

- PC-Based for Easy Use, Data Management and Interfacing to Analysis Software
- Superb Hardware for Fast, Accurate Measurements
- Software and Hardware Expansion Options Protect Investment

### APPLICATIONS:

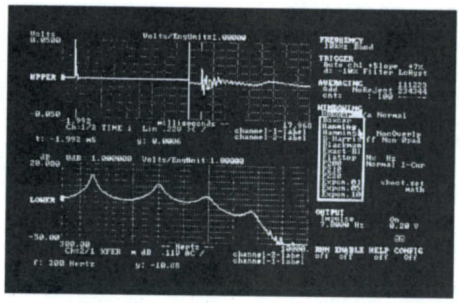
- Real Time Spectrum, Network (Frequency Response), and Waveform Analysis
- Complete Modal System for Structural Analysis
- Accessory Software for Control Systems Analysis, Production Tests, 1/3 Octave Analysis, Spectral Maps, and More

*Advanced analysis of analog and digital signals in the time and frequency domains, from DC to 200 kHz.*

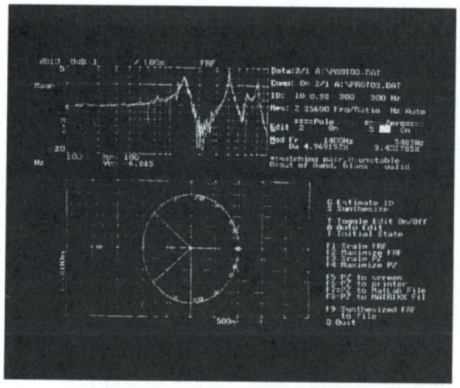
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

**2622**
**2630**
**2642A**

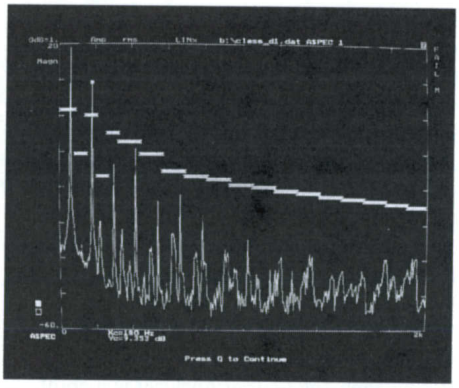
# Fourier Analyzers



*The Instrument Program provides high-quality color graphics and easy-to-learn pull-down menus for data analysis and acquisition control.*



*One of many accessory software packages, the RLS System Identification software produces pole/zero system models from measured stimulus/response data.*



*Production Test Manager Software allows fully automated production testing for noise, vibration, electrical system performance or other applications.*

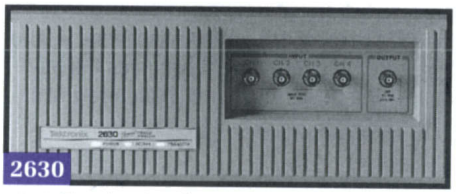
**POWERFUL**

While IP satisfies the majority of measurement needs, the utility of the analyzers is further enhanced with these additional standard programs:

- Transient Capture 500K Samples (Std) up to 3.5 M Samples (2642 A with Opt. 6M) or 1.5 M Samples (2622/2030 with Opt. 2M).
- Automated measurement program.
- Waveform Math Program with 17 standard (+ – * /) and advanced (cepstrum, open-loop mapping) operations for general purpose waveform manipulation.
- Swept sine testing for measurement conditions requiring maximum signal to noise ratio (built-in signal generator required).
- Other display, hardcopy, and data translation utilities.




*2622 Fourier Analyzer – DC-20 kHz*




*2630 Fourier Analyzer – DC-20 kHz*

# Fourier Analyzers

**2622**
**2630**
**2642A**



**ADVANCED SOLUTIONS**
In addition to the standard software, optional accessory programs extend the capabilities of the Fourier Analyzer – providing everything from advanced tools to complete solutions for a variety of applications.

**Production Test Automation –** The Production Test Manager program dramatically reduces the development time for creating automated production tests using Fourier Analyzers. Using the LIMITS program, test limits can be defined quickly using a table of values, previously measured data, or rubberband style graphics. Other routines provide failure report generation, results archiving, multiple limit checks for quality sorting, a simple pass/fail operator interface, and many more standard functions. Executed individually or included in larger programs, these routines can replace hundreds of lines of program code saving valuable time and money.

**Control System Analysis –** The optional RLS and CFIT System Identification programs (RLS shown in photo) analyze time or frequency domain stimulus/response data to produce system models expressed as poles and zeros in either the S or Z planes. For further analysis, the pole/zero models can be passed on to powerful system development programs such as PC-MATLAB™

**Acoustics and Vibration –** When monitoring acoustic signals, the optional Third Octave program provides 1/3 octave analysis of up to four signals simultaneously.

The Machine program automatically labels significant vibration peaks and allows switching among displacement, velocity, and acceleration displays.

**Modal Analysis –** The 2600MS Structural Analysis Solution includes the TekSTAR™ data acquisition manager software plus SMS STARModal or STARStruct analysis software, for a complete, turn-key structural analysis package. Interfaces to other modal analysis software are also available.

**Spectral Maps and Order Tracking –** The 2600SMT software provides capabilities for the analysis of signals which change over time, such as rotating machinery, speech, or underwater device tracking. Three dimensional displays include waterfall plots and color intensity maps to permit viewing changes in amplitude and frequency versus either time or RPM. Detailed analysis of individual orders, frequencies, or spectra is also possible.

*Continued on next page.*

# Fourier Analyzers



## 2600 Systems

### 2622

The 2622 is a small, lightweight, two channel analysis system with a very economical price. Primary applications include production line testing and education. When the integrated system controller (Opt. 33) is added, it becomes an ideal transportable system for machinery, vibration, or acoustic analysis.

### 2630

The 2630 is a two or four input channel system with an optional signal generator. The system's flexibility and PC integration make it perfect for applications such as modal analysis, control system analysis, or general signal and system analysis. When your data record length exceeds the analyzer's transient capture buffer and even the 1.5 M Sample Large Data Memory option isn't enough, Option 5H Data Record/Playback streams data directly to the host PC's hard disk, allowing virtually unlimited record lengths. The four channel configuration also makes it possible to production test three or four units at a time, greatly increasing throughput. An integrated PC, transportable configuration is also available.

### 2642A

The 2642A is the flagship of the 2600 line, providing dedicated DSP performance for a pace-setting 100 kHz real time bandwidth, and full floating-point FFT processing for maximum precision. It offers two 200 kHz input channels, zoom processing, and an arbitrary output generator standard at an extremely attractive price. Extended performance (16-Bit) input channels, a large data memory, an integrated controller, and two additional input channels may be added. Applications include electronic systems analysis, sonar and underwater acoustics, speech analysis, and numerous others.

**SELECTION GUIDE**

| | 2622 | 2630 | 2642A |
|---|---|---|---|
| Frequency Range | 20 kHz | 20 kHz | 200 kHz |
| Input Channel | 2 | 2 (4 with Opt. 1H) | 2 (4 with Opt. 1H or 17) |
| Max Real time BW | 5 kHz | 10 kHz | 100 kHz |
| Dynamic Range | 75 dB | 75 dB | 75 dB (90 dB* with Opt. 16 or 17) |
| Channel Match | ±0.2 dB, ±0.5 deg | ±0.2 dB, ±0.5 deg | ±0.075 dB*, ±0.5 deg |
| Spectral Lines | 25 to 800 | 25 to 1600 | 25 to 1600 |
| Zoom | Opt. 2H | Opt. 2H, 3H | Std. |
| Signal Generator | – | Opt. 4H | Std. |
| Data Rec/Playback | – | Opt. 5H | – |
| Weight | 12 lb. (5.5 kg) | 17 lb. (7.7 kg) | 27 lb. (12.3 kg) |

**(DC – 50 kHz)*

# Fourier Analyzers





## ORDERING INFORMATION

**2622**
2-CH Standard ..... **$6,950**
**Opt. 2H** – 2-CH Zoom ..... **+$500**
**Opt. 2M** – Large Data Memory (add 2 MB) ..... **+$800**

**2630**
2-CH Standard ..... **+$9,950**
**Opt. 1H** – Four Input Channels ..... **+$3,950**
**Opt. 2H** – 2-CH Zoom ..... **+$500**
**Opt. 2M** – Large Data Memory (add 2 MB) ..... **+$800**
**Opt. 3H** – 4-CH Zoom ..... **+$1,000**
**Opt. 4H** – Signal Generator ..... **+$1,750**
**Opt. 5H** – Data Record/Playback ..... **+$3,150**

**2642A**
2-CH Standard ..... **+$15,900**
**Opt. 1H** – Four Input Channels ..... **+$7,000**
**Opt. 16** – Two 16-Bit Input Channels ..... **+$4,000**
**Opt. 17** – Four 16-Bit Input Channels ..... **+$15,000**
**Opt. 6M** – Large Data Memory (add 6 MB) ..... **+$2,400**

All products include IP, MEASURE, TCAP, SEEFILE, MATH, SWSINE, PLT, ASCIILNK*[1]

**CONTROLLER OPTIONS FOR ALL ANALYZERS (2622, 2630, AND 2642A)**
**Opt. 26** – Desktop System Controller ..... **+$3,540**

*[1] **IP (Instrument Program)** – For general signal analysis

*[1] **MEASURE** – For automated measurements

*[1] **TCAP** – For capture to memory of transient data

*[1] **SEEFILE** – For analysis of captured transients

*[1] **MATH** – For waveform arithmetic

*[1] **SWSINE** – For transfer function analysis using swept sine excitation

*[1] **PLT** – For advanced data plotting and display

*[1] **ASCIILNK** – For data conversion to formats suitable for input into other analysis software (PC-Matlab, MATRIXx, spreadsheets, etc.)

**Application Development Kit** – Includes Borland's Turbo Pascal and a collection of high level subroutines (analyzer control, data display, menu driver, etc.) to allow custom application program development. Order 2600ADK ..... **$1,200**

**Application Utilities** – A collection of application routines developed by Tektronix to address specific testing needs. Examples include 1/1 and 1/3 octave analysis, THD measurements, and probability density measurements. Order 2600AU ..... **$950**

**TekSTAR** – Provides a highly integrated interface between IP and PC modal analysis software packages. Drivers are available for most commercially available modal software. Order S3JMS05 ..... **$250**

**STARModal and STARStruct** – Offer a complete PC based modal and structural analysis solution from the leaders in PC modal software, Structural Measurement Systems.

**STARModal** – (Includes TekSTAR) Order 2600MS ..... **$7,500**

**STARStruct** – Order 2600MS with Opt. 01 ..... **$16,600**

**Production Test Manager** – Acquires data and compares it to manually defined or automatically generated limits. Includes pass/fail operator interface, error reports, data archiving, and serial number tracking. Order 2600PTM ..... **$2,500**

**Spectral Maps and Order Tracking** – Provides three dimensional displays (waterfalls or intensity maps), order tracking, RPM extraction, and other features for transient analysis. Order 2600SMT ..... **$1,500**

**RECOMMENDED ACCESSORIES**
**Cart** – See Cart Section page 504 for complete description. Order K420 ..... **$695**

**MINIMUM PC REQUIREMENTS**
Fourier Analyzers operate with an IBM PC, XT, AT, PS/2 or 100% compatible having the following minimum configuration: DOS 3.0 or higher, RAM – 640 KB, One 3.5 or 5.25 in. floppy drive and 20 MB Hard Drive, One RS-232-C serial port, Intel 8087, 80287, or 80387 Co-processor, Enhanced Graphics Adapter (EGA), Monochrome or color EGA monitor (Second serial port and mouse recommended).

**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1** – Universal Euro 220 V, 50 Hz ..... **NC**
**Opt. A2** – United Kingdom 240 V, 50 Hz ..... **NC**
**Opt. A3** – Australian 240 V, 50 Hz ..... **NC**
**Opt. A4** – North American 240 V, 60 Hz ..... **NC**
**Opt. A5** – Switzerland 220 V, 50 Hz ..... **NC**
Also see General Customer Information Section.

**WARRANTY-PLUS SERVICE PLANS OPTIONS**
**Opt. M7** – Calibration Service
2622 ..... **+$300**
2630 ..... **+$350**
2642A ..... **+$400**

**Opt. M9** – Repair Protection
2622 ..... **+$695**
2630 ..... **+$765**
2642A ..... **+$975**

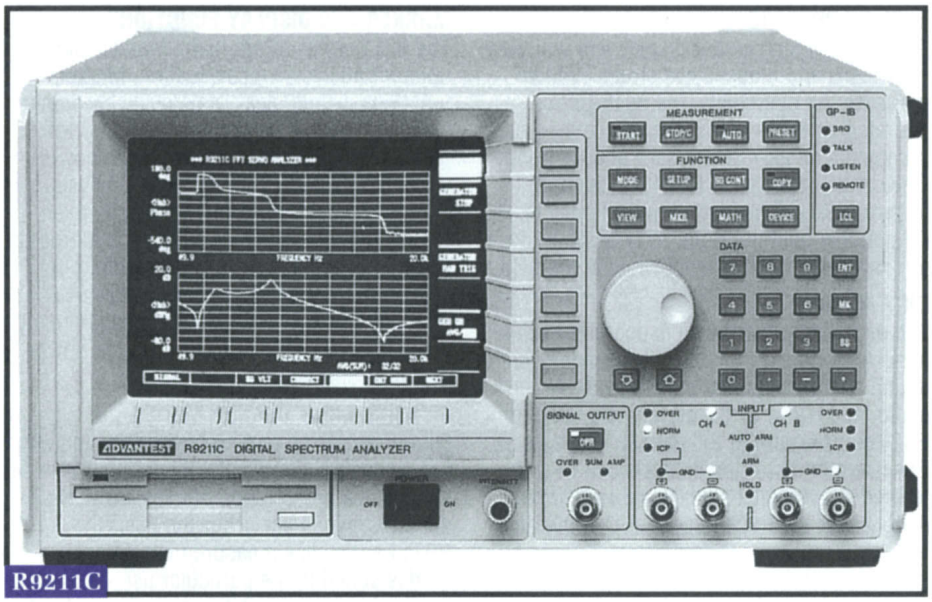
*[1] *Included with 2622, 2630, 2642A.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Fourier Analyzers

**R9211A**
**R9211B**






R9211C

## High Performance Instruments

R9211 Analyzer models are portable, high performance Fourier Analyzers. Simple push button operation, convenient measurement menu modes, and a large eight inch amber screen help you get results fast.

The R9211 series consists of four analyzer models: the economical R9211E; the advanced R9211A with zoom processing; the R9211B with control system analysis functions; and the R9211C with control system analysis, curve fit, and frequency response function synthesis.

All models have a frequency range of 10 MHz to 100 kHz, and 16-Bit inputs with 90 dB (typical value) dynamic range. The high input sensitivity of 140 dBV (typical value, 2 kHz range) and frequency resolution of between 25 and 1600 lines makes the series ideal for measurement of micro-level signals and fine resolution spectra. In addition to this excellent performance, operation is easier than with conventional Fourier analyzers because of a unique domain operation mode that simplifies setup and measurement for a wide range of applications.

**R9211A/R9211B/ R9211C/R9211E**

**FEATURES:**

- 2-Channel, 100 kHz, Portable Instruments
- High Precision and Wide Dynamic Range
- Powerful Tools for Analyzing Frequency Functions, Audio Signals, Vibration, and Noise
- Accurate Measurements for Structural Dynamics and Modal Analysis
- High Speed Control System Analysis, Curve Fitting and Frequency Response Synthesis

*Simplified setup and measurement for a wide range of applications.*

## SELECTION GUIDE

| | R9211E | R9211A | R9211B | R9211C |
|---|---|---|---|---|
| Frequency Range | 100 kHz | 100 kHz | 100 kHz | 100 kHz |
| Input Channels | 2 | 2 | 2 | 2 |
| Dynamic Range | 90 dB*1 | 90 dB*1 | 90 dB*1 | 90 dB*1 |
| Channel Match | ±0.3 dB, ±3.0 Deg | ±0.3 dB, ±3.0 Deg | ±0.1 dB, ±1.0 Deg | ±0.1 dB, ±1.0 Deg |
| Spectral Lines | 25 to 1600 | 25 to 1600 | 25 to 1600 | 25 to 1600 |
| Zoom | — | Std. | — | Std. |
| Signal Generator | — | — | Std. | Std. |
| Co-Processor | — | Opt. 12 | — | Std. |
| Digital Input/Output | Opt. 11*2 | Opt. 11 | Opt.11 | Std. |
| Floppy Disk | Opt. 06*2 | Std. | Std. | Std. |
| Weight | 26 lb. (12 kg) | 31 lb. (14 kg) | 31 lb. (14 kg) | 35 lb. (16kg) |

*1 *Typical*

*2 *Only one choice can be made from among these options*

ADVANTEST

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488

The R9211 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats

# R9211A
# R9211B

# Fourier Analyzers

**FLEXIBLE FREQUENCY RANGE**
High-precision analog and digital filters together provide alias protection for frequency ranges from 10 MHz to 100 kHz. Frequency resolutions from 25 lines to 1600 lines provide exact spectral measurements. Flexible display scale options allow you to expand the spectrum plot to show the critical frequency band.

**WIDE DYNAMIC RANGE**
Advanced analog/digital signal processing techniques enable wide dynamic range measurements of 90 dB (typical value). To make full use of the performance of the built-in A/D converter, the input sensitivity range can be varied in 1 dB steps. The R9211 series is particularly useful for measurement of mechanical characteristics of optical magnetic disks, analysis of audio signal distortion and transient signals, and measurement of transfer functions by using impulse hammer.

**HIGH SENSITIVITY MEASUREMENTS**
By combining low-noise circuit designs with differential inputs, a high measurement sensitivity of 140 dBV (0.1 uV. typical value at 2 kHz range) is realized. These highly sensitive instruments are ideally suited for analyzing noise levels in semiconductor devices.

**EASY TO OPERATE**
A large eight inch amber display lets you view data easily and reduces eye strain. With an emphasis on operability, the push-button operated software menus let you setup measurements quickly. A standard built-in floppy disk drive (optional for R9211E) can write data to MS-DOS formatted microfloppy disks. An optional built-in printer allows you to document measurements even when in the field.

**DIGITAL INPUT**
The digital input hardware is useful for evaluating A/D converter or DSP performance on digital audio equipment such as a digital audio tape (DAT) or CD player. The "16-Bits + EOC (complement of 2)" data format is used. Spectrum or distortion analysis can be performed when digital signals are input immediately after the R9211 series A/D converter.

**MARKER AND DISPLAY FUNCTIONS**
The 9211 series offers many marker functions for analysis and evaluation. Marker functions include peak, next peak, harmonic, sideband, overall power, attenuation power, partial power, average power, mean power, variance, shape factor and ripple analysis. Screen display modes feature single, dual or quad plots; two superimposed data traces; and three-dimensional displays with up to 50 spectra. A convenient bar display also provides an easy check on the measurement overall power, partial power, average power, or power distribution.

**MEASUREMENT DOMAIN MODES**
Fourier analyzers tend to have many analysis functions and complicated operation because they have a broad range of uses. To make operation much easier for the user, the R9211 series has measurement domain modes suited to the particular use. You select the mode you want, without worrying about pre-setting all analysis functions or conditions – just use a single software key.

**WAVEFORM MEASUREMENT**
This time domain measurement mode is suitable for analysis of sound transients for acoustic instruments, engine start characteristic testing, POWER ON RESET signal waveform analysis, or D/A converter differential linearity testing. You can use the analyzer as a 16-Bit, 256 kHz sampling digital oscilloscope. Adding an optional memory card increases the data storage capacity to 4 MB. With this card, you can capture data continuously for 6 minutes and 50 seconds at a measurement frequency range of 2 kHz.

# Fourier Analyzers

**R9211A** **R9211C**
**R9211B** **R9211E**



**TIME AND FREQUENCY ANALYSIS**
Analyze variation in musical instrument sound or hall reverberation characteristics, paying attention to a specific spectrum. It is also possible to analysis the time characteristic of spectrum variation for wow and flutter in VCRs (frequency monitor function) or the time characteristic of jitter phase variation (phase monitor function).

**SPECTRUM MEASUREMENT**
This mode is particularly useful for analysis of distortion in higher harmonics or micro-level noise analysis. Precisely measure spectra using the 90 dB (typical value) dynamic range and 140 dBV (typical value at 2 kHz range) high sensitivity input channels. Logarithmic measurements, including 1/3 and 1/1 Octave band analysis, and spectral resolution of up to 3200 lines (single channel), give the accuracy needed for challenging measurements.

**FREQUENCY RESPONSE FUNCTION**
For modal analysis applications, this mode speeds measurement of high resolution frequency response functions (FRF) of up to 800 spectral lines. On-line monitoring of coherence allows quick verification of the FRF measurement quality. A built-in sensor power supply allows use of integral-amplifier type accelerometers or impact hammers without the need for external power units.

**CONTROL SYSTEMS (R9211B, R9211C)**
An internal summing amplifier, a signal generator featuring low output impedance, and swept-sine excitations make the R9211 analyzers ideal for control system measurements. An advanced, fast curving fitting capability and frequency response synthesis also provide sophisticated control system modeling tools.

## R9211 Instruments

**R9211E**
The R9211E is an economical, yet high performance Fourier Analyzer. This rugged portable unit is ideal for maintenance and vehicle-borne applications. Standard with this model are 2 input channels with frequency ranges from 10 MHz to 100 kHz.

**R9211A**
The R9211A adds zoom acquisition for ultra-high frequency resolution and a built-in DOS compatible floppy for data storage. It is ideal for speech, noise spectrum and modal analysis applications.

**R9211B**
A dynamic range of 90 dB (typical) and frequency range of up to 100 kHz make the R9211C ideal for control system design and electronic performance verification testing. A high purity signal generator provides sine, multi-sine, swept sine, impulse, random and arbitrary waveform output capability. Using swept sine, measurement dynamic ranges of 130 dB are achievable.

**R9211C**
Extending performance, the R9211C adds curve fitting, frequency response function synthesis, digital input/output hardware and a high-speed arithmetic processing card. This model also has special signal generator features for control system measurements – including built-in summing amplifier, variable output impedance (1, 50 or 600 Ω), programmable DC offset, and a ±15 volt range.

## ORDERING INFORMATION

**R9211E**
Digital Spectrum Analyzer ..... **$10,500**
**Opt. 06*[1]** – Floppy Disk Drive ..... **+$985**
**Opt. 11*[1]** – I/O + Memory Card (2 MB) ..... **+$2,000**

**R9211A**
Digital Spectrum Analyzer, Disk Drive, Zoom ..... **$12,500**
**Opt. 11** – I/O + Memory Card (2 MB) ..... **+$2,000**
**Opt. 12** – High Speed Numerical Calculation Card ..... **+$2,500**

**R9211B**
FFT Servo Analyzer, Disk Drive, Signal Generator ..... **$14,500**
**Opt. 11** – I/O + Memory Card (2 MB) ..... **+$2,000**

**R9211C**
FFT Servo Analyzer, Full Featured ..... **$19,500**

**ACCESSORY OPTIONS FOR ALL ANALYZERS**
**Opt. 07** – Built-in printer ..... **+$2,000**
**Opt. 10** – CMOS Memory Card (2 MB)
**R9211A** ..... **+$2,500**
**R9211B** ..... **+$2,500**
**R9211C** ..... **+$2,280**
**R9211E** ..... **+$2,500**

*[1]*For the R9211E, only one choice can be made from among these options.*

**ADVANTEST**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488

The R9211 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats

2505
2510
2520

# 2500 Series TestLab

*Basic features of oscilloscopes, paper-based recorders, and personal computers integrated into one instrument.*

**2500 SERIES**

**FEATURES:**

- Portable: up to 16 Channels in a Briefcase-sized Package
- Simultaneous Acquisition: 2 to 48 Differential Analog Channels; 0 to 48 Digital Channels
- Long Records: Up to One Million Samples per Channel

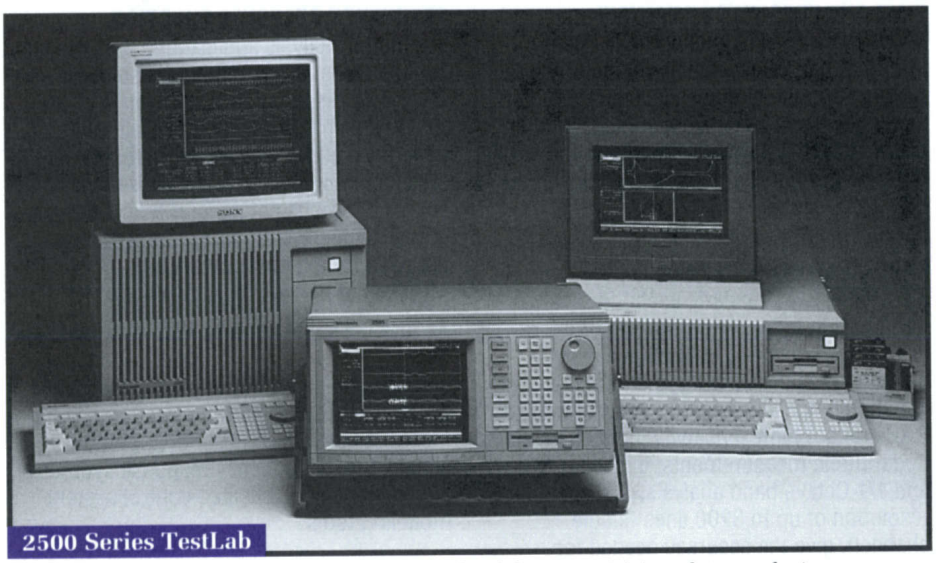
**BENEFITS:**

- Data Analysis: Powerful Visual Analysis and Custom User-Entered Formulas
- Read Signal Magnitudes in Engineering Units
- Data Management: Many Tests with Many Channels Conveniently Organized and Presented

**APPLICATIONS:**

- Mechanical System and Component Testing
- Manufacturing Process Development, Documentation and Troubleshooting
  - Semiconductor
  - Steel
  - Plastics
- Electrical Power Distribution and Switching
- Fluid Power Control Systems
- Telecommunications System Testing

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.




*2500 Series TestLab provides 2 to 48 channels of data acquisition, data analysis and data management.*

## TestLab™ Multi-Channel Waveform Analyzers

The 2500 Series TestLab presents a new problem-solving capability to scientists, engineers and technicians. TestLab integrates into one instrument key features of oscilloscopes, paper-based recorders and personal computers. TestLab's key advantages include:

- Reduce test set-up time with simple connections and automatic acquisition parameter settings.
- Look at the whole system under test – 2 to 48 channels of simultaneous data.
- Understand your data easily – powerful data analysis.
- Handle many tests and many channels – straight-forward data management and test notation.

### SYSTEM CONFIGURATION

Three models (2505, 2510 and 2520) allow configuring for up to 8, 16 or 48 12-Bit, differential analog channels, respectively. An equal number of digital-event channels accommodate high/low, on/off types of signals.

Use TestLab in the lab or the field. In the field, use the 2505 or 2510 (8 or 16 channels) of data acquisition in a package about the size of a briefcase. In the lab, use the 2510 with a color display, or alternatively use the 2520 rack-mountable lab configuration which provides up to 48 analog channels and a color display.

TestLab is card modular. Any of three acquisition cards may be installed in any of the models to provide flexibility in channel count, record length and bandwidth. The acquisition cards may be mixed or matched in the 2510 or 2520.

### DATA ACQUISITION

The 2510 and 2520 accommodate multiple acquisition cards. Acquisition cards may be mixed or matched to suit the testing requirement. The sampling speed of each acquisition card may be set independently. Faster signals (e.g. transients) may be captured at a faster rate and slower signals at a slower rate over a longer period of time. All data, across all channels is time synchronous - there is no time skew between channels.

Data may be captured with record lengths of milliseconds to days at up to 12-Bit vertical/magnitude resolution (one part in 4096). Voltage or unit offsets are easily dialed in. Input voltage ranges from ±100 mV to ±100 V.

Triggering for each channel may be set independently with magnitude and slope (+, –, either). Channels may be logically ANDed and ORed together to define very specific triggering conditions.

TestLab's auto save capability allows unattended operation. Triggered acquisitions are automatically saved to disk until the user-specified number of tests have been achieved.

# 2500 Series TestLab

**2505**
**2510**
**2520**



### DATA ANALYSIS

See up to 16 signals on the display simultaneously. View stored data with newly acquired data in stacked, overlay or X-Y display formats. Zoom and pan data for a close look. Dual cursors provide precise signal magnitude and event relationship measurements. Read magnitudes in engineering units.

Analyze data with built-in waveform mathematical functions including: + – * / ^, sin, cos, tan, differentiate, integrate, $Log_{10}$, Ln, Root Mean Square, Standard Deviation, FFT and many more. No programming is necessary.

Export data and set-up parameters to host computers. Formats include: WKS, ASCII, Binary, DADiSP and user defined.

### DATA MANAGEMENT

Saved test parameters, notes and data are conveniently organized in a spreadsheet-like format. Test data is easily added to the display for viewing with other saved data, calculated data, or newly acquired data. Documentation notes can be printed as hardcopy for indexing purposes.

### DATA ARCHIVING

All saved tests are time and date stamped and stored with setup parameters on internal hard disk or floppy disk.

### HARD COPY & REPORT GENERATION

Hardcopy options include: Dot-matrix printer (single button-press to initiate copy) or plotter (HPGL format). Waveforms may be printed or plotted to a file for later printing/plotting or for importing into word processing programs for report generation.



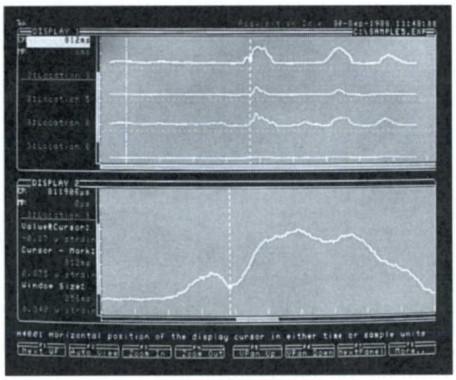

*Optional Signal Conditioning Accessory 25BP4*

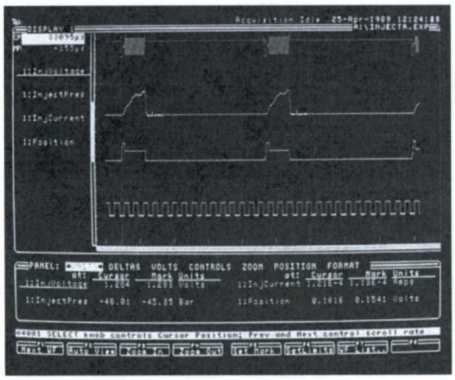
## ACQUISITION CARDS

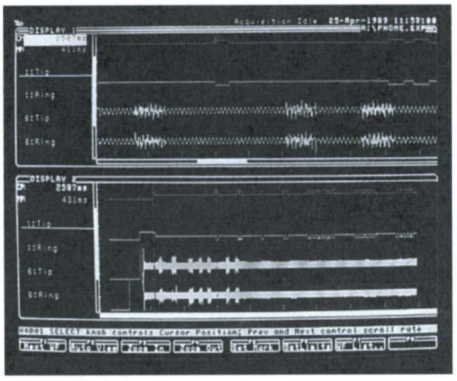
| | Acquisition Card 25AD3 | Acquisition Card 25AA2 | Acquisition Card 25AA1 |
|---|---|---|---|
| **Vertical Amplifiers Input** | 8 analog channels with independent A/D converters for simultaneous acquisition and 8 digital event channels | 2 analog channels with independent A/D converters for simultaneous acquisition | 4 analog channels with independent sample and hold for simultaneous acquisition |
| **Channel Type** | Single-ended or differential Selectable per channel | Single-ended | Single-ended or differential Selectable per channel |
| **Input Ranges** | ±100 mV to ±100 V Full Scale in 1, 2, 5 sequence | ±100 mV to ±50 V Full Scale in 1, 2, 5 sequence | ±100 mV to ±10 V Full Scale in 1, 2, 5 sequence |
| **Vertical Resolution** | 12-Bit | 10-Bit | 12-Bit |
| **Input Impedance** | 1 MΩ | 1 MΩ | 1 MΩ |
| **DC Offset** | ±15 V minus the selected FS range from ±100 mV to ±10 V ranges. ±150 V minus the selected FS range from ±20 V to ±100 V ranges | NA | ±15 V minus the selected FS range |
| **CMRR** | –60 dB at 100 Hz (up to ±10 V) | NA | –60 dB at 100 Hz |
| **Crosstalk** | –40 dB at 100 Hz | –60 dB at 100 Hz | –40 dB at 100 Hz |
| **Acquisition Memory** | 64K samples per channel (standard) 512K and 1 M samples per CH (optional) | 64K samples per channel | 256K samples for 4 channels |
| **Time Base Sample Rate** | 1 S/min to 100 KS/s | 200 S/sec to 12.5 MS/s | 12.5 S/sec to 100 KS/s (multiplexed) |
| **Resolution** | 10 µsec per point minimum. Selectable in increments of: 10 µsec up to 100 ms 1 ms up to 60 sec | 80 ns per point minimum. Selectable in increments of 80 ns | 10 µsec per point minimum. Selectable in increments of 2 µsec |
| **External Clock** | Full range of sample rate | NA | Full range of sample rate |
| **Triggering Level Range** | 100% of full scale (plus offset) | 100% of full scale | 100% of full scale (plus offset) |
| **Trigger Level Resolution** | 0.5% of full scale | 1.0% of full scale | 0.5% of full scale |
| **Trigger Slope** | +, –, Either, or Off | +, –, Either, or Off | +, –, Either, or Off |
| **Trigger Window Mode** | Yes | NA | NA |
| **Trigger Programmability** | Logical OR, logical AND combination of individual trigger criteria from each channel (analog or digital) | Logical OR combination of individual trigger criteria from each channel | Logical OR combination of individual trigger criteria from each channel |
| **Pretrigger Range** | Pretrigger and record length and are selectable in 1 sample increments | Pretrigger and record length and are selectable in 1 sample increments | Pretrigger and record length and are selectable in 1 sample increments |

2505
2510
2520

# 2500 Series TestLab







*Powerful display system allows user configured formats for different applications–without writing software.*

## Characteristics

The 2505, 2510 and 2520 are identical in feature set and capability except in where specified in the following description:

**DISPLAY**

**Resolution –** 640 x 350 pixels for all displays.

2505: Built-in 9 in. monochrome.

2510: Multi-synch color monitor or electro-luminescent flat panel.

2520: Multi-synch color monitor.

**Waveform Display –** Two independent display windows; in each display up to eight stacked waveforms, or XY plot w/zoom.

**Cursors –** A cursor and mark in each display window provide cursor measurements on each displayed waveform. Both may be linked together and/or linked between the two display windows.

**ACQUISITION**

Single-shot triggered, repeat triggered, roll (chart recorder emulation), roll direct to disk, auto-save to disk at the end of the acquisition cycle.

Acquisition characteristics are dependent on acquisition cards used (see previous page). Number of acquisition cards accommodated in each model: 2505 – 1 acq card; 2510 – 2 acq cards; 2520 – 6 acq cards.

**DATA STORAGE**

**Internal Hard Disk –** 60 MB standard, 120 MB optional.

**Internal Floppy Disk –** MS-DOS formatted 3.5 in., 720 KB.

**DATA EXPORT & FORMAT CONVERSION**

Move data to PCs via diskette or bus.

**Format Conversions –** Lotus 1-2-3® .WKS, ASCII, Binary, DADiSP, custom.

**HARD COPY**

Epson compatible dot matrix printer with Centronix interface. HPGL plotter.

**INTERFACING**

IEEE-488 (GPIB), RS-232C via COMM Pack module. GPIB command set.

**SIGNAL CONDITIONING**

25BP4 Signal conditioning accessory provides for four standard 5B-Series signal conditioning modules. Modules for thermocouples, RTDs, strain gauges, amplification and isolation are available.

**Power source –** 5 V, 1 A power is available in the 15-Pin D-connector on the 25AA1 and 25AD3 acquisition cards.

**POWER REQUIREMENTS**

**2505 Mainframe –** 110 VAC to 220 VAC 50/60 Hz, 125 watts, max.

**2510 Mainframe –** 110 VAC to 220 VAC 50/60 Hz, 175 watts, max.

**2520 Mainframe –** 110 VAC to 220 VAC 50/60 Hz, 300 watts, max.

**MECHANICAL & ENVIRONMENTAL**

**Temperature Range –** Operating: 10°C to 40°C. Nonoperating: –10°C to 50°C.

**Relative Humidity –** Up to 80% RH non-condensing.

**Safety –** UL Listed 1244, Certified CSA C22.2 No. 231-M89.

**PHYSICAL CHARACTERISTICS**

| | 2505 | | 2510S2 | | 2520 | |
|---|---|---|---|---|---|---|
| **Dimensions** | **mm** | **in.** | **mm** | **in.** | **mm** | **in.** |
| Width | 470 | 18.5 | 455 | 17.9 | 425 | 16.8 |
| Height | 225 | 8.85 | 203 | 8 | 260 | 10.25 |
| Depth | 502 | 19.75 | 432 | 17 | 600 | 23.5 |
| **Weight** | **kg** | **lb.** | **kg** | **lb.** | **kg** | **lb.** |
| Net | 15.5 | 34 | 16.8 | 37 | 24.1 | 53 |

## ORDERING INFORMATION

**2505**
One Slot Model.....**$8,100**
**Includes:** System software, built-in monochrome monitor, 60 MB hard disk, parallel printer COMM Pack, soft sided case, Operator's manual and detachable keyboard. Requires one acquisition card.

**2505S11 –** 2505 with installed 4-CH 25AA1 Acquisition card.....**$9,975**

**2505S13 –** 2505 with installed 8-CH 25AD3 Acquisition card.....**$15,600**

**2510S1**
Two-slot model.....**$9,500**
**Includes:** System software, color monitor, 60 MB hard disk, parallel printer COMM Pack and Operator's manual. Requires one or two acquisition cards

**2510S11 –** 2510S1 with installed 4-CH 25AA1 Acquisition card.....**$12,900**

**2510S12 –** 2510S1 with installed 2-CH 25AA2 Acquisition card.....**$14,200**

**2510S13 –** 2510S1 with installed 8-CH 25AD3 Acquisition card.....**$17,000**

**2510S2**
Two-slot model.....**$10,750**
**Includes:** System software, flat panel display, 60 MB hard disk, parallel printer COMM Pack, soft sided case and Operator's manual. Requires one or two acquisition cards.

**2510S21 –** 2510S2 with installed 4-CH 25AA1 Acquisition card.....**$14,150**

**2510S22 –** 2510S2 with installed 2-CH 25AA2 Acquisition card.....**$15,450**

**2510S23 –** 2510S2 with installed 8-CH 25AD3 Acquisition card.....**$18,250**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# 2500 Series TestLab





## ORDERING INFORMATION

**2520**
TestLab Six-slot model ..... **+$10,900**
**Includes:** system software, color monitor, 60 MB hard disk, parallel printer COMM Pack, and Operator's manual. Requires at least one acquisition card.

**Opt 03** – RS-232C Remote Control COMM Pack and manual ..... **+$750**
**Opt 10** – IEEE-488 (GPIB) COMM Pack and manual ..... **+$850**
**Opt 15** – Add Color monitor for 2510S2X ..... **+$695**
**Opt 23** – Substitute 120 MB Hard Drive ..... **+$1,500**
**Opt 88** – Factory Install Acquisition Cards ..... **NC**
*NOTE: On orders with a mainframe and acquisition cards as separate line items, Opt. 88 designates the items to be built and tested as a system, not replacement parts.*
**Opt 94** – Cal Certificate, NIST ..... **NC**
**Opt 95** – Cal Certificate & Test Results ..... **NC**
**Opt 1R** – 2520 Rack Mount Kit ..... **+$400**

**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1** – Universal Euro 220 V, 50 Hz ..... **NC**
**Opt. A2** – United Kingdom 240 V, 50 Hz ..... **NC**
**Opt. A3** – Australian 240 V, 50 Hz ..... **NC**
**Opt. A4** – North American 240 V, 60 Hz ..... **NC**
**Opt. A5** – Switzerland 220 V, 50 Hz ..... **NC**
See Customer Information Section for additional descriptions.

**HC220** – Bubble Jet Printer ..... **$349**

**ACQUISITION CARDS**
**25AA1** Four Differential Analog Channels ..... **$3,400**
**Includes:** 100 KS/sec, 256 KS total memory, 12-Bit vertical resolution

**25AA2** Two Single Ended Channels ..... **$4,700**
**Includes:** 12.5 MS/sec, 64 KS/channel, 10-Bit vert res

**25AD3** Eight Diff Analog Channels and Eight Digital Event Channels ..... **$7,500**
**Includes:** 100 KS/sec/ CH, 64 KS/ CH, 12-Bit vert res

**Opt. 1D** – Expand 25AD3 to 512K Sample/ CH ..... **+$2,200**
**Opt. 2D** – Expand 25AD3 to 1 M Sample/ CH ..... **+$4,000**
**25AD3F1** – Field Upgrade 25AD3 to 512 KS/ CH ..... **$2,200**
**25AD3F2** – Field Upgrade 25AD3 to 1 MS/ CH ..... **$4,000**

**Signal Conditioning –**
**25BP4** Four-slot Interface Backplane for 5B series signal conditioning modules. Use with 25AA1 & 25AD3 Acquisition cards ..... **$285**

**5B Series Module –**
**5B34-01** – 100 Ω Plat RTD in, –100° to 100°C, 0 to +5 VDC out. Order 119-3524-00 ..... **$150**
**5B34-04** – 100 Ω Plat RTD input, 0° to 600°C, 0 to +5 VDC out. Order 119-3527-00 ..... **$150**
**5B38-02** – Full Bridge Amplifier, 300 Ω to 10 KΩ input, (such as strain gages), –5 to +5 VDC output. Order 119-3533-00 ..... **$180**
**5B40-01** – –10 mV to 10 mV input, –5 to +5 VDC output. Order 119-3536-00 ..... **$150**
**5B47-J-02** – J Type thermocouple input, –100° to 300°C, linearized, 0 to +5 VDC output. Order 119-3542-00 ..... **$205**
**5B47-K-04** – K Type thermocouple input, 0° to 1000°C, linearized, 0 to +5 VDC output. Order 119-3543-00 ..... **$205**
**AC1367** – One-to-one non-isolated voltage feedthrough, –10 VDC to +10 VDC maximum input and output. Order 119-3546-00 ..... **$39**
For additional signal conditioners see the 25BP4 data sheet or Burr Brown or Analog Devices catalogues.

**WARRANTY-PLUS SERVICE PLANS OPTIONS**
**Opt. M7** – Calibration Service
2505 ..... **+$105**
2505S13 ..... **+$420**
2510S1 ..... **+$115**
2510S11 ..... **+$320**
2510S12 ..... **+$320**
2510S13 ..... **+$420**
2510S2 ..... **+$120**
2510S21 ..... **+$320**
2510S22 ..... **+$320**
2510S23 ..... **+$420**
2520 ..... **+$120**
25AA1 ..... **+$215**
25AA2 ..... **+$215**
25AD3 ..... **+$315**
**Opt. M9** – Repair Protection
2505 ..... **+$425**
2505S13 ..... **+$820**
2510S1 ..... **+$475**
2510S11 ..... **+$705**
2510S12 ..... **+$720**
2510S13 ..... **+$820**
2510S2 ..... **+$495**
2510S21 ..... **+$705**
2510S22 ..... **+$720**
2510S23 ..... **+$820**
2520 ..... **+$570**
25AA1 ..... **+$280**
25AA2 ..... **+$295**
25AD3 ..... **+$395**

**ADDITIONAL ACCESSORIES**
**Soft case** – 2505. Order 016-1095-00 ..... **$340**
2510. Order 016-0909-01 ..... **$210**
**Transit case** – Wheels and hard side for 2505 & 2510S2. Order 016-0994-00 ..... **$855**
**Color Monitor** – Domestic. Order 119-4279-00 ..... **$650**
International. Order 119-4279-00 ..... **$650**
**Flat Panel Display Upgrade** – Order 30F0 ..... *2

**Comm Packs –**
**RS-232** – Order 1200C01 ..... **$750**
**GPIB** – Order 1200C02 ..... **$850**
**Parallel Printer** – Order 1200C11 ..... **$500**

**MANUALS**
**Operator's** – Order 070-6921-05 ..... **$170**
**Programmer's Reference** – Order 070-7200-02 ..... **$55***1
**MP Board Service** – Order 070-7413-02 ..... **$175**
**25AA1 Acquisition Card Service** – Order 070-7850-01 ..... **$125**
**25AA2 Acquisition Card Service** – Order 070-7851-01 ..... **$125**
**25AD3 Acquisition Card Service** – Order 070-8245-01 ..... **$125**
**2505 Service***1 – Order 070-6676-01 ..... **$170**
**2510 Service***1 – Order 070-7412-03 ..... **$175**

*1 *A Mainframe Service Manual and an MP Board Service Manual are needed for complete "Mainframe" service documentation. In addition, a manual for the installed acquisition card(s) is required for complete "system" service documentation.*

*2 *Contact your Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Telecommunications

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**ACCESSORIES**

Probes ....425
SMD Adapters ....450
Plotter/Printer ....496
Cameras ....499
Instrumentation Carts ....504


## 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 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 hand-held 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 customer's changing needs.
- SDH and SONET analyzers, either in a VXI configuration or as a stand-alone 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 10 gigabits. They are used for design and evaluation of components and product sub-assemblies.
- Optical spectrum analyzers measure wavelength and spectral width of fiberoptic 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 call our free technical support line, 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.

FiberMaster™

# Optical Time Domain Reflectometer

*Faster, easier, more efficient solution to Fiber Optic Network testing equipment.*

**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/ Inter-changeable Optical Connector Adapter
- High-Resolution Internal Printer (Optional)
- Link and Event Return Loss Capability
- MS-DOS File Compatible
- Floppy Disk Drive and/or Internal RAM
- AT Compatible Keyboard Interface
- GPIB and RS-232C interfaces
- PC Trace Analysis Software, FMTAP

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-833-9200.

GPIB IEEE-488

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




FiberMaster

## FiberMaster™

Unlike any other OTDR on the market, the TFP2 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-in with 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.

**Factory and User Selectable Defaults**

# Optical Time Domain Reflectometer

FiberMaster™



**NON-VOLATILE MEMORY**
**Mass Storage –** MS-DOS Compatible.

**Internal Floppy Disk Drive –** Size: 8.9 cm (3.5 inch); 1.44 MB or 720 KB.

**Internal RAM –** Capacity: 1 MB, non-volatile.

**Keyboard Interface –** AT compatible.

**DISPLAY RANGE**
**Vertical System –** Vertical Display Range (one way): 1.0 dB to 50 dB. Loss Readout Resolution Range: 0.001 dB to 0.01 dB.

**Mainframe Horizontal System –** Distance Display Range: 1 m to 200 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 –** 16K max. (Normal), 32K max. (High Density).

**PHYSICAL**
**Weight –** 15 kg (33 lb.). Includes mainframe optics module, internal printer, disk drive.

**Dimensions (including front cover, handle and feet) –** Length: 60.7 cm (23.9 in.); Width: 45.2 cm (17.8 in.): Height: 19.8 cm (7.8 in.).

**Power Requirements –** AC Operation: 90-130 VAC, 47-440 Hz, 180-253 VAC, 47-73 Hz.

**Laser Product Safety Classification –** Class I.

## ORDERING INFORMATION

**FiberMaster with Color Display**
Order TFP2 ..... **$12,600**

**FiberMaster with MonoChrome Display**
Order TFP2M ..... **$10,800**

**Includes:** Operators Manual (070-7906-02); Soft Carrying Case (016-1037-00); Front Panel Cover(200-3566-00); Power Cord (161-0104-00).

**OPTICS PLUG-IN OPTIONS – MULTIMODE**
**Opt. 01 –** 850 nm MM ..... **+$7,000**
**Opt. 02 –** 1300 nm MM ..... **+$13,500**
**Opt. 03 –** 850 nm/1300 nm MM ..... **+$16,000**

**OPTICS PLUG-IN OPTIONS – SINGLEMODE**
**Opt. 04 –** 1310 nm SM ..... **+$15,000**
**Opt. 05 –** 1550 nm SM ..... **+$17,500**
**Opt. 06 –** 1310 nm/1550 nm SM ..... **+$23,000**
**Opt. 07 –** 1310 nm SM Long Range ..... **+$13,800**
**Opt. 08 –** 1310/1550 nm SM Long Range ..... **+$20,000**
**Opt. 09 –** 1550 nm SM Long Range ..... **+$17,000**

For Options 01–09 select connector option.

**CONNECTOR OPTIONS – MULTIMODE**
**Opt. 20 –** Biconic (119-4515-00) ..... **NC**
**Opt. 21 –** FCPC (119-4516-00) ..... **NC**
**Opt. 22 –** D4PC (119-4514-00) ..... **NC**
**Opt. 23 –** SMA906 (119-4517-00) ..... **NC**
**Opt. 24 –** STPC (119-4513-00) ..... **NC**
**Opt. 25 –** DINPC 47256 (119-4546-00) ..... **NC**
**Opt. 26 –** Diamond 3.5 (119-4558-00) ..... **NC**

**CONNECTOR OPTIONS – SINGLEMODE**
**Opt. 30 –** Biconic 119-4515-00 ..... **NC**
**Opt. 31 –** FCPC 119-4516-00 ..... **NC**
**Opt. 32 –** D4PC 119-4514-00 ..... **NC**
**Opt. 34 –** STPC 119-4513-00 ..... **NC**
**Opt. 35 –** DINPC 47256 119-4546-00 ..... **NC**
**Opt. 36 –** Diamond 3.5 119-4558-00 ..... **NC**
**Opt. 38 –** SCPC 119-4518-00 ..... **NC**

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

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M1 –** Extends warranty repair to three years and two calibrations ..... **+$1,975**
**Opt. M3 –** Extends warranty repair to five years and four calibrations ..... **+$3,750**
**Opt. M7 –** Calibration Service ..... **+$565**
**Opt. M9 –** Repair Protection ..... **+$1,410**

**ADDITIONAL ACCESSORIES**
**Factory Installed Options**
**Opt. 11 –** 3.5 inch Floppy Disk Drive ..... **+$400**
**Opt. 14 –** Internal RAM, 1 MB ..... **+$870**
**Opt. 16 –** Internal High Speed Thermal Printer ..... **+$1,400**
**Opt. 17 –** DC Power Input (10-32 VDC) ..... **+$895**

**Field Installed Options**
**Trace Analysis Package PC Software –** Order FMTAP .... **+$1,495**
**Opt. 19 –** AT Compatible Keyboard. Order 118-7637-00 ..... **+$200**
**Opt. 1R –** Rack Mount Kits (fits 19 in./23 in. racks) ..... *1
**Opt. 1T –** Hard Shell Transit Case. Order 016-1036-00 ..... **+$895**

**OPTICS MODULES/CONNECTOR**
When ordering Optics Module connector outputs for previously purchased mainframes, use the following numbers:

**FM8500 –** 850 nm Multimode, 62.5 µm ..... **$7,000**
**FM1300 –** 1300 nm Multimode 62.5 µm ..... **$13,500**
**FM8513 –** 850 nm/1300 nm Multimode 62.5 µm ..... **$16,000**
**FS1300 –** 1310 nm Singlemode ..... **$15,000**
**FS1500 –** 1550 nm Singlemode ..... **$17,500**
**FS1315 –** 1310 nm/1550 nm Singlemode ..... **$23,000**
**FL1300 –** 1310 nm SM Long Range ..... **+$13,800**
**FL1315 –** 1310/1550 nm SM Long Range ..... **+$20,000**
**FL1500 –** 1550 nm SM Long Range ..... **+$17,000**

*1 *Contact your Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-833-9200.

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

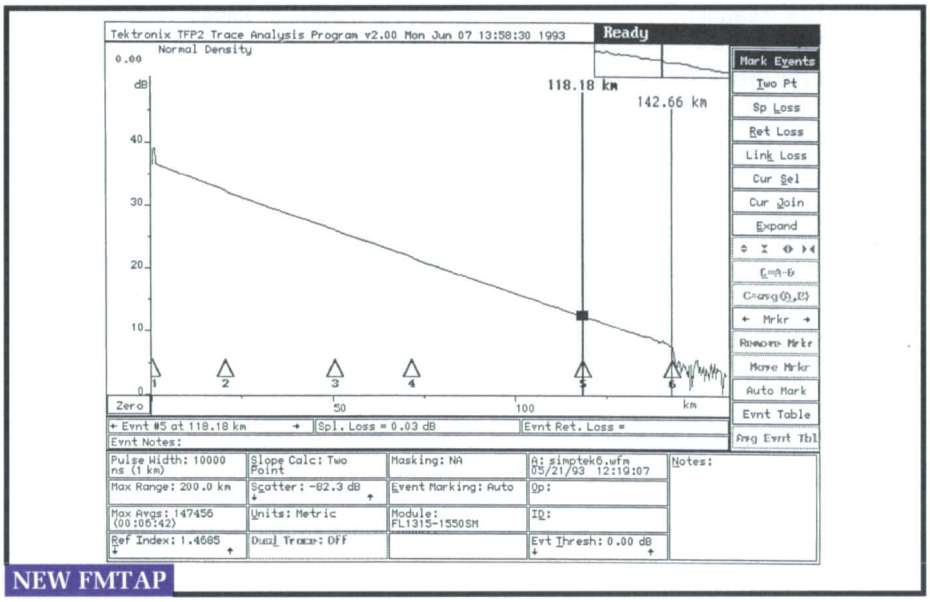
# FiberMaster™ Trace Analysis Package



*Use your IBM PC or compatible for display and analysis of waveforms.*

**FMTAP FiberMaster™**

- 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 to a Disk File
- Export of Waveform Data for Use with Spreadsheet




NEW FMTAP

## FMTAP FiberMaster™ Trace Analysis Package

Trace Analysis Software for the TFP2 FiberMaster™ OTDR, and TFS3030 FiberMini, FMTAP, allows you to use an IBM PC or compatible to display and analyze color waveforms created by a FiberMaster OTDR and TFS3030 FiberMini.

Use the FiberMaster to acquire the waveform data and save it on a floppy disk file. Copy the file onto the PC. Then use the PC to manipulate the waveforms and perform many of the same kinds of measurements that are possible on the FiberMaster.

- 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

The FiberMaster's front control panel is displayed on the PC screen. By using a Microsoft compatible two- or three-button mouse you can access front panel controls.

Extensive pull down menus are available for file management and printing functions to a number of popular printing devices, as well as on-line help.

### 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. Two distance cursors are located at 0 kilometers. 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.

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, masking type.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-833-9200

# FiberMaster™ Trace Analysis Package





## 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 –** 640K minimum.

**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 or 5.25 in., 1.2 MB capacity, IBM compatible*1.

**Fixed Disk Drive –** 10 MB minimum.

**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)

*Note *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 Seiki Co., Ltd.*

**3IBM, IBM PS/2 and PC-DOS are a registered Trademarks of IBM, Inc.*

**4Hewlett-Packard ThinkJet, LaserJet and DeskJet are registered Trademarks of Hewlett Packard Company.*

**5PostScript is a registered Trademark of Adobe Systems, Inc.*

**6Apple LaserWriter is a registered Trademark of Apple Computer, Inc.*

**7 Tek and Phaser are registered Trademarks of Tektronix, Inc.*

**8MS-DOS is a registered trademark of Microsoft, Inc.*

## ORDERING INFORMATION

**FMTAP**

Package PC Software ..... **$1,495**

**STANDARD ACCESSORIES**

**Disk Pack** – Order 063-0971-01 ..... **$1,460**

**FMTAP Users Manual** – Order 070-8433-01 ..... **$30**

**FMTAP Quick Reference Card** – Order 063-0828-01 ..... **$5.00**

**FiberMaster Utilities Disk Pack** – Order 063-1493-00 ..... **$5.00**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-833-9200

# Mini Optical Time Domain Reflectometer

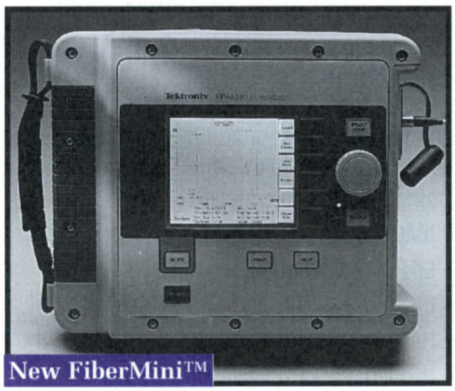


*Three products in one: OTDR, BreakFinder and a unique EventFinder.*

**FiberMini™**

**FEATURES**

- Automatic Fiber Analysis
- 0.05 dB Fault Threshold
- Extended Dynamic/Measurement Range
- Single or Dual Wavelength Available:
  – 1310 nm,
  – 1550 nm or Both from a Single Optical Port
- True OTDR Waveform
- Internal Data Storage
- Field Changeable/ Cleanable Optical Connector Adapter
- Rugged, Handheld and Easy to Use
- Interactive/Context Sensitive HELP
- Backlit High-Resolution LCD Display
- Real Time Display
- RS-232 Output Port for a PC, or Printer
- Powered from Internal Battery AC, Vehicle Cigarette Lighter or CO Station Battery



New FiberMini™

## FiberMini™

The TFS3030 FiberMini is a portable, user-friendly, mini-optical time domain reflectometer (OTDR) that offers single or dual wavelength fiber analysis.

The FiberMini functions as three products in one: an OTDR, BreakFinder and a unique EventFinder.

Patented algorithms and a specialized digital signal processor combine to offer an automated EventFinder mode that accurately reports more events across greater fiber lengths than any other mini-OTDR.

### TRUE OTDR CAPABILITIES

FiberMini features multiple automatic measurements, OTDR versatility, user-selectable measurement parameters, dual cursor function and a high resolution display with variable zoom.

The user interface offers easy-to-use features, soft keys, bank machine-style menus for setup and operation and context-sensitive on-screen help. These features significantly reduce training time for first-time users.

### AUTOMATED EVENTFINDER MODE

Only FiberMini has single-button automated location of events as small as 0.05 dB. Information is displayed as either an easily understandable event table or symbolic display format. Because EventFinder dynamically selects the acquisition parameters (such as pulse width and number of averages), it gives superior performance for measurement range and two-event distance resolution, eliminating the need to interpret a waveform.

### RUGGED, FIELD-FRIENDLY FEATURES

Small and light, the FiberMini weighs only 9.2 lb. (4.2 kg) and measures 11.5 x 4.5 x 9.5 in. (29.2 x 11.4 x 24.1 cm). An internal eight-hour NiCad battery frees you from the need for an AC power source. It can also operate from a 10 V to 60 V DC power source. Its case is dust-, shock- and water-resistant.

The FiberMini features a backlit 640 x 400 high resolution, high contrast LCD display. New technology allows the optical connector to be easily cleaned and changed in the field without tools, eliminating the time, expense and trouble of carrying multiple optical jumper cables.

Tektronix offers the FiberMini in four distinct configurations to meet your price and performance needs:

- A low-cost 1310 nm version (Option 01)
- A high-performance 1310 nm version (Option 03)
- A high-performance 1550 nm version (Option 05)
- A high-performance dual-wavelength 1310 nm and 1550 nm version (Option 06)

All versions have an RS-232 port allowing data output to a PC, portable or desktop printer.

Waveforms, as well as EventFinder and BreakFinder results, can easily be stored in the internal memory and down loaded over the RS-232 interface and/or recalled to the display.

The FiberMini is the best possible choice for users adopting the Bellcore Mini-OTDR TR (TR-NWT-001138).

The FiberMini is well suited for users in the telecommunications and CATV industries. Its low price will allow users to deploy mini-OTDRs more broadly throughout their systems.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-833-9200

# Mini Optical Time Domain Reflectometer

FiberMini™



## Characteristics

**1310 nm optical output –** 1310 ±30 nm*[1].
**1550 nm optical output –** 1545 ±30 nm*[1].

**Dynamic Range*[2]/Measurement Range*[3] –**

| | –15°C to 45°C Minimum Spec. | | Room Temp. Typical |
|---|---|---|---|
| | Dynamic Range[2] | Measmt. Range[3] | Measmt. Range[3] |
| 1310 nm (Opt. 01) | 23 dB | 18 dB | 20 dB |
| 1310 nm (Opt. 03) | 26 dB | 21 dB | 23 dB |
| 1550 nm (Opt. 05) | 24 dB | 19 dB | 21 dB |
| 1310/1550 nm (Opt. 06) | 26/24 dB | 21/19 dB | 23/21 dB |

**Loss Threshold –** 0.05 dB (minimum).

**Loss Resolution –** 0.001 dB.

**Readout Resolution (Waveform Mode) –** 0.1 m (High Density Acquisition).

**OTDR Distance Range Setting –** 2 km to 140 km.

**Distance Resolution (EventFinder) –** 1 m for any range.

**Measurement Time (Auto Measurement Mode) –** Approximately 3 min. (20 dB accumulated loss).

**Power Options –** AC (100 to 240 V; 50 to 60 Hz); 10 to 60 V DC; Battery (8 hours typ).

**ENVIRONMENTAL**

**Operating Temperature Range –** –15°C to 45°C.

**Storage Temperature Range –** –20°C to 60°C.

**Relative Humidity –** 5% to 95%, ±5% non-condensing.

**Weight –** 9.2 lb. (4.2 kg).

**Dimensions –** 11.5 x 4.5 x 9.5 in. (29.2 x 11.4 x 24.1 cm).

**Field Usage –** Rain proof, tested to Bellcore Mini-OTDR TR Environmental Specifications (i.e. 30-inch drop, dust, etc.).

**OPERATING CHARACTERISTICS**

**Measurements Reported:**

- All losses greater than user selected threshold.
- Loss tolerance for each reported event.
- Distance to/from front panel as well as surrounding events.
- Distance tolerance for each reported event.
- Grouped events.
- Echo identification.
- Return loss for each reported event.
- Loss/km for previous fiber segment.
- Total link loss to each event.
- Distance, loss and loss/km between two cursors in waveform mode.

**Display –** High resolution (640 x 400), high contrast black on fluorescent white, backlit LCD.

**Selectable Pulse Widths (Waveform Mode) –** 5 m, 10 m, 20 m, 50 m, 100 m, 200 m, 500 m, 1 km, 2 km.

**Memory Capacity –** 100 traces typical.

*[1] Performance accurate over operating temperature range of –15° to –45°C*

*[2] Dynamic Range is defined as the distance (in dB) from the backscatter level at the front panel to an imaginary line which lies above 98% of the displayed noise. (2.3 sigma)*

*[3] Measurement Range is defined (per Bellcore TR-NWT-001138) as follows: Operating at 1310 nm, find a 0.5 dB loss with a ±0.1 dB tolerance, within three minutes, meeting the TR's single event distance accuracy and multiple event distance resolution.*

## ORDERING INFORMATION

**FiberMini™**
Base Unit. Order TFS3030 ..... **$5,750**

**OUTPUT PORT OPTIONS (CHOOSE ONE)**
**Opt. 01** – Single Wavelength 1310nm ..... **+$2,500**
**Opt. 03** – Single Wavelength 1310nm ER ..... **+$5,150**
**Opt. 05** – Single Wavelength 1550nm ..... **+$7,900**
**Opt. 06** – Dual Wavelength 1310/1550nm ..... **+$10,700**

**CONNECTOR OPTIONS (CHOOSE ONE)*[1]**
**Opt. 20** – Biconic (119-4515-00) ..... **+$160**
**Opt. 21** – FCPC (119-4516-00) ..... **+$160**
**Opt. 22** – D4PC (119-4514-00) ..... **+$160**
**Opt. 23** – SMA 2.5 (119-4517-00) ..... **+$160**
**Opt. 24** – STPC (119-4513-00) ..... **+$160**
**Opt. 25** – DINPC 47256 (119-4546-00) ..... **+$160**
**Opt. 26** – Diamond 3.5 (119-4558-00) ..... **+$160**
**Opt. 27** – Diamond 2.5 (119-4556-00) ..... **+$160**
**Opt. 28** – SCPC (119-4518-00) ..... **+$160**

**WARRANTY PLUS SERVICE OPTIONS**
**Opt. M1** – Repair Protection/Calibrations ..... **+$365**
**Opt. M7** – Calibration Service ..... **+$175**
**Opt. M9** – Repair Protection ..... **+$210**

**STANDARD ACCESSORIES**
**Operator Manual** – Order 070-8724-00 ..... **NC**
**Reference Card** – Order 063-1462-00 ..... **NC**
**NiCad Battery Pack** – Order 146-0095-00 ..... **NC**
**Power/Charger Adapter** – Order 119-4545-00 ..... **NC**
**Power Cord for Charger/Adapter** – Order 161-0228-00 ..... **NC**
**Soft Carrying Case** – Order 016-1215-00 ..... **NC**

**POWER CORD OPTIONS**
**Opt. A1** – (220 V Euro) Order 161-0066-09 ..... **NC**
**Opt. A2** – (240 V UK) Order 161-0066-10 ..... **NC**
**Opt. A3** – (240 V Australian) Order 161-0066-11 ..... **NC**
**Opt. A4** – (220 V Switzerland) Order 161-0154-00 ..... **NC**

**OPTIONAL ACCESSORIES**
**Hard Travel Case** – Order 016-1210-00 ..... **$260**
**FSTIP Test Interface Package, PC Software** ..... **$470**
**Seiko DPU411 Cable, 9-Pin male to 25-Pin female** – Order 174-2562-00 ..... **$60**
**PC/AT Cable, 9-Pin male to 9-Pin female for Epson printer** – Order 174-2561-00 ..... **$55**
**Seiko DPU411 printer** – Order 119-4594-00 ..... **$470**

*[1] Additional Connectors may be ordered by 9-digit part number.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-833-9200

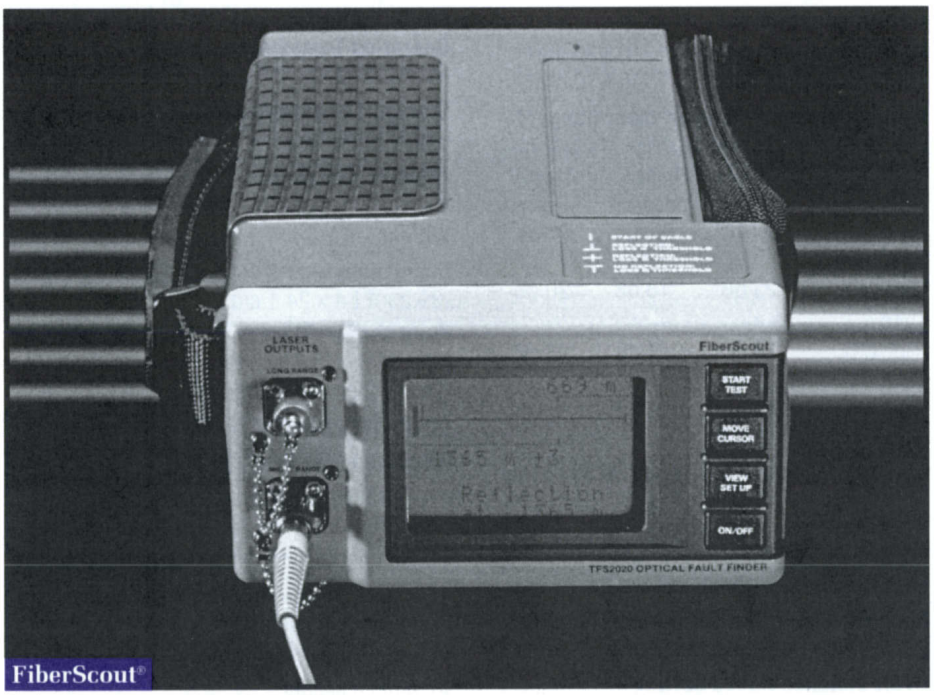
FiberScout®

# Handheld Optical Fault Finder

*Priced for widespread use in cable restoration environment.*

**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
- Universal Short 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®

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 light-weight, 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.

TD

Product available within 24 hours through TekDirect
Call 1-800-426-2200.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-833-9200.

# Handheld Optical Fault Finder

FiberScout®



## CHARACTERISTICS

### OPERATING PERFORMANCE*1

| | Multimode Short Range | Universal Short Range | Long Range |
|---|---|---|---|
| Operating Distance Range*2 | ≥3.0 km @ 3.5 dB/km | ≥3.0 km @ 2.5 dB/km | ≥40.0 km @ 0.4 dB/km |
| Fault Detection Range (one way) | ≥10.5 dB @ 62.5 µm | ≥7.5 dB | ≥16 dB*3 |
| Distance Measurement Accuracy*4 | | | |
| To Reflective Event | ±2 meters | ±2 meters | ±5 meters |
| To Non-Reflective Event | ±2 meters | ±2 meters | ±5 to 20 meters*5 |
| Distance Readout Resolution | 1 meter or 1 foot | 1 meter or 1 foot | 1 meter or 1 foot |
| Two Event Resolution*6 | | | |
| Distance to Detect 2nd Reflection | ≤10 meters | ≤10 meters | ≤40 meters |
| Loss Measurement Repeatability | ±0.2 dB | NA | ±0.3 dB |
| Loss Readout Resolution | ±0.1 dB | NA | ±0.1 dB |
| Fault Threshold Selections | 1, 2, 3, or 4 dB | NA*7 | 1, 2, 3, or 4 dB |
| Optical Output | | | |
| Wavelength | 835 nm ±35 nm | 835 nm ±35 nm | 1300 nm ±25 nm |
| Output Core Size | 50 or 62.5 microns | 8 to 10 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

**FiberScout®**

Handheld Optical Fault Finder. Order TFS2020..... TD **NC**

**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 order, select one of the option groups listed below:

**Opt. 01** – Equip with Long Range and Universal Short Range Ports .....**+$8,200**

**Opt. 02** – Equip with Long Range Port.....**+$5,000**

**Opt. 03** – Equip with Universal Short Range Port .....**+$5,200**

**Opt. 09** – Equip with Multimode Short Range Port .....**+$5,400**

**Opt. MC** – Equip with Multimode (50 µm) Short Range Port.....**+$5,900**

**Opt. MM** – Equip with Long Range and Multimode (62.5 µm) Short Range Ports.....**+$8,500**

**Opt. MN** – Equip with Long Range and Multimode (50 µm) Short Range Ports.....**+$9,000**

**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).....**NC**

**Opt. 2C** – 240 V AC/DC Power Supply (UK).....**NC**

**WARRANTY-PLUS SERVICE OPTIONS**

**Opt. M7** – Calibration Service.....**+$165**

**Opt. M9** – Repair Protection.....**+$405**

**ADDITIONAL ACCESSORIES**

**Battery Pack** – Order 146-1000-01 .....**$115**

**110 V AC/DC Power Supply** (USA/Canada) – Order 119-2731-00.....**$30**

**Travel Case** – Order 016-1024-00*1.....**$105**

**Accessory Pouch** – Order 016-0993-00 .....**$18.75**

**Operator Manual and Supplement** – Order 070-7167-04*1.....**$23**

**Reference Label** – Order 062-9360-01*1 .....**$5.25**

*1 *For more information contact your local sales office or call toll free: 1-800-833-9200.*

**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.

TD
Product available within 24 hours through TekDirect
Call 1-800-426-2200.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-833-9200.

**FiberChamp™**
**TPS 100**

# Optical Power Meter Twisted Pair Cable Analyzer

*FiberChamp – Accurate optical power and loss measurements in a single, rugged handheld unit.*

*TPS 100 – for qualifying and troubleshooting unshielded twisted pair (UTP) cabling.*

**FiberChamp™**
- 3% Accuracy
- Selectable dB Threshold Audio Indicator
- Readouts in dBm, dB and Watts

**FiberChamp™ APPLICATIONS**
- Absolute Power Measurements
- Link Loss
- Threshold Testing
- Monitoring Power Levels
- Representative Users: TELCO, R&D,CATV, LAN.

**TPS 100**
- Qualifies Installed Cabling for 10 BaseT and 802.5 Token Ring Operation
- Automatic Measurements and Calculations
- Automatically Identifies Split Pairs.
- Measures Cable Parameters Specified in EIA/TIA 568
- RS-232C Output Port for a Seiko DPU-411 Printer



FiberChamp™

## FiberChamp™ Characteristics

**ELECTRICAL/OPTICAL**
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 22°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 inch).

**ENVIRONMENTAL**
**Temperature –** Operating: –10°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 feet); Storage: 15,000 meters (50,000 feet).

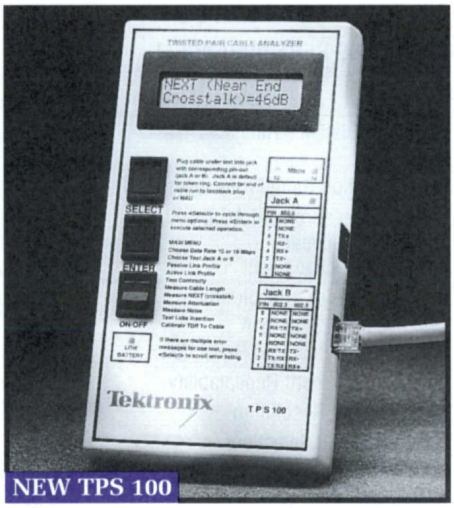
**POWER REQUIREMENTS**
**Internal –** 9 V Alkaline (non-rechargeable) or 7.2 V, 6 cell NiCad (rechargeable).

**Battery Life –** Alkaline 28 hours, NiCad 8 hours.

**External –** 12-20 VDC (AC/DC converter) at 100 mA minimum.

**PHYSICAL**
**Dimensions –** Length: 3.74 in. (9.5 cm); Width: 1.3 in. (3.3 cm); Height: 7.91 in. (20.1cm).

**Weight –** 1 lb. (0.45 kg)



NEW TPS 100

## Twisted Pair Cable Analyzer Characteristics

**Dimensions –** Length: 1.45 in. 3.7 cm); Width: 4.0 in. (10.2 cm); Height: 7.5 in. (19 cm)

**Power Requirements –** Source: 9 V battery
Battery Life (approximate): 8 hrs. of on time
2 hrs. continuous testing

**Environmental –**
Temperature: 0 to 40°C
Humidity: 10% to 90% non-condensing

**Passive and Active Link Profiles –** Signal to noise (SNR) measurement accuracy: ±1.0 dB

**NEXT (Near End Crosstalk) –**
Test Range (10 Mbps): 5 to 10 MHz, 100 kHz steps
Test Range (16 Mbps): 8 to 16 MHz, 100 kHz steps
Sensitivity: 45 dB maximum
Accuracy: ±1.5 dB

**Attenuation –**
Test Range (10Mbps): 5 to 10 MHz, 100 kHz steps
Test Range (16Mbps): 8 to 16 MHz, 100 kHz steps
Sensitivity: 45 dB maximum
Accuracy: ±1.5 dB

**Ambient Noise –** Test Range: 0 to 40 MHz, Sensitivity: –20 dBmV

TD
Products available within 24 hours through TekDirect Call 1-800-426-2200.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-833-9200.

## ORDERING INFORMATION

**FiberChamp™**
Optical Power Meter. Order TFC200 ..... TD **$1,280**
**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.

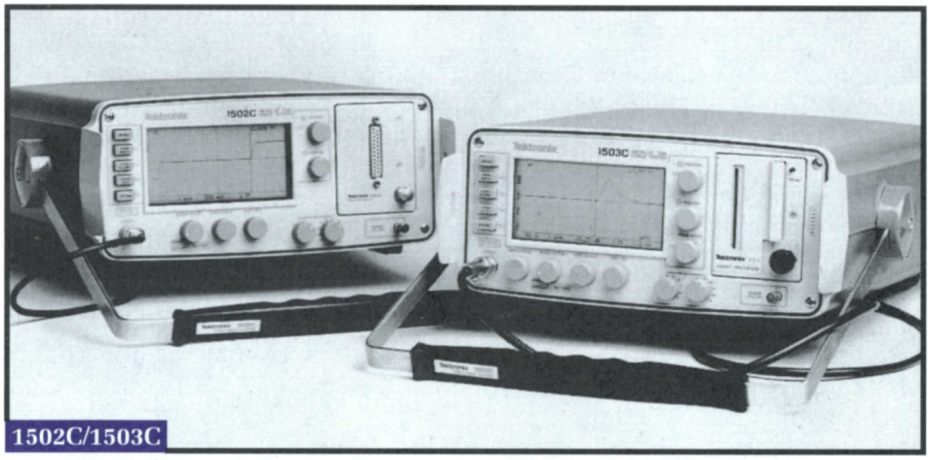
**Twisted Pair Cable Analyzer**
Basic Package. Order TPS 100 ..... TD **$1,495**
**Includes:** Hand-held cable analyzer. Supports 10BaseT and 16 Mbps IEEE 802.5 UTP cable testing and certification. Includes RS-232C interface, 1 UTP Loopback Plug (174-3070-00), 1 Alkaline Battery (146-0094-00), 2 UTP Adapter Cables (174-3067-00), 1 User Manual (070-7023-00), 1 Carrying Case (016-0914-00).
Cable set, Adapters, and additional accessories are available.

# Metallic Cable Testers

**1503C**
**1503B**

**1502C**
**1502B**






*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 choice.

**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 risetime 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.

**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

*Custom configure to meet your needs.*

## ORDERING INFORMATION

**1503C** – Metallic TDR ..... TD **$4,950**
**1503B** – Metallic TDR ..... **$5,850**
**1502C** – Metallic TDR ..... **$6,950**
**1502B** – Metallic TDR ..... **$7,850**
**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..... TD **+$250**
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 ..... TD **+$950**
Records all information displayed on LCD, including waveform and settings for a permanent record.

**Opt. 06** – (1503 only) Live Ethernet testing capability..... **+$350**
**Opt. 08** – Token Ring TDR Adapter (1503 only)..... **+$150**
**Opt. 09** – USOC Adapter (1503 only) ..... **+$150**
**Opt. 10** – Token Ring Interface (1503 only) ..... **+$350**
**SP232 Serial Interface Module** ..... **$595**
Provides a serial link to a host PC for remote control, waveform storage, and automated fault finding. Includes host software for IBM-compatible PCs.

**WARRANTY-PLUS SERVICE OPTIONS**

**Opt. M1** – Extends warranty repair to three years plus two calibrations.
1503C/1503B ..... **+$575**
1502C/1502B ..... **+$645**

**Opt. M7** – Calibration Service
1503C/1503B ..... **+$240**
1502C/1502B ..... **+$275**

**Opt. M9** – Repair Protection
1503C/1503B ..... **+$335**
1502C/1502B ..... **+$470**

A wide range of other options and connectors are available.

TD
1503C and Opt. 03/Opt. 04 available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-833-9200.

TelScout

# TDR Telephone Cable Tester

*Spend less time operating the TDR and more time repairing the faults.*

**FEATURES**

- 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.)




NEW TelScout

## TelScout TDR

If your job is to find faults on telephone twisted pair cable, the new Tektronix TS100 TelScout is built for you. Designed specifically for telephone local loop applications, TelScout applies the newest technology to provide both ease of use and telephony 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 crosstalk is occurring.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-833-9200.

# TDR Telephone Cable Tester

TelScout



## Characteristics

**Test Signal –** 1/2 Sine, balanced

**Amplitude –** 20 V into 100 Ω

**OutPut Impedance –** 100 Ω

**Pulse Widths –** 20 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.)

**Filter –** High pass, cutoff frequency 150 kHz, user selectable

**Amplifier –** A 5 mV reflection produces a full-screen vertical deflection

**Gain –** 0 to 63dB

**Waveform Storage –** Up to 20 waveforms with notes

### PHYSICAL CHARACTERISTICS

| Dimensions | cm | in. |
|---|---|---|
| Width | 30 | 12 |
| Height | 25 | 10 |
| Depth | 9 | 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 SPECIFICATIONS

**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

## ORDERING INFORMATION

**TelScout**

Basic Configuration. Order TS100 ..... **$3,200**

**Includes:** Test leads (two sets), soft carrying case with shoulder strap, U.S. AC adapter/charger, 120VAC, 60 Hz, 9 V @ 1A, User Manual, Quick reference card, the rechargeable internal battery is a standard feature.

**Opt. 1C –** Universal Euro adapter/charger, 220VAC, 6A, 50 Hz (119-4240-00) ..... **NC**

**Opt. 2C –** United Kingdom adapter/charger, 240VAC, 5A, 50 Hz (119-4239-00) ..... **NC**

**Opt. 3C –** Australian adapter/charger, 240VAC, 5A, 50 Hz (119-4238-00) ..... **NC**

**Opt. M9 –** Repair Protection ..... **$120**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-833-9200.

CrafTek™

# Subscriber Loop Portable Test Set

*Rugged, hand-held test set designed to support multiple loop technologies from multiple vendors.*

**CrafTek**

- Craft Tool for Subscriber Loop Installation and Maintenance:
  - –POTS/CLASS
  - –ISDN Basic Rate
  - –EBS (P-Phone)
- Highly Flexible Architecture for Easy Upgrading
- Rugged, Lightweight, Battery Operation
- ISDN Service Verification
  - – EOC and Cause Messages
  - – NEBE/FEBE Block Errors
  - – Info, LAP-D, and Call States
  - – Local Power
  - – Sealing Current
- EBS P-Phone Verification
  - – Call Appearance and Feature Verification
  - – DC Voltage
  - – Signaling Channel




*CrafTek Subscriber Loop Portable Test Set.*

## CrafTek™ Subscriber Loop Portable Test Set

The CrafTek Subscriber Loop Test Set is designed to meet the changing needs of the telephony craftperson, 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.

As ISDN standards evolve, such as ANSI 2B1Q, you can easily upgrade the CrafTek by simply snapping in up to three interface modules. When switch generics are released (for example, National ISDN-1), upgrading CrafTek's software is just as easy. The software EPROM is mounted in a simple module that the craftsperson plugs into a keyed module socket.

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 POTS service, with all the features of the analog craft test set you're used to using. In addition, CLASS service such as Calling Party ID can be captured and decoded.

In the ISDN environment, this portable hand-held set becomes the fundamental Basic Rate Service installation and maintenance tool.

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 rely on expensive protocol analyzers or multiple test equipment.

*Continued on next page.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Subscriber Loop Portable Test Set

CrafTek™



## 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 VAC 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.

**PHYSICAL CHARACTERISTICS**

| Dimensions | cm | in. |
|---|---|---|
| Width | 8.4 | 3.30 |
| Length | 27.3 | 10.75 |
| Depth | 8.3 | 3.25 |
| **Weight ≈** | **kg** | **lb.** |
| Net | 1.5 | 3.35 |

**Safety –** UL 1244, CSA C22.2 No. 231-M89.

**POTS**

**Dial Modes –** DTMF, Pulse.

**Functions –** Meets monitor mode, talk mode, and acoustic response requirements as specified in Bellcore TR-TSY-000344.

**Measurements –** Polarity.

**CLASS$^{SM}$*1 –** Support of "Customized Local Access Signaling Services" (Calling Line ID, with Calling Name).

**1CLASS$^{SM}$ is a service mark of Bellcore.*

**ISDN TE**

**TE Compatibility –** AT&T Type C and Type D terminal equipment; Northern Telecom terminal equipment; and National ISDN equipment.

**Software Generics –** Currently compatible with AT&T software generics up to and including 5E8, Northern Telecom DMS-100 up to and including BCS-35; 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 calling testing.

**S/T Interface –** Complies with T1.605-1991 ISDN Basic Rate Interface Specifications.

**"T" 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**

**AMI Interface (Opt. 1B) –** Meets specifications defined in AT&T Technical Reference 801-802-100 for AMI Loop Interface.

**2B1Q Interface (Opt. 2B) –** Meets specifications defined in ANSI T1.601-1988 (1991 Draft Revision) Standard. Complies with all 15 defined ANSI "U" loops. Supports Quiet and Insertion Loss Modes (AC/DC Triggers).

**S/T 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**

**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.

**BER Testing –** Provides BER testing on either B-Channel, (56 kbps, 64 kbps)

**EBS (P-PHONE)**

**P-Phone Interface (Opt. 3B) –** Provides support for Northern Telecom "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).

**ANALOG TERMINAL ADAPTER**

**ATA Interface (Opt. 1A) –** Provides analog terminal adapter to connect analog devices (e.g., Craft Access) to ISDN or EBS lines.

**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

**CrafTek Subscriber Loop Portable Test Set**
Order CT-100 ..... **$1,495**
**Includes:** User Manual (070-7895-05); Reference Card (070-7921-05); 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. 1A –** ATA Interface ..... **+$195**
**Opt. 1B –** AT&T AMI "U" Interface ..... **+$495**
**Opt. 2A –** RS-232 Interface ..... **+$495**
**Opt. 2B –** ANSI 2B1Q "U" Interface ..... **+$895**
**Opt. 3B –** EBS (P-Phone) Interface ..... **+$495**
**Opt. 38 –** Soft-Padded Carrying Case. (016-1073-00) ..... **+$60**
**Opt. 46 –** RJ45 to Bed-Of-Nails Clips. (012-1366-01) ..... **+$50**

**WARRANTY**

One year warranty

**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 NMC at 1-800-426-2200 Ext. 99.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-833-9200.

# CTS 710
# CTS 750

# SDH and Sonet Test Sets

*The CTS 700 Series of Communications Test Sets provides SDH and SONET testing that combines bit error rate test capabilities with overhead testing and payload analysis.*

**FEATURES**

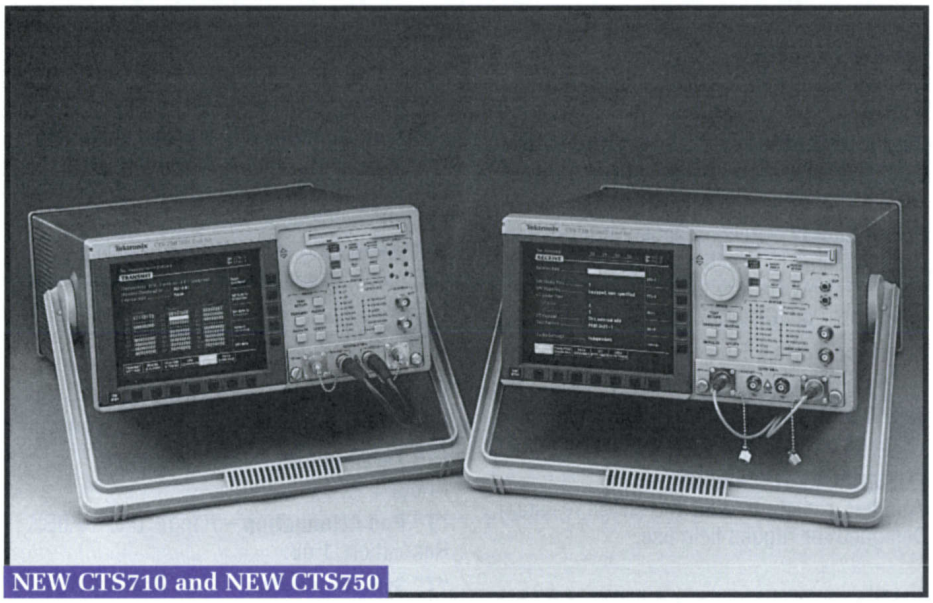
- 52 Mb/s, 155 Mb/s, and 622 Mb/s Transmit and Receive
- Bit Error Rate Testing Including BIP Error Monitoring and Analysis
- Payload Mapping and Demapping
- Tributary Test Capabilities (Optional).
- Pointer Generation and Analysis
- Alarms Generation and Analysis
- DCC and User Channel Access
- APS/MSP 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

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The CTS 700 Series complies with IEEE Standard 488.2, and RS-232C.



NEW CTS710 and NEW CTS750

## CTS 700 Series

The CCITT 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 CCITT 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 but through its unique architecture, it will grow with you as SDH and SONET grows. When you require additional capabilities like optical interfaces, jitter analysis, ATM testing, etc., you still keep it from becoming obsolete. Its 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 set-up
- 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.

# SDH and Sonet Test Sets

**CTS 710**
**CTS 750**



## CTS 710 SONET Test Set

**TRANSMIT AND RECEIVE RATES**

- STS-1, STS-3 (electrical)
- OC-1, OC-3, OC-12 (optical)
- DS1, DS3 (option 20)
- 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
- Histories up to 72 hours with 1 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: DCC's, F1, F2

## CTS 750 SDH Test Set

**TRANSMIT AND RECEIVE RATES**

- STM-1E (electrical)
- STM-1, STM-4 (optical)
- 2 Mb/s, 34 Mb/s (Opt. 30)
- Compliance to CCITT 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
- Histories up to 72 hours
- Measurements with CCITT G.821 analysis

**OVERHEAD MANAGEMENT**

Section Overhead, Path Overhead and TU Overhead

- Set and View Byte Value: All
- Set and View Byte Trace Message : J1
- Add/Drop: DCC's, F1, F2

## CTS 710/CTS 750

**OTHER**

- APS/MPS Control
- Pointer movement control
- Timing offset up to +/- 100 ppm
- DS1 and DS3 T-Carrier testing (Option 20)
- 2 Mb/s and 34 Mb/s PDH testing
- Printer in pouch (option 3P)
- 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 |

## ORDERING INFORMATION

**CTS 710** – SONET Test Set ..... *1
**Includes:** User Manual, Programmer's Manual, Performance Verification, Front Cover, Accessory Pouch, 75 Ω Cable, U.S. Power Cord 161-0230-01.

**CTS 750** – SDH Test Set ..... *1
**Includes:** User Manual, Programmer's Manual, Performance Verification, Front Cover, Accessory Pouch, 75 Ω Cable, Euro Power Cord 161-0230-0x.

**OPTIONS FOR CTS 710 AND CTS 750**

**Opt. 03** – Optical interface 52 Mb/s,155 Mb/s, 1310nm ..... *1
**Includes:** Two optical connector kits 020-1885-00 for FC-PC, ST, DIN, SC

**Opt. 04** – Optical interface 52 Mb/s, 55 Mb/s, 622 Mb/s, 1310 nm ..... *1
**Includes:** Two optical connector kits 020-1885-00 for FC-PC, ST, DIN, SC

**Opt. 3P** – Printer, 80 column, thermal, fits in pouch ..... *1
**Includes:** User Manual, RS232 cable, Power Cable

**OPTIONS FOR CTS 710 ONLY**

**Opt. 20** – DS1 and DS3 add/drop, testing ..... *1

**OPTIONS FOR CTS 750 ONLY**

**Opt. 30** – 2 Mb/s and 34 Mb/s add/drop, testing ..... *1

**WARRANTY PLUS SERVICE OPTIONS**

Three years warranty, covering all parts and labor

**Opt. M2** – Repair Protection ..... *1
**Opt. M8** – Calibration Service ..... *1

**INTERNATIONAL POWER PLUG OPTIONS**

**Opt. A1** – Universal Euro: 220 V, 50 Hz ..... **NC**
**Opt. A2** – United Kingdom: 240 V, 50 Hz ..... **NC**
**Opt. A3** – Australian: 240 V, 50 Hz ..... **NC**
**Opt. A4** – North American: 240 V, 60 Hz ..... **NC**
**Opt. A5** – Switzerland: 220 V, 50 Hz ..... **NC**

**FIELD UPGRADE KITS**

**C71001F** – Electrical interface 52 Mb/s, 155 Mb/s, 75 Ω BNC ..... *1

**C71003F** – Optical interface 52 Mb/s, 155 Mb/s, 1310 nm ..... *1
**Includes:** Two optical connector kits 020-1885-00 for FC-PC, ST, DIN, SC

**C71004F** – Optical interface 52 Mb/s, 55 Mb/s, 622 Mb/s, 1310 nm ..... *1
**Includes:** Two optical connector kits 020-1885-00 for FC-PC, ST, DIN, SC

**C71020F** – DS1 and DS3 add/drop, testing

**C75030F** – 2 Mb/s and 34 Mb/s add/drop, testing

**ACCESSORIES**

**Cart** – Order K212 ..... **$395**
**Rackmount** – Order 016-0819-1x ..... *1
**Optical Connector Kit** – Order 020-1885-00 ..... *1
**Includes:** FC-PC, ST, DIN,SC
**Hard Transit Case** – Order 016-1157-00 ..... *1
**Soft Carrying Bag** – Order 016-1158-00 ..... **$140**

*1 *Contact your Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# SDH/SONET Analyzer



*The SX4610 SDH/ SONET Analyzer is a Broadband Test Platform that combines bit error rate testing, overhead testing and payload analysis for SDH and SONET test applications.*

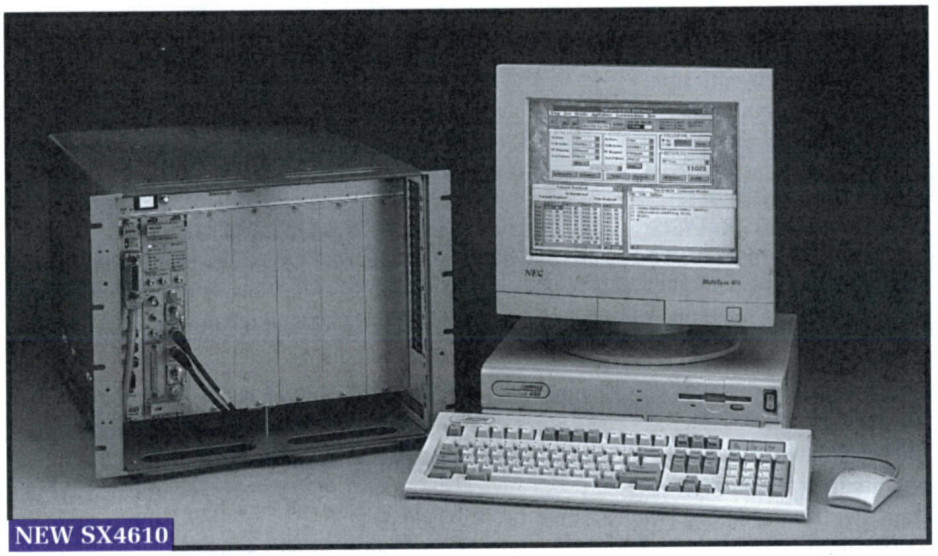
**FEATURES**

- 52, 155 and 622 Mb/s Transmit and Receive
- Bit Error Rate Testing
- BIP Error Testing and Analysis
- VT/TU/SPE 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
- VXI Rev. 1.3 Compatible
- IEEE 488.2 With SCPI Compatible Commands

**APPLICATIONS**

- Production Test
- Design Verification and Debug
- Standards Compliance Evaluation

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, ext. 99




## SX4610 SDH/SONET Analyzer

The new 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, 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 CCITT 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 frame generation and capture
- Programmable 64 byte sequence for a selected overhead byte
- Frequency offset up to +/- 100 ppm with 0.1 ppm resolution
- Extended triggering with trigger position control
- Frame and clock stress testing
- Pointer movement control, including jitter generation sequences according to CCITT Rec. G.783 and ANSI T1X1.6.

**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.

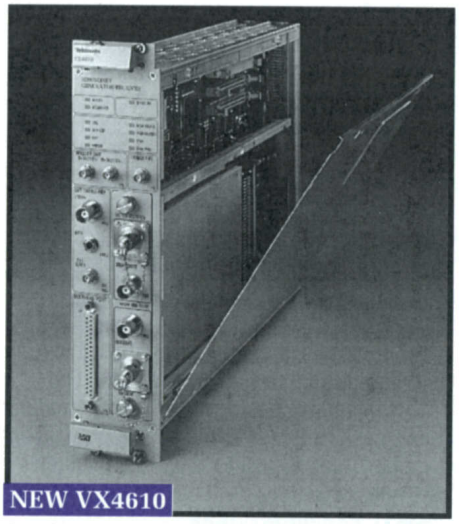
Secondly, the User Interface contains a Command Builder and Command Monitor, which can be used to quickly generate and evaluate commands and command test sequences. These commands can then be "cut and pasted" into virtually any software development environment.

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.

# SDH/SONET Analyzer

**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 and firmware that can be upgraded on-site from a floppy disk. 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 & 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 and 34 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 (VX0A41 Optical Attenuator, VX4491 Boundary Scan Serial Test Module) and other vendors, can augment the test capabilities. In the future, additional modules will become available to extend the broadband testing to areas such as full tributary testing for 140 Mbps, ATM testing, and jitter generation/analysis. The architecture of the SDH/SONET analyzer is designed to offer additional functionality (new measurement capabilities and measurements such as pointer sequencing). With just an on-site firmware upgrade, you can enhance the functionality of both the analyzer and the module.

**SPECIFICATIONS**

**Frame formats:** STS-1, STS-3, STS-3c, STS-12 to ANSI T1.105 and TR-TSY-0000253; STM-1, STM-4 to CCITT 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

**TEST INTERFACES**

**Optical:** 52, 155, 622 Mb/s (1310 nm)

**Coded Electrical:** 52 Mb/s (B3ZS) and 155 Mb/s (CMI)

**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.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 & Frame Capture:** Triggered capture of 64 sequential section overheads, 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.

## ORDERING INFORMATION

**SX4610** – SDH/SONET Analyzer ..... *1
**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 & 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 ..... *1
**Includes:** 52 & 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. 03** – 52/155 Mb/s electrical and 155 Mb/s optical plug-in ..... *1

**Opt. 04** – 52/155 Mb/s electrical and 52/155/622 Mb/s optical plug-in ..... *1

For Add/Drop and Tributary testing, order the following option modules:

**Opt. 20** – DS1/DS3 (1.5/45 Mb/s) ..... *1

**Opt. 30** – 2/34 Mb/s ..... *1

Options for the SX4610 Analyzer only :

**Opt. 1C** – Delete PC Controller ..... *1

**INTERNATIONAL POWER PLUG OPTIONS (MAINFRAME)**

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

**Opt. A2** – United Kingdom 240 V, 50 Hz ..... **NC**

**Opt. A3** – Australian 240 V, 50 Hz ..... **NC**

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

**Opt. A5** – Switzerland 220 V, 50 Hz ..... **NC**

See General Customer Information Section for additional description.

**1 For price and order information call your local Tektronix representative.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, ext. 99

# VXI Programmable Optical Attenuator



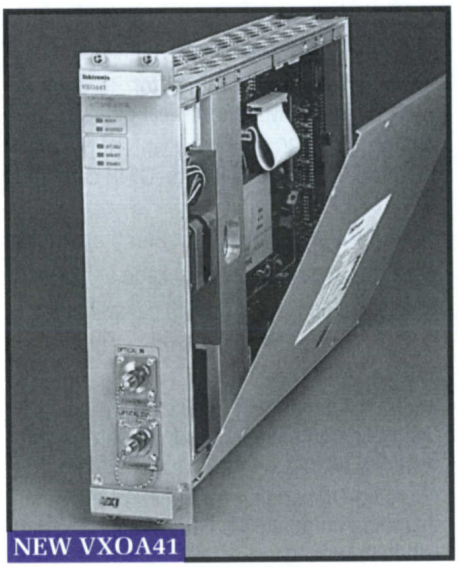
*The VX0A41 is a computer controlled optical attenuation plug-in module for use in VXI-based automated test systems.*

**FEATURES**

- Message Based Control
- "C" Sized Card Configuration
- VXI Rev. 1.3 Compatible
- Singlemode and Multimode Input/Outputs
- Compact Physical Size
- Four User Changeable Optical Fiber Connector Type

**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 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 (Specification Rev.1.3). The VXOA41 occupies two slots in a VXIbus card-modular instrument mainframe. 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, & 03 provide for the input & output of the three most commonly used multimode fiber sizes (50µm, 62.5µm, 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 trigger and local bus resources 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 over the VXIbus through the Word Serial Protocol and 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.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, ext. 99

# VXI Programmable Optical Attenuator





**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 that 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.

**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 stand-alone instrument and must be used with a Tektronix VX1400 or VX1405 Mainframe or other VXI compatible C-size or D-size mainframe with a minimum cooling capacity of 1.5 liters/sec (at 0.04 mm H2O). Also required is a VXI slot-0 controller and/or Resource Manager such as a Tektronix VX4521 Resource Manager, or Tektronix EPC-2, or EPC-7 System Controller. 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: If using an EPC-2 controller this may be the BusProbe utility; if using the VX4521 then this may be any GPIB talker-listener utility on a controller with a GPIB card (i.e., an IBIC DOS or Windows utility).

## 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 & 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**

| 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 Dissipation, Total –**
$P_{total\ max} \leq 22$ W in instrument.
$P_{typical} = 13.25$ W in instrument.

## ORDERING INFORMATION

**VXOA41 –** VXI Programmable Optical Attenuator.....**$7,750**
**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 & output.

**Opt. 01 –** Substitute 50/125 µm fiber input and output.....**–$255**
**Opt. 02 –** Substitute 62.5/125 µm fiber input and output.....**–$255**
**Opt. 03 –** Substitute 100/140 µm fiber input and output.....**–$255**

**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 .....**$450**

**Fiber Optic Cables –** Refer to page 283 for complete list.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, ext. 99

# CSA 803A

# Communications Signal Analyzer

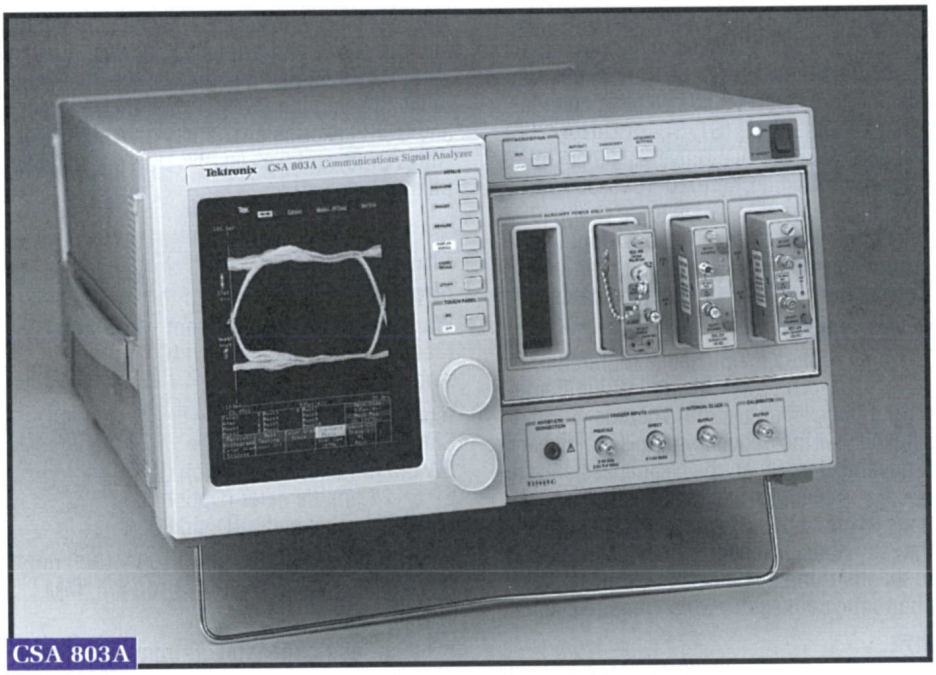
*Specifically designed for communications applications, the CSA 803A Communications Signal Analyzer is the ideal tool for design, development, and production testing of telecommunications and data communications components, terminals, and systems.*

**CSA 803A**

- DC to 50 GHz Bandwidth
- Automatic Statistical Analysis
- 38 Industry Standard Masks (CCITT & ANSI)
- High Resolution and Repeatability
- 7 ps Risetime (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, setting 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 94.

**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.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The CSA 803A complies with IEEE Standard 488.1-1987, RS-232C and Tektronix Standard Codes and Formats.

# Communications Signal Analyzer





### 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.

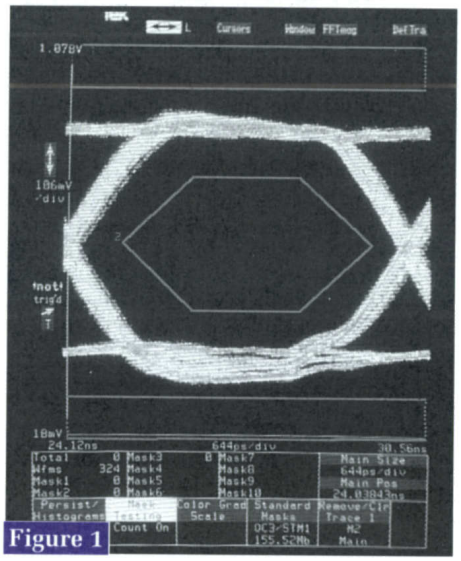



Figure 1

*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.*

### MASK TESTING

For Compliance test to CCITT 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 CCITT and ANSI Eye Pattern and Pulse Masks (Opt. 1T)

**CCITT SDH and ANSI SONET Optical Standards**

| | | |
|---|---|---|
| OC-1<br>51.84 Mbits/s | OC-3/STM-1<br>155.52 Mbits/s | OC-9<br>466.56 Mbits/s |
| OC-12/STM-4<br>622.08 Mbits/s | OC-18<br>933.12 Mbits/s | OC-24<br>1.2442 Gbits/s |
| OC-36<br>1.8662 Gbits | OC-48/STM-16<br>2.4883 Gbits/s | |

**ANSI T1.102 Electrical Standards**

| | | |
|---|---|---|
| DS1<br>1.544 Mbits/s | DS1 (old)<br>1.544 Mbits/s | DS1C<br>3.152 Mbits/s |
| DS2<br>6.312 Mbits/s | DS3<br>44.736 Mbits/s | DS4NA<br>139.26 Mbits/s |
| DS4XNA<br>139.26 Mbits/s | STS1<br>51.84 Mbits/s | STS3<br>155.52 Mbits/s |
| STSX3<br>155.52 Mbits/s | | |

**CCITT G.703 Electrical Standards**

| | | |
|---|---|---|
| Single Pulse<br>64 kbits/s | Double Pulse<br>64 kbits/s | Data Pulse<br>64 kbits/s |
| Timing Pulse<br>64 kbits/s | Pulse<br>1.544 Mbits/s | Sym. Pair<br>2.048 Mbits/s |
| Coax Pair<br>2.048 Mbits/s | Sym. Pair<br>6.312 Mbits/s | Coax Pair<br>6.312 Mbits/s |
| Pulse<br>8.448 Mbits/s | Coax Pair<br>32.064 Mbits/s | Pulse<br>34.368 Mbits/s |
| Coax Pair<br>44.736 Mbits/s | Pulse<br>97.728 Mbits/s | Zero Pulse<br>139.26 Mbits/s |
| One Pulse<br>139.26 Mbits/s | STM1<br>155.52 Mbits/s | CEPT<br>565 Mbits/s |

**Other Masks**

| | |
|---|---|
| FDDI<br>125 Mbits/s | User Programmable<br>(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.

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.

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.

*Continued on next page.*

# CSA 803A

# Communications Signal Analyzer

## 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 94. 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.*

## ORDERING INFORMATION

**CSA 803A**

Communications Signal Analyzer ..... **$25,150**

**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-inch SMA-SMA cable, 1 wrist strap, Power Cord, U.S., Power Cord, U.S., 120 V (161-0066-00).

**Opt. 1T –** Predefined Telecom Masks ..... **NC**

**Opt. 1R –** Rackmount ..... **+$250**

**Opt. 10 –** Deletes the 10 GHz prescaler trigger capability. This does not affect the 3.0 GHz trigger. ..... **–$1,000**

**INTERNATIONAL POWER PLUG OPTIONS**

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

**Opt. A2 –** United Kingdom 240 V, 50 Hz ..... **NC**

**Opt. A3 –** Australian 240 V, 50 Hz ..... **NC**

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

**Opt. A5 –** Switzerland 220 V, 50 Hz ..... **NC**

See General Customer Information Section for additional description.

**WARRANTY-PLUS SERVICE OPTIONS**

**Opt. M7 –** Calibration Service ..... **+$505**

**Opt. M9 –** Repair Protection ..... **+$1,010**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The CSA 803A complies with IEEE Standard 488.1-1987, RS-232C and Tektronix Standard Codes and Formats.

# Communications Signal Analyzer

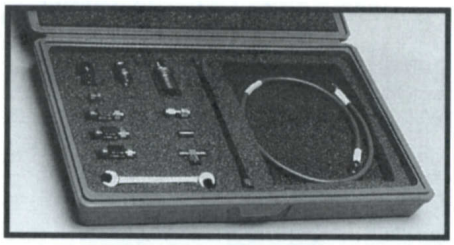


## • ACCESSORY •

**AK02**

- Provides adaptability to most signal sources for 50 Ω termination.
- Includes 50 Ω attenuators, 50 Ω cables, gender adapters.

*For complete selection information on all Accessory products, see page 424.*



## ORDERING INFORMATION

**SOFTWARE**
See Software Section for selection guide and complete description of software available.

**SD-14**
High Impedance Prove Sampler 3 GHz.....**$4,500**
**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.....**$4,400**
**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.....**$5,250**
**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.....**$3,780**
**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.....**$3,780**
**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.....**$9,450**
**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.....**$12,500**
**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.....**$3,995**

**SD-46**
Optical-to-Electrical Converter 20 GHz.....**$6,995**

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

**PROBES**

**LOW-Z-PROBES (50 Ω INPUT)**
10X, DC – 9.0 GHz. Order P6150.....**$995**

**ACTIVE PROBES (Requires 1103 Power Supply) –**
10X. DC – 1 GHz, ≥10 MΩ input impedance, 1.9 pF.
Order P6204.....**$1,550**
10X. DC – 4 GHz, ≥100 kΩ input impedance, 0.4 pF.
Order P6217.....**$3,495**

**ADDITIONAL ACCESSORIES**
**Cart –** Order K465.....**$795**
**Power Strip –** Four Outlet, 6 ft., Noise/Surge Suppression.....**$45**
**Camera –** Order C-9 with Opt. 1A and Opt. 11.....**$905**
**Plotter –** Order HC 100.....**$1,145**

**CALIBRATION STEP GENERATOR**
**U.S. –** Order 067-1338-00.....**$5,490**
**Universal European –** (240 V, 50 Hz). Order 067-1338-01...**$5,490**
**UK –** (240 V, 50 Hz) Order 067-1338-02.....**$5,490**
**Australia –** (240 V, 50 Hz). Order 067-1338-03.....**$5,490**
**Switzerland –** (240 V, 50 Hz). Order 067-1338-05.....**$5,490**
**Japan –** (100 V, 50-60 Hz). Order 067-1338-06.....**$5,490**

**ADDITIONAL ACCESSORIES**
**SMA Accessory Kit –** Order 020-1693-00.....**$2,195**
**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 each 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).

**3.5 mm Accessory Kit –** Order 020-1692-00.....**$7,400**
**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 pint), 1 ea. Combination Wrench (0.281, 6 point).

**2X Attenuator –** SMA Male-to-Female. Order 015-1001-00...**$185**
**5X Attenuator –** SMA Male-to-Female. Order 015-1002-00...**$175**
**75 Ω to 50 Ω Min. Loss Attenuator –**
BNC, AC coupled. Order 011-0112-00.....**$105**
**Power Divider –** Order 015-1014-00.....**$315**
**Blank Sampling Head –** Order 200-3395-00.....**$0.85**
**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.....**$910**
**DC Block (Coupling Capacitor) –** BNC Order 015-1013-00...**$380**
**Slip-On Connector –** Order 015-0553-00.....**$46**
**Connector Savers –** SMA: Order 015-0549-00.....**$185**
APC: Order 015-0552-00.....**$245**

**CABLES AND EXTENDERS**
**Sampling Head Extender Cables –**
(1 m). Order 012-1220-00.....**$710**
(2 m). Order 012-1221-00.....**$735**
**Acquisition Extender –** Order 067-1324-00.....**$105**
**Card Cage Extender –** Order 067-1267-00.....**$895**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The CSA 803A complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Communications Signal Analyzer



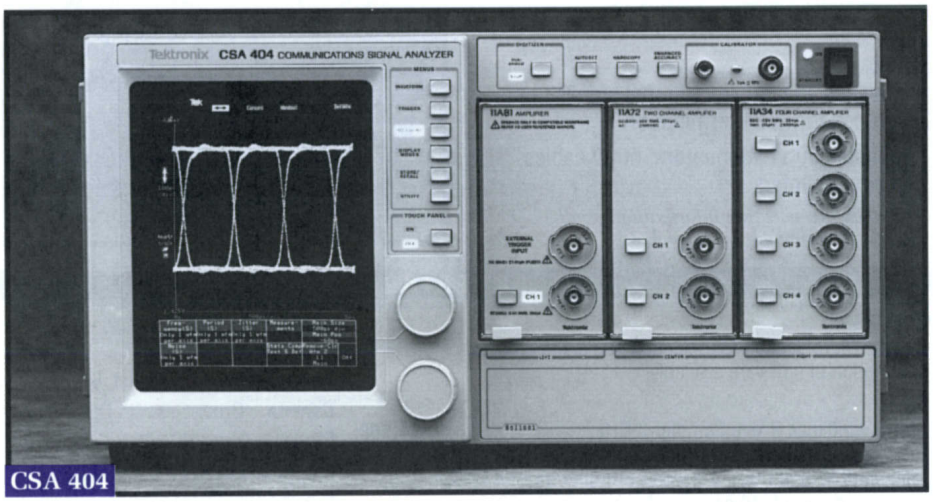
*Specifically designed for communications applications, the CSA 404 Communications Signal Analyzer is the ideal tool for design, development, and production testing of telecommunications and data communications components, terminals, and systems.*

**CSA 404**

- 200 ps Single Shot Time Interval Resolution (Main-to Window Trigger Measurement.
- Choice of Bandwidths Through Modularity
- CSA 404: DC to 150, 300, 400, 600.
- Trigger up to 1 GHz, Trigger to 2 GHz with the 11A81 Amplifier with up to 2 GHz Trigger Bandwidth
- Fully Automatic Extinction Ratio, Jitter and Noise Measurements
- Infinite, Variable Persistence, and Color Graded Display Modes

**APPLICATIONS**

- Optical Standards Compliance Testing
- Electrical Standards Compliance Testing
- Timing Analysis
- Pass/Fail Mask Measurements for Telecom (SDH/SONET) and Datacomm (FDDI/Fiberchannel)



CSA 404

## CSA 404

The CSA 404 Communications Signal Analyzer is equipped with a comprehensive, communications-focused measurement set, on-board statistical database, variable persistence and color graded displays, histograms, mask testing, constellation diagrams, and optical waveform measurement capabilities. A large selection of modular plug-ins and sampling heads lets you easily reconfigure your communications test and measurement system for your particular needs.

### MULTIPROCESSOR CONTROL PLATFORMS

A multiprocessor control platform allows functions previously managed by external computers and controllers to be performed within the analyzer itself. This sophisticated platform lets you generate measurement results – not just raw data – with time and voltage histograms, mask testing, and statistical pulse parameter measurements. It virtually eliminates the need for external computers and specialized software. And it provides a communications-focused measurement set that includes jitter, noise, duty cycle, overshoot, undershoot, extinction ration and amplitude measurements.

In addition, mask testing of SDH/SONET and FDDI compliant signals broadens your analysis capabilities. A full color display helps you discriminate waveform details, while variable persistence mode gives you the real time feel of analog. A color-graded display mode adds a third dimension – sample density – to your signal acquisitions and analysis. And color hardcopy capabilities allow you to accurately document your measurement results.

### MODULARITY ALLOWS CUSTOMIZATION

The 11A81 provides up to 3 GHz with a 2 GHz trigger bandwidth. Use the 11A16 for direct acquisition of current waveforms to compute and analyze power. With the 11A33, 150 MHz with true differential input is achieved.

High bandwidth probes are also available for constructing a total acquisition and measurement solution. The P6204 active probe offers 1 GHz bandwidth, while the P6150 and P6156 passive probes offer 9.0 and 3.5 GHz respectively. The P6204 and P6156 are equipped with Identify and Readout capabilities and provide key information, such as attenuation, input impedance and offset scale factor.

### STATISTICAL DATABASE

A built-in statistical database gives the CSA 404 the ability to accumulate three-dimensional waveform data – time, voltage, and now *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 (Figure 1). This information is then displayed in a color-graded format that gives you a qualitative view of the acquired waveform data. You can view data distribution in eye and constellation diagrams at a glance.

The instrument provides a menu showing the sample density assigned to each color, giving you the ability to generate time and voltage histograms for any portion of the acquired waveform.

The power of this statistical database is the measurement capabilities – time and voltage measurements.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The CSA 404 complies with IEEE Standard 488.1-1987, RS-232C and Tektronix Standard Codes and Formats.

# Communications Signal Analyzer





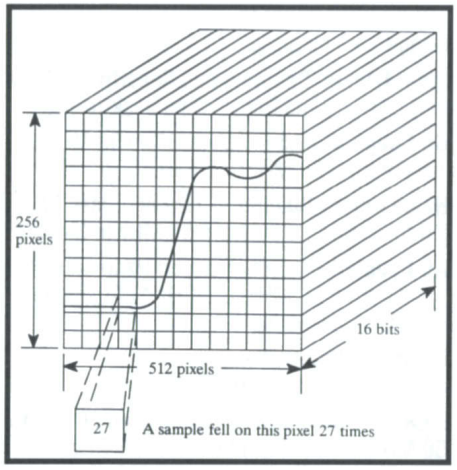



*Figure 1: The unique 512 x 256 x 16-Bit data array counts and records the number of times each pixel in the display is activated.*

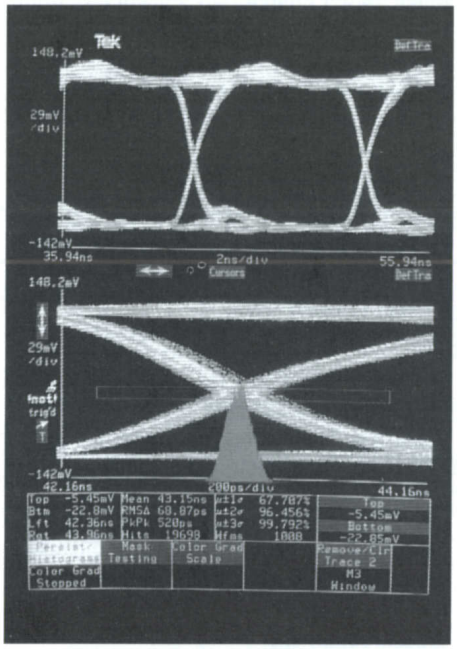



*Figure 2: Histograms let you make extremely accurate jitter and noise measurements with one Data Acquisition.*

## HISTOGRAMS

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 peak to peak, and are displayed and continuously updated at a user-selectable rate (Figure 2). High sample rates make it possible to analyze data concurrent with acquisition, rather than in a batch mode later on. The statistical data base allows you to change histogram parameters without reacquiring data.

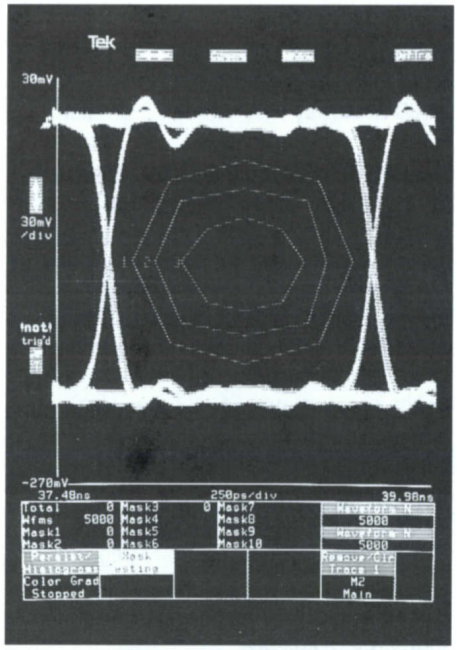



*Figure 3: You can perform tolerance testing with the unique mask testing capabilities of the Communications Signal Analyzers.*

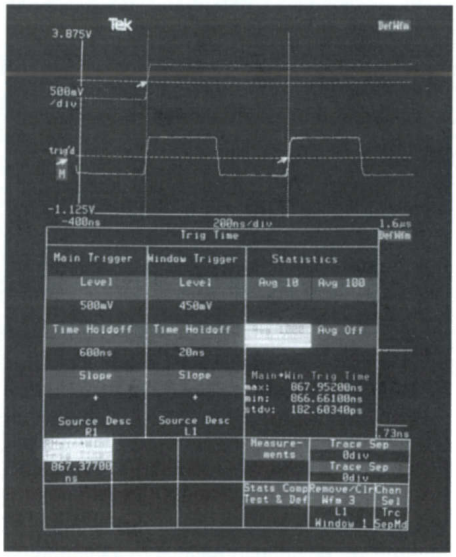



*Figure 4: The CSA 404 is equipped with precision Time Interval Hardware for Counter/Timer like measurements. Time Interval measurement resolution of 200 ps single shot and 10 ps averaged provide a higher level of utility than measurements performed by waveform digitizing.*

## AUTOMATIC JITTER AND NOISE MEASUREMENTS

For the first time, you can make jitter and noise measurements with one simple selection from an on-screen menu. Controls are provided, with default settings, for adjusting left and right limits, selecting RMS or pk-pk, tracking on/off, and absolute or relative positions.

For eye diagrams, you can select either the eye crossing or the mesial level for the jitter measurement location. Either top line or base line can be selected for the noise measurements. The CSA does the rest, and displays the jitter and noise measurements in the status menu at the bottom of the screen.

## AUTOMATIC PULSE PARAMETER MEASUREMENTS

Until now, automatic timing measurements such as "clock to data" phase measurements were not possible on random data such as eye diagrams. With the Tektronix-proprietary statistical measurement mode you can make all automatic pulse parameter measurements directly on random data.

In addition, you can make automatic extinction ratio and amplitude measurements for laser diodes, optical receiver components, and other optical devices. The CSA 404 offers 24 automatic measurements. Each will display up to six selected measurements simultaneously. All measurement results are updated continuously, as are the mean and standard deviation statistics for each measurement.

## MEASUREMENT STATISTICS

Measurement statistics – including mean, minimum value, maximum value, and standard deviation – can be automatically generated and displayed for all measurements. In the CSA 404, you can display the statistical results of up to six measurements simultaneously in the statistic pop-up menu, accessible through the measurements menu. This powerful feature gives you a clear picture of circuit operation over time, simplifies performance characterization, and provides for statistical quality control.

## PASS/FAIL TESTING

Boundary conditions can be defined for all pulse parametric measurements. After running a test, two summary modes are available. Go or No-go gives a quick green/red status indication. For a more complete characterization, the Statistical mode gives a summary of all measurement types.

## VARIABLE PERSISTENCE AND COLOR GRADED DISPLAYS

You can view up to 8 waveforms at once in any of the four available persistence modes – normal, infinite, variable and color-graded. Variable persistence lets you examine signal aberrations over a specified period of time from 200 ms to 20 seconds, and gives you the feel of real time analog. The unique use of color-graded persistence clearly exhibits the sample density on all parts of the waveform.

*Continued on next page.*

# Communications Signal Analyzer



**MASK TESTING**
For tolerance testing in design or on the manufacturing floor, you can define and edit up to 10 masks simultaneously. These masks (polygons) may each have up to 50 vertices (Figure 3). The CSA 404 then counts the individual and total samples that fall in each of the defined masks. You can store defined masks for future use.

**OPTICAL WAVEFORM ACQUISITION AND ANALYSIS**
The P6700 Series of Optical to Electrical Converters transform your CSA 404 into a powerful tool for characterizing, calibrating or troubleshooting electro-optic devices such as diode lasers, LEDs, electro-optic modulators, and optical waveguides. Network designers can use these converters to develop fiber optic control networks, LANs, and optical disk storage systems.

When any of the P6700 Series converters are connected to the CSA 404, scale factors are automatically changed to mW, µW or nW in order to show optical average or pulse power levels of the incoming signals, eliminating the need for tedious calculations.

With the OIG 501/OIG 502 Optical Impulse Generators and the OCP 5002/OCP 5502 Optical to Electrical Converter/Power Meter complete optical test and measurement systems can be constructed. These high performance tools make complete optical system component measurements effortless for even the novice.

The CSA 404 offers the performance you need to work with the emerging SDH/SONET and FDDI standards, and the modularity you need to adapt your system as new standards are introduced.

## Characteristics

**VERTICAL SYSTEM**
**WITH ENHANCED ACCURACY**
**ΔVDC Accuracy** – ≤1% for an 8-division signal.

**Absolute DC Accuracy** – ≤0.6% when using full scale of the plug-in offset range.

ENHANCED ACCURACY automatically expires when the instrument temperature changes by approximately ±5°C from the temperature of the last calibration. Even if the ENHANCED ACCURACY is not renewed, the accuracy typically remains ≤2%.

11000 Series Probes can be included in calibration. The instrument will prompt you to connect the probes to the CALIBRATOR.

**Vertical Resolution** – 10-Bits (1024 levels). Resolution can be increased to 14-Bits (16384 levels) with signal averaging.

**Equivalent-Time Bandwidth** – 3 GHz max determined by plug-in. See page 80.

**HORIZONTAL SYSTEM**
**Time Bases** – Two independent, built-in time bases.

**Record Duration** – 5.11 ns to 1024 s.

**Time Base Accuracy** – 100 ps +0.002% of measurement interval.

**Record Length** – 512, 1024, 2048, 4096, 5120, 8192, and 10240 points.

**Sampling Rate** – 20 MS/s max.

**Main Record Positioning** – The main record is positioned with respect to the main trigger point. Pretrigger: One record duration. Posttrigger: One record duration. Resolution: One main record point.

**Windows** – The main record plus two window records can be acquired and displayed. The window records can be of a different length (duration) and can have a shorter time/div than the main record. If two window records are used, they have the same duration and time/div settings, but can be positioned independently.

**Window Record Positioning** – The window records are positioned relative to a window trigger point which can be delayed by either time or events relative to the main record's trigger point.

**Main-to-Window Trigger Time Measurements** –
The time between the Main record trigger and the Window trigger can be measured precisely, even if each trigger only occurs once. Repetitive events allow this measurement to be averaged for better resolution and accuracy. Single Trigger Resolution: 200 ps Repetitive Resolution: 10 ps with averaging Accuracy: 250 ps +0.002% of measured interval.

**TRIGGERING SYSTEM**
**Range** – ± Full Scale.

**Main Trigger, Coupling and Sensitivity: Jitter** (Typical) – 10 ps RMS; 70 ps peak-to-peak.

**DC Coupled** – 0.5 div from DC to 50 MHz; 1.5 div from 50 MHz to 3 GHz.*1

**Noise Reject Coupled** – 1.2 div or less from DC to 50 MHz; 3 div from 50 MHz to 3 GHz.*1

**AC Coupled** – 0.5 div from 60 Hz to 50 MHz; 1.5 div from 50 MHz to 1 GHz.*1 Attenuates signals below 60 Hz.

**HF Reject Coupled** –
0.65 div from DC to 30 kHz.

**LF Reject Coupled** – 0.65 div from 80 kHz to 50 MHz; 1.5 div from 50 MHz to 1 GHz.*1

**Window Trigger, Coupling and Sensitivity:**
**DC Coupled** – 0.5 div from DC to 50 MHz; 1.5 div from 50 MHz to 500 MHz.*1

**Noise Reject Coupled** – 1.2 div or less from DC to 50 MHz; 3 div from 50 MHz to 500 MHz.*1

**AC Coupled** – 0.5 div from 60 Hz to 50 MHz; 1.5 div from 50 MHz to 500 MHz.*1 Attenuates signals below 60 Hz.

**HF Reject Coupled** –
0.65 div from DC to 30 kHz.

**LF Reject Coupled** – 0.65 div from 80 kHz to 50 MHz; 1.5 div from 50 MHz to 500 MHz.*1

**Holdoff Range:**
**Main Record** – Min: 490 ns; max: 10x.

**Window Triggering** – By time, or event.

**MEASUREMENT SYSTEM**
**Waveform Processing Functions:**
**Waveform Functions** – Differentiate, integrate, interpolate, smooth, average, envelope, square root, signum, logarithm, natural log, absolute value, and exponential.

**Arithmetic Operators** – Add, subtract, multiply, divide.

**Measurement Set:**
**Amplitude** – Min, max, mid, mean, gain, p-p, undershoot, overshoot, amplitude, noise, extinction ratio, and RMS.

**Timing** – Rise, fall, width, delay, main-to-window trigger time, phase, period, duty cycle, skew, jitter, propagation delay, cross, and frequency.

**Area and Energy** – Area +, area –, and energy.

**Measurement Statistics** – Min, max, mean, and standard deviation of all active measurements.

**Cursors** – Dual dots in split or paired mode, horizontal and vertical bars, measurement zone delimiters.

*1 *At minimum holdoff setting.*

# Communications Signal Analyzer



**INPUTS/OUTPUTS**
Centronics, GPIB, and RS-232C ports standard. Fully GPIB and RS-232C programmable.

**Hardcopy Drivers –** Support for 9-Pin and 24-Pin Epson-graphics compatible printers; Tektronix HC100 and HPGL-compatible plotters; Tektronix 4693, 4696, 4697 color printers; HP Laserjet and Thinkjet printers; bitmap transfer to computers. Draft, high resolution, and reduced modes.

**CRT AND DISPLAY FEATURES**
**CRT –** Magnetic deflection, vertical raster-scan orientation. 7.5 in. diagonal color CRT.

**Colors –** Eight-color set; selectable from a palette of 262, 144 colors.

**Video Resolution –** 552 horizontal by 704 vertical displayed pixels.

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

**Humidity –** Operating and Nonoperating: Up to 95% relative humidity, up to +50°C.

**Altitude –** Operating and Nonoperating: meets MIL-T-28800C, Type Class 5.

**Electromagnetic Compatibility –** Referenced to MIL-STD-461B. Meets FCC part 15, subpart J, class A. Meets VDE 0871/6.78 for Class "B."

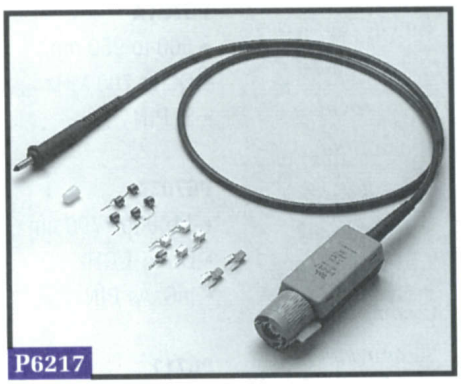
**Shock –** Nonoperating: meets MIL-T-28800C, Section 4.5.5.4.1, Type Class 5.

**Bench Handling –** Operating: meets MIL-T-28800C, Section 4.5.5.4.3., Type Class 5. Electromagnetic Compatibility – Meets the following requirements of MIL-STD-461B - CE-03, Part 4, Curve 1; CS-01, Part 7; CS-01, Part 4; CS-06, Part 5; RE-02, Part 7; RS-01, Part 4; RS-02, Part 5; RS-03, Part 7 (limited to 1 GHz). Meets FCC part 15, subpart J, class A. Meets VDE 0871/6.78 for Class B.

**Safety –** Listed UL 1244; Certified CSA C22.2, No. 231-M89.

**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 | 20.0 | 44 | 22.0 | 46.0 |
| Shipping | 24.0 | 44 | 25.0 | 54.0 |




• ACCESSORY •

## Maximize Your Signal Acquisition Performance

**P6217 FET PROBE**
- 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 424.*

## ORDERING INFORMATION

**CSA 404**
Communications Signal Analyzer ..... **$22,000**
**Includes:** Tutorial manual (070-8185-00), User Reference (070-8186-00), Programmer Reference (070-8187-00), Quick Reference (070-8188-00), Service Reference (070-8189-00), Power Cord, U.S., 120 V (161-0066-00).

**SOFTWARE**
See Software Section for selection guide and complete description of utility software available for the CSA 404.

**INSTRUMENT OPTIONS**
**Opt. 1C –** Cable Feedthrough Connectors. ..... **+$200**
**Opt. 1R –** Rackmount. ..... **+$250**
**Opt. 2D –** Memory Expansion Adds 768 KB of nonvolatile memory for storage of waveforms and settings. ..... **+$1,500**
**Opt. 4D –** DMA Controller increases transfer speed over GPIB. ..... **+$400**

**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1 –** Universal Euro, 220 V, 50 Hz ..... **NC**
**Opt. A2 –** United Kingdom, 240 V, 50 Hz ..... **NC**
**Opt. A3 –** Australian, 240 V, 50 Hz ..... **NC**
**Opt. A4 –** North American, 240 V, 60 Hz ..... **NC**
**Opt. A5 –** Switzerland, 220 V, 50 Hz ..... **NC**
See General Customer Information Section for additional description.

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M7 –** Calibration Service ..... **+$435**
**Opt. M9 –** Repair Protection ..... **+$1,225**
**Opt. Q2 –** Customer Site HW Service ..... **+$1,395**

**OPTICAL -TO-ELECTRIC CONVERTERS**
See page 282 for complete information.
**DC to 1 GHz, 1100 nm to 1700 nm –**
Specify Opt. 01-05 listed on page 283.Order P6703A ..... **$3,605**
**DC to 700 GHz, 450 nm to 1050 nm –**
Specify Opt. 01-05 listed on page 283. Order P6701A ..... **$2,625**
**DC to 300 GHz, 1000 nm to 1700 nm, High gain –**
Specify Opt. 01-05 listed on page 283. Order P6713 ..... **$2,500**
**DC to 250 GHz, 450 nm to 1050 nm, High gain –**
Specify Opt. 01-05 listed on page 283. Order P6711 ..... **$2,100**

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.
**Probes –** See page 424.
**Cart –** Instrument cart with tilt tray, wire basket, four heavy duty safety straps. Order K465 ..... **$795**
**Power Strip –** Four Outlet, 6 ft., Noise/Surge Suppression ..... **$45**
**Cables –** RS-232C, 10 ft. Order 012-0911-00 ..... **$100**
Centronics, 10 ft. Order 012-1233 ..... **$125**
**GPIB Cable –** ..... *1
**Blank Panels –** Plug-in. Order 016-0829-00 ..... **$195**
**Camera –** Order C-9 with Opt. 11 and Opt. 1A ..... **$905**
**Plotter –** Order HC100 ..... **$1,145**

*[1]Contact your local Tektronix representative for price and ordering information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The CSA 404 complies with IEEE Standard 488.1-1987, RS-232C and with Tektronix Standard Codes and Formats.

P6701A
P6703A
P6711
P6713
P6721
P6751

# Optical to Electrical Converters

*The P6700 Series products, provide calibrated optical to electrical conversion in a compact and convenient package for use at commonly used optical communications wavelengths and modulation bandwidths.*

**P6701A**
- 500 to 950 nm
- DC to 700 MHz
- Si PIN

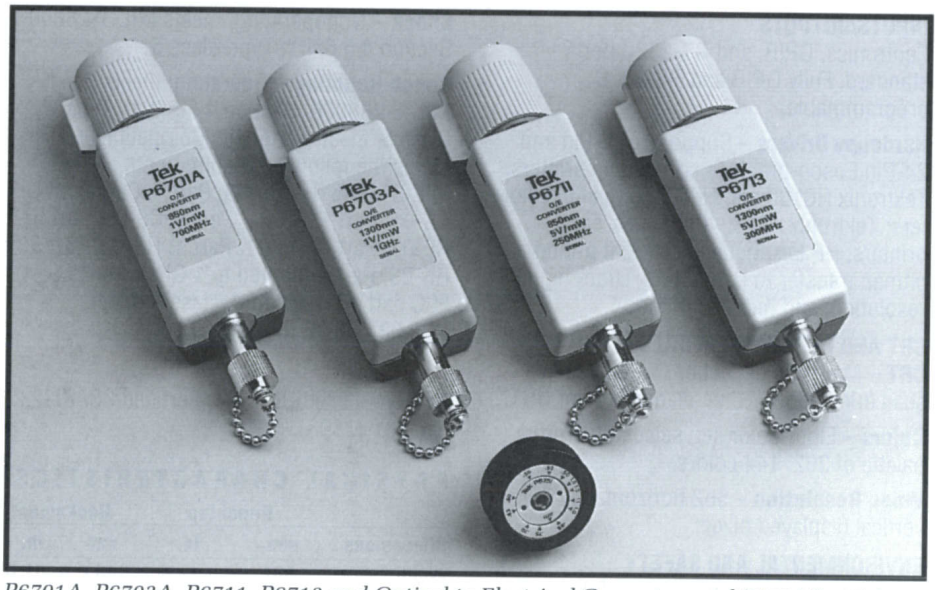
**P6703A**
- 1100 to 1700 nm
- DC to 1 GHz
- InGaAs PIN

**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
- Tuneable
- Collimated Beam Input
- Multimode Fiber Output




*P6701A, P6703A, P6711, P6713 and Optical to Electrical Converters and P6751 Spatial Input Head.*

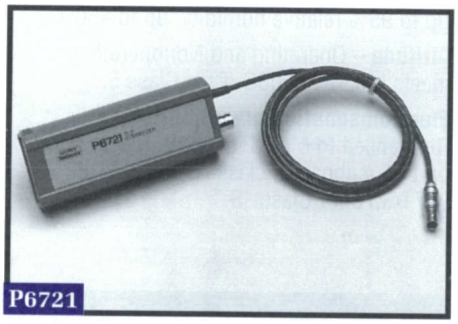
## Product Description

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 11000 Series 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 450 to 1050 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, 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 are a series of fiber optic jumper cables for interfacing the P6700 Series and P6751 with other industry standard optical fiber connectors.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Optical to Electrical Converters

**P6701A** | **P6713**
**P6703A** | **P6721**
**P6711** | **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.

As an example, eight probes of the P6700 Series type coupled with two 11A34 Amplifier Plug-ins and an 11000 Series oscilloscope can be configured as an 8-channel optical oscilloscope.

## 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

**P6701A**
Optical-to-Electrical Converter ..... **NC**
**Includes:** Option specified fiber optic input connector, carrying case (016-0156-03), and Instruction Manual (070-8237-00).
**Opt. 01** – FC input connector ..... **+$2,625**
**Opt. 02** – ST*[1] input connector ..... **+$2,625**
**Opt. 03** – DIN 47256 input connector ..... **+$2,625**
**Opt. 04** – SMA input connector ..... **+$2,625**
**Opt. 05** – SC input connector ..... **+$2,625**

**P6703A**
Optical-to-Electrical Converter ..... **NC**
**Includes:** Option specified fiber optic input connector, carrying case (016-0156-03), and Instruction Manual (070-8237-00).
**Opt. 01** – FC input connector ..... **+$3,605**
**Opt. 02** – ST*[1] input connector ..... **+$3,605**
**Opt. 03** – DIN 47256 connector ..... **+$3,605**
**Opt. 04** – SMA input connector ..... **+$3,605**
**Opt. 05** – SC input connector ..... **+$3,605**

**P6711**
Optical-to-Electrical Converter ..... **NC**
**Includes:** Option specified fiber optic input connector, carrying case (016-0156-03), and Instruction Manual (070-8237-00).
**Opt. 01** – FC input connector ..... **+$2,100**
**Opt. 02** – ST*[1] input connector ..... **+$2,100**
**Opt. 03** – DIN 47256 connector ..... **+$2,100**
**Opt. 04** – SMA input connector ..... **+$2,100**
**Opt. 05** – SC input connector ..... **+$2,100**

**P6713**
Optical-to-Electrical Converter ..... **NC**
**Includes:** Option specified fiber optic input connector, carrying case (016-0156-03), and Instruction Manual (070-8237-00).
**Opt. 01** – FC input connector ..... **+$2,500**
**Opt. 02** – ST*[1] input connector ..... **+$2,500**
**Opt. 03** – DIN 47256 connector ..... **+$2,500**
**Opt. 04** – SMA input connector ..... **+$2,500**
**Opt. 05** – SC input connector ..... **+$2,500**

**P6721**
Optical to Electrical Converter ..... **$1,450**
**Includes:** Standard TOSLINK fiber optic input Connector, and Instruction Manual (070-7842-00).

**P6751**
Spatial Input Head ..... **$445**
**Includes:** Adjustment tool and instruction sheet.

**OPTIONAL ACCESSORIES**
**TEKPROBE Power Supply** – Order 1103 ..... **$600**

**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 ..... **$605**
FC/PC to ST*[1] connectors. Order 174-1386-00 ..... **$770**
FC/PC to FC/PC connectors. Order 174-1387-00 ..... **$440**
FC/PC to Biconic connectors. Order 174-1388-00 ..... **$550**
FC/PC to Diamond 2.5 connectors. Order 174-1497-00 ..... **$580**

**Multimode**
**Fiber Optic Cables** – 2 meter length, 62.5/125 µm core/cladding diameter.
FC/PC to FC/PC connectors. Order 174-2322-00 ..... **$175**
FC/PC to Biconic connectors. Order 174-2323-00 ..... **$250**
FC/PC to SMA connectors. Order 174-2324-00 ..... **$175**
**Fiber Optic Cables** – 2 meter length, 100/140 µm core/cladding diameter.
SMA to ST*[1] connectors. Order 174-0876-00 ..... **$320**
SMA to Diamond 3.5 connectors. Order 174-0877-00 ..... **$350**
SMA to FC connectors. Order 174-0878-00 ..... **$370**
SMA to SMA connectors. Order 174-0879-00 ..... **$370**
SMA to Biconic connectors. Order 174-0880-00 ..... **$260**
SMA to Diamond 2.5 connectors. Order 174-1303-00 ..... **$300**

*[1] ST is a registered trademark of AT&T*

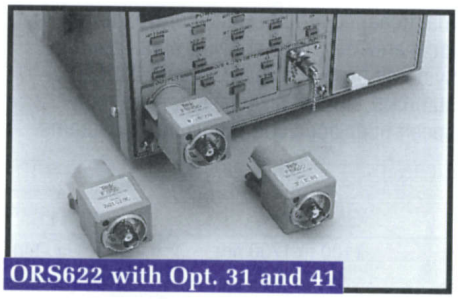
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# ORS52 ORS156 ORS622 ORS2488 SDH/SONET Reference Receivers

*The ORS Series of SDH/SONET Reference Receivers provides calibrated testing to ensure optical transmitter compliance with SDH/SONET OC-1, OC-3/STM-1, OC-12/STM-4, and OC-48/STM-16 frequency-response specifications.*

**ORS52/ORS156/ ORS622/ORS2488**

- Strict CCITT G.957 Compliance
- Data Rates Through 2.488 Gbits/sec
- 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 Opt. 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 Opt. 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/fr 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) |
|---|---|---|
| 0.15 | 0.2 | 0.1 |
| 0.3 | 0.4 | 0.4 |
| 0.45 | 0.6 | 1.0 |
| 0.6 | 0.8 | 1.9 |
| 0.75 | 1.0 | 3.0 |
| 0.9 | 1.2 | 4.5 |
| 1.0 | 1.33 | 5.7 |
| 1.05 | 1.4 | 6.4 |
| 1.2 | 1.6 | 8.5 |
| 1.35 | 1.8 | 10.9 |
| 1.5 | 2.0 | 13.4 |
| 2.0 | 2.67 | 21.5 |

Each Tektronix ORS Series SDH/SONET Reference Receiver under goes 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.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The SDH/SONET Reference Receivers comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# SDH/SONET Reference Receivers

**ORS622 ORS2488** | **ORS52 ORS156**



## SELECTION TABLES

| Receiver | Option | Configuration | Optical Connectors | Key Benefits |
|---|---|---|---|---|
| **OC-1 (51.84 MBits/Sec)** | | | | |
| ORS52 | | OCP5502/FS52 & OC-1 Calibration | FC, ST, DIN 47256, and SC | Greatest flexibility. Can add filters for OC-3 and OC-12. Built-in powermeter. GPIB. |
| | 1P | Delete OCP5502 power supply resulting in TM5000 compatible plug-in instrument | Same | Provides compatibility with bench or rack-mountable TM5000 Series Modular Instrument Mainframes. |
| | 1x*1 | P6703A/FS52 & OC-1 Calibration | *1 | Greatest value.Can add filter for OC-3. |
| | 2x*1 | P6713/FS52 & OC-1 Calibration | *1 | Highest sensitivity. |
| **OC-3/STM-1 (155.52 MBits/Sec)** | | | | |
| ORS156 | | OCP5502/FS156 & 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 rack-mountable TM5000 Series Modular Instrument Mainframes. |
| | 1x*1 | P6703A/FS156 & OC-3 Calibration | *1 | Greatest value. Can add filter for OC-1. |
| | 31 | Add FS52 & OC-1 Calibration | | |
| **OC-12/STM-4 (622.08 MBits/Sec)** | | | | |
| ORS622 | | OCP5502/FS622 & 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 rack-mountable TM5000 Series Modular Instrument Mainframes. |
| | 31 | Add FS52 & OC-1 Calibration | | |
| | 41 | Add FS156 & OC-3 Calibration | | |
| **OC-48/STM-16 (2.488 GBits/sec)** | | | | |
| 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 rack-mountable 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

**ORS52**
SDH/SONET Receiver ..... **$11,295**
**Includes:** OCP5502, FS52 Filter, Calibration Document (062-1266-00), Instruction Manuals (070-8562-00).

**Opt. 1P** – Delete OCP5502 Power Supply ..... **–$495**
**Opt. 11** – Delete OCP5502/Add P6703A Opt. 01 – FC Optical Input Connector ..... **–$6,300**
**Opt. 12** – Delete OCP5502/Add P6703A Opt. 02 – ST Optical Input Connector ..... **–$6,300**
**Opt. 13** – Delete OCP5502/Add P6703A Opt. 03 – DIN 47256 Optical Input Connector ..... **–$6,300**
**Opt. 14** – Delete OCP5502/Add P6703A Opt. 04 – SMA Optical Input Connector ..... **–$6,300**
**Opt. 15** – Delete OCP5502/Add P6703A Opt. 05 – SC Optical Input Connector ..... **–$6,300**
**Opt. 21** – Delete OCP5502/Add P6713A Opt. 01 – FC Optical Input Connector ..... **–$7,300**
**Opt. 22** – Delete OCP5502/Add P6713A Opt. 02 – ST Optical Input Connector ..... **–$7,300**
**Opt. 23** – Delete OCP5502/Add P6713A Opt. 03 – DIN 47256 Optical Input Connector ..... **–$7,300**
**Opt. 24** – Delete OCP5502/Add P6713A Opt. 04 – SMA Optical Input Connector ..... **–$7,300**
**Opt. 25** – Delete OCP5502/Add P6713A Opt. 05 – SC Optical Input Connector ..... **–$7,300**

**ORS156**
SDH/SONET Receiver ..... **$11,395**
**Includes:** OCP5502, FS156 Filter, Calibration Document (063-1266-00), Instruction Manuals (070-8562-00).

**Opt. 1P** – Delete OCP5502 Power Supply ..... **–$495**
**Opt. 11** – Delete OCP5502/Add P6703A Opt. 01 – FC Optical Input Connector ..... **–$6,300**
**Opt. 12** – Delete OCP5502/Add P6703A Opt. 02 – ST Optical Input Connector ..... **–$6,300**
**Opt. 13** – Delete OCP5502/Add P6703A Opt. 03 – DIN 47256 Optical Input Connector ..... **–$6,300**
**Opt. 14** – Delete OCP5502/Add P6703A Opt. 04 – SMA Optical Input Connector ..... **–$6,300**
**Opt. 15** – Delete OCP5502/Add P6703A Opt. 05 – SC Optical Input Connector ..... **–$6,300**
**Opt. 31** – Add FS52 Filter and OC-1 Calibration ..... **+$1,500**

**ORS622**
SDH/SONET Receiver ..... **$11,495**
**Includes:** OCP5502, FS622 Filter, Calibration Document (063-1266-00), Instruction Manuals (070-8562-00).

**Opt. 1P** – Delete OCP5502 Power Supply ..... **–$495**
**Opt. 31** – Add FS52 Filter and OC-1 Calibration ..... **+$1,500**
**Opt. 41** – Add FS156 Filter and OC-3/STM-1 Calibration ... **+$1,600**

**ORS2488**
SDH/SONET Receiver ..... **$17,950**
**Includes:** Calibration Document (063-1266-0), Instruction Manual (070-8731-00).

**Opt. 1P** – Delete ORS2488 Power Supply ..... **–$495**

**ADDITIONAL ACCESSORIES**
**Fiber Optic Cables** – Refer to page 283 for complete list.
**TEKPROBE™ Interface Cable** – Order 012-1372-00 ..... **$350**
**TEKPROBE™ Power Supply** – Order 1103*1 ..... **$600**

**1 For use with oscilloscopes or other signal analysis instruments not having Tektronix TEKPROBE Interface compatibility, the ORS52 and ORS156 reference receivers using the P6703A or P6713 O/E Converters require a Tektronix 1103 Power Supply to be ordered separately.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# OCP 5002
# OCP 5502

# Optical to Electrical Converters/Power Meters

*The OCP 5000 Series products provide general purpose optical to electrical conversion and simultaneous measurement and display of average optical power over a wide signal bandwidth.*

**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

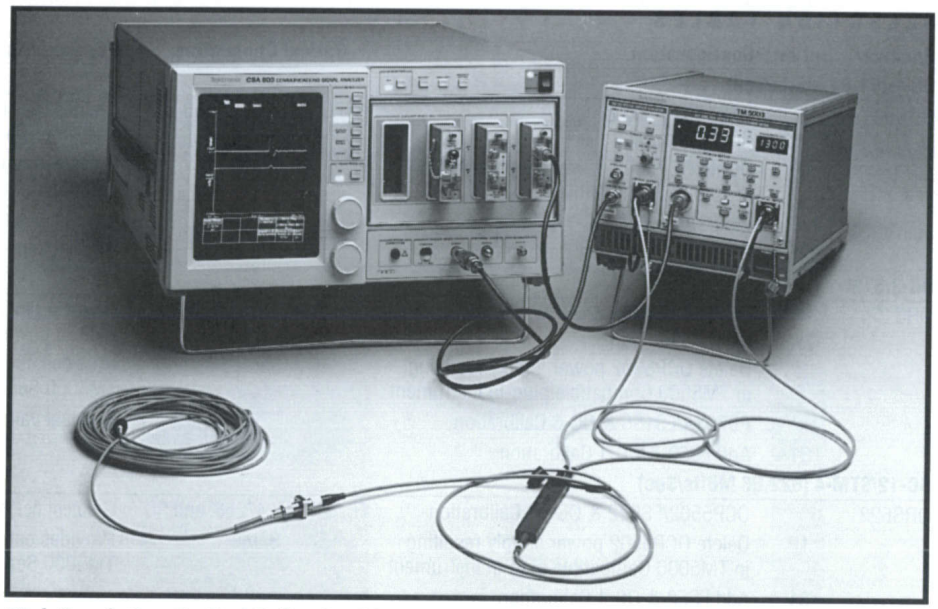
**APPLICATIONS**

- 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

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The OCP 5002/ OCP 5502 comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.



*High Resolution Optical Reflection Measurement using OIG 502, OCP 5502 and the CSA 803A.*

## OCP 5002/OCP 5502

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.

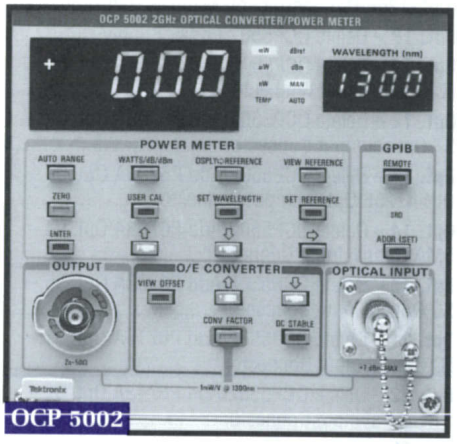
The OCP 5002 occupies two slots in a Tektronix TM 5000 Series Modular Instrument Mainframe. The OCP 5502 is a functionally equivalent instrument, packaged as a stand-alone, monolithic unit. The OCP 5000 Series instruments can be operated from the front panel keypad or from a GPIB controller. The GPIB 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 Watts, 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.

**1ST is a registered trademark of AT&T.*



# Optical to Electrical Converters/Power Meters

**OCP 5002**
**OCP 5502**



### 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.

The OCP 5000 Series instruments can be used with the Tektronix CSA 803A, CSA 404 Communication Signal Analyzers or other 11000 Series oscilloscopes 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.

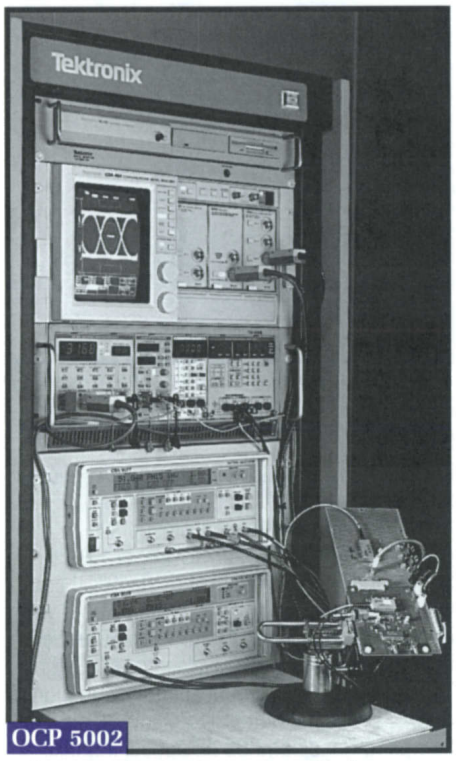
### OPTICAL DIGITAL COMMUNICATION TESTS

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 or CSA 404 Communication Signal Analyzers 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 CSA 404 or other Tektronix 11000 Series oscilloscopes 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.

The OCP5000 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 Receiver consult the separate entry on these products appearing in this catalog.




*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.*

### 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 |
| Risetime | 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<br>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

**OCP 5002**
2 GHz Optical Converter/Power Meter ..... **$8,950**
**Includes:** Instruction manual (070-7817-00), Universal Optical Input/output Connector Kit (020-1885-00).

**OCP 5502**
2 GHz Optical Converter/Power Meter ..... **$9,950**
**Includes:** Instruction manual (070-7817-00), Universal Optical Input/output Connector Kit (020-1885-00).

**OPTIONAL ACCESSORIES**
**Fiber Optic Cables –** Refer to page 283 for complete list.
**TEKPROBE™ Interface Cable –** Order 012-1372-00..... **$330**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Optical to Electrical Converters



*The SD and SA Series products are general purpose optical to electrical converters for use with oscilloscopes and spectrum analyzers.*

**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

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.




*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 CSA800 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 CSA800 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 are 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.

### STAND-ALONE CONVERTER MODULES

The SA-46 and SA-42 are stand-alone, 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 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.

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. The units have 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 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 risetime, aberration, optical power vs drive current and voltage, modulation bandwidth, and sensitivity can now be made at high bandwidth, accurately and easily.

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 optoelectronic components and modules found in fiber optic transmission networks and fiber optic sensor systems.

# Optical to Electrical Converters

**SA-42** **SD-42**
**SA-46** **SD-46**



## 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/$\sqrt{Hz}$*2<br>≤33 µW*3<br>≤10 µW*4 | 32 pW/$\sqrt{Hz}$*2<br>≤45 µW*3<br>≤16 µW*4 | 23 pW/$\sqrt{Hz}$*2 | 32 pW/$\sqrt{Hz}$*2<br>≤45 µW*3<br>≤16 µW*4 |
| Linear Response Range | ≤25 mW Peak Power<br>≤5 mW Average Power | ≤25 mW Peak Power<br>≤5 mW Average Power | ≤25 mW Peak Power<br>≤5 mW Average Power | ≤25 mW Peak Power<br>≤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

| | SD-42 | SD-46 | SA-42 | SA-46 |
|---|---|---|---|---|
| Dynamic Range | 5 nW to 5 mW (60 dB) | 5 nW to 5 mW (60 dB) | NA | NA |
| Sensitivity Range 1 | 1 V/mW ±10% | 1 V/mW ±10% | NA | NA |
| Sensitivity Range 2 | 1 V/µW ±10% | 1 V/µW ±10% | | |

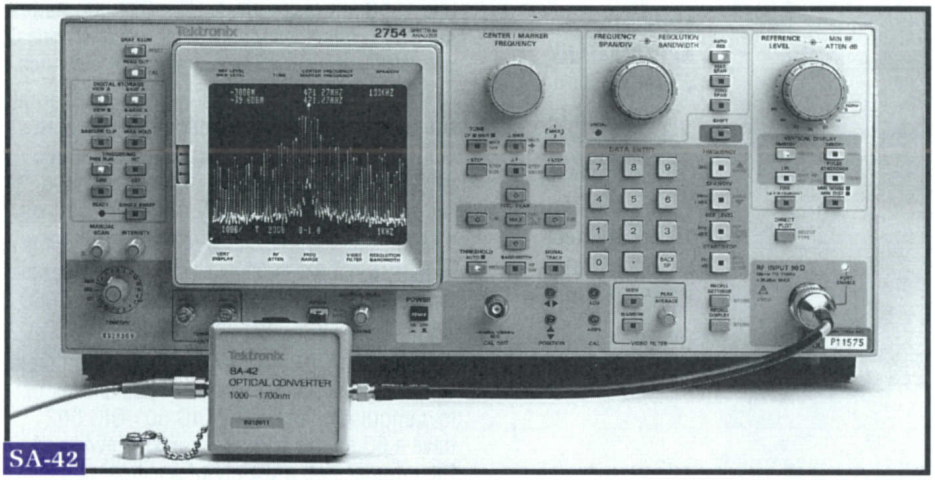
**1 Calculated (.44/Optical Bandwidth).*

**2 Root Hertz Into 50 Ω.*

**3 System specification with SD-24/SD-26.*

**4 System specification with SD-22.*

**ENVIRONMENTAL**
**Operating Temperature Range –** 0°C to 50°C.



SA-42

*SA-42 Optical to Electrical Converter with Tektronix 2754 Spectrum Analyzer.*

## ORDERING INFORMATION

**SD-42**
Optical to Electrical Converter ..... **$3,995**
**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 ..... **$6,995**
**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 ..... **$3,995**
**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 ..... **$6,995**
**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).

**OPTIONAL ACCESSORIES**
**Fiber Optic Cables –** Refer to page 283 for complete list.

**OTHER ACCESSORIES**
**Sampling Head Extender Cables –**
(1 m). Order 012-1220-00 (SD-42 and SD-46) ..... **$710**
(2 m). Order 012-1221-00 (SD-42 and SD-46) ..... **$735**
**10 kHz to 21 GHz DC Block –**
("N" Type). Order 015-0509-00 ..... **$430**
(K to "N" type adapter). Order 015-0369-00 ..... **$49**

**INTERNATIONAL POWER PLUG OPTIONS (SA-42 AND SA-46 ONLY)**
**Opt. A1 –** Universal Euro 220 V, 50 Hz. (161-0104-06) ..... **NC**
**Opt. A2 –** United Kingdom 240 V, 50 Hz. (161-0104-07) ..... **NC**
**Opt. A3 –** Australian 240 V, 50 Hz. (161-0104-05) ..... **NC**
**Opt. A4 –** North American 240 V, 60 Hz. (161-0104-08) ..... **NC**
**Opt. A5 –** Switzerland 220 V, 50 Hz. (161-0167-00) ..... **NC**
See General Customer Information Section for additional description.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# OIG 501
# OIG 502

# Optical Impulse Generators

*The OIG Series products generate extremely narrow laser impulses for use in general purpose optical reflection measurements and opto-electronic device characterization.*

**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

**TYPICAL APPLICATIONS**

- Millimeter Resolution Optical Time Domain Reflectometry
- Optical Reflection Measurement
- Optical Component Characterization



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. These units are compatible with either the Tektronix TM 500 or TM 5000 Series Modular Instrument Mainframes.

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 404, CSA 803A, 11400, or 11800 Series products) the OIG500 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 2 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 the Tektronix CSA 803A, CSA 404 Communication Signal Analyzers or other 11000 Series oscilloscopes 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 or CSA 404, the user can easily characterize optical devices in terms of their frequency response, rise time, and aberration levels.

**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<br>100 kHz<br>1.0 MHz | 10 kHz<br>100 kHz<br>1.0 MHz |

*1 ±50 nm *2 ±20 nm

*Note: For further technical information request Product Data Sheet #3TW-7797-1.*

**1ST is a registered trademark of AT&T*

**ORDERING INFORMATION**

**OIG 501**
Optical Impulse Generator ..... **$9,250**
**Includes:** Instruction manual (070-7817-01), Universal Optical Input/output Connector Kit (020-1885-00).

**OIG 502**
Optical Impulse Generator ..... **$9,750**
**Includes:** Instruction manual (070-7818-01), Universal Optical Input/output Connector Kit (020-1885-00).

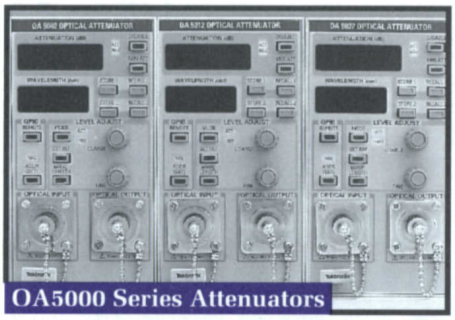
**OPTIONAL ACCESSORIES**
**Fiber Optic Cables –** Refer to page 283 for complete list.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Optical Attenuators

**OA5002 OA5012**
**OA5022 OA5032**





OA5000 Series Attenuators

## 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. These instruments are packaged as compact single-wide plug-in units compatible with Tektronix TM 5000 Series Modular Instrument Mainframes. Six units will fit side-by-side in a TM5006 Mainframe taking up approximately seven inches of vertical space in a standard 19 inch wide equipment rack.

### 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. The CSA 907 BER Test Set and OA5000 Series Optical Attenuators meet the requirements for performing this test.

### FDDI/LAN DESIGN

Using the OA5000 Series Optical Attenuators with the CSA 907 BER Tester and the CSA 404 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.

### 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<br>≤ –25 dB*2 |
| Attenuation Range | | ≥ 60 dB*3<br>≥ 50 dB*4 |
| Disable | | ≥ 100 dB*5<br>≥ 90 dB*5 |
| Repeatability | | ±0.05 dB |
| Linearity | | ±0.05 dB |

*1 OA5002
*2 OA5012/OA5022/OA5032
*3 750-1350 nm
*4 1350-1600 nm
*5 OA5032

*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.*

### FEATURES

- 750 nm to 1600 nm Calibrated Spectral Response in One Unit
- Multiple Optical Connector Types Accommodated
  –FC/PC
  –DIN 47256
  –ST
  –SC
- GPIB, IEEE 488.2 Controllable
- Models for Single and Multimode Fiber
- Can be Mounted 6 Abreast in Standard Rackmount

### APPLICATIONS

- 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

*The OA5000 Series products provide calibrated levels of optical path attenuation for use in general purpose fiber optic measurements and optical receiver characterization.*

## ORDERING INFORMATION

**OA5002**
Optical Attenuator.....**$7,250**
**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.....**$6,995**
**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.....**$6,995**
**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.....**$6,995**
**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 283 for complete list.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The OA5002/ OA5012/OA5022 comply with IEEE Standard 488.2, and with Tektronix Standard Codes and Formats.

# CSA 907A Bit Error Rate Tester

*The CSA907A Bit Error Tester is a stimulus-response system with high speed serial pattern generator and companion error detection.*

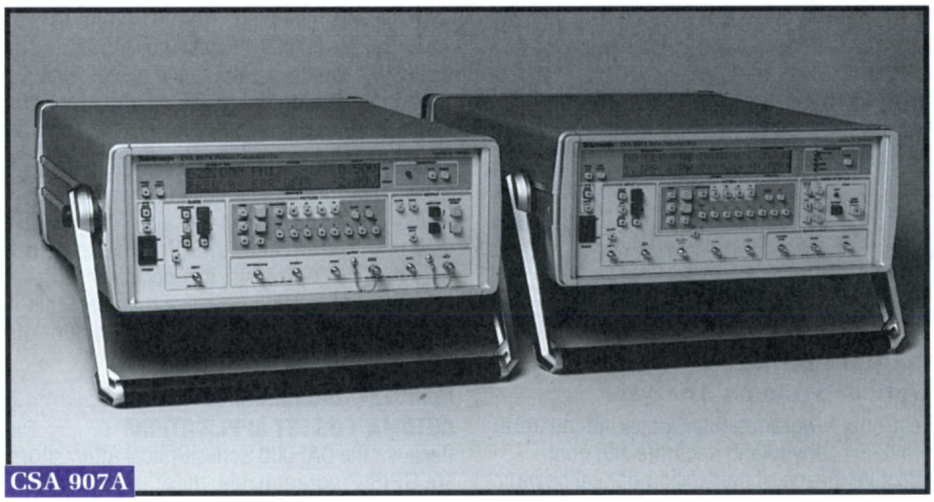
**CSA 907A**

- SDH/SONET and FDDI Pattern Generation
- 150 KHz to 700 MHz Internal PLL Clock Source
- PRBS Patterns: $2^{(7,15,17,20,23)} - 1$
- Optional 128K-Bit Programmable Word Memory
- PC Based Frame Editing Software for Added Versatility
- Error Injection: Single Errors, Selectable Error Rate, or Gated Errors
- Differential and Single Ended Inputs
- External Reference Data Input for User Generated Patterns
- Automatic Data/Clock Setup
- Versatile Bit Error Rate Measurements and Analysis
- Centronics, RS-232 and GPIB (IEEE-488.2) Remote Interfaces
- ECL, PECL and Programmable Voltage Levels

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The CSA907A complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.




## CSA 907A

The CSA 907A Bit Error Rate Tester is a stimulus-response system that features a high-speed serial pattern generator, the CSA 907A Tx, and a companion error detector, the CSA 907A Rx. Each unit is portable, and can be used in a lab, production testing, or field environment. The CSA 907A Bit Error Rate Tester can be used to evaluate transmission quality of high speed modules and systems for a variety of testing applications including SDH/SONET, FDDI, and satellite communications.

Along with the CSA 803A Communications Signal Analyzer, and a full line of optical test products, a complete SDH/SONET/FDDI Standards Test System is formed to verify compliance to physical layer standards for bit error rate, noise, jitter, and mask templates.

### DATA PATTERN GENERATION

Pseudo Random Bit Sequence patterns (PRBS) simulate real data and are important in order to make statistical measurements such as error rate, jitter and noise on communication devices, modules and systems. The CSA 907A Tx has the ability to generate five PRBS patterns that include $2^{(7,15,17,20,23)} - 1$. In addition, single errors, a programmed error rate, or burst errors can be transmitted in the data stream for continuity checks and system stress evaluation. In addition to the PRBS patterns, the CSA 907A features ten 16-Bit programmable words.

### FDDI/SDH/SONET PATTERN GENERATION

For long word lengths, the Framewriter software package, together with an 128K extended memory option provide the tools to make application specific or user defined patterns. Applications include the ability to send 20 contiguous STS-1 patterns, up to 6 contiguous STM-1/STS-3c patterns, or a single STM-4/STS-12c pattern. To insure test repeatability, the extended memory option also features 10 fixed ROM based patterns:

- FDDI: 4B/5B NRZ pattern, 4B/5B NRZ-I pattern
- SDH: STM-1 pattern, STM-1 scrambled pattern
- SONET: STS-1 pattern, STS-1 scrambled pattern, 4 STS-1 patterns, 4 STS-1 scrambled patterns, STS-3 pattern, STS-3 scrambled pattern

### DATA PATTERN EDITING SOFTWARE

A menu driven IBM-PC compatible software package, "FrameWriter™", is provided with the CSA 907A. FDDI, and SDH/SONET patterns are easily created and edited on a computer or controller external to the CSA 907A, and then down-loaded to the CSA 907A through the GPIB interface. These signal frames can then be quickly and reliably recalled with a single front panel button on the CSA 907A or recalled automatically under program control.

### VERSATILE CLOCKING SOURCES

The CSA 907A has an internal PLL clock source that transmits patterns at speeds of 150 KHz to 700 MHz, thereby eliminating the need for an external clock synthesizer. The clock source has a resolution of 1 KHz and 10 ppm stability. This extra resolution is especially important in:

- SDH/SONET applications where frequencies are allocated in increments of 10KHz
- Testing a clock recovery circuit where the user wants to sweep across the bandpass of the PLL to check lock-in and hold ranges.

*Continued on next page.*

# Bit Error Rate Tester

## CSA 907A



Ten commonly used frequencies can be stored and later recalled for repeatability and standards compliance testing. For applications where the test is to be performed using a known reference clock, the CSA 907A Tx has the ability to accept an external clock input. The external clock input can be used to inject jitter in conjunction with an external signal generator.

The CSA 907A Tx external clock input is conditioned to accept a clock burst, and output a pattern with periods of no data (burst mode). The CSA 907A Rx can recognize the pattern with periods of no data without losing synchronization. The burst mode simulates communication and telemetry systems that often send data in "bursts" with variable times of inactivity between bursts.

**AUTO SET AND SYNC**

The CSA 907A "auto-set" synchronization feature allows effortless system setup and operation. The "auto-set and sync" feature simplifies adjusting multiple input parameters by providing automatic clock /data threshold level, clock to data phase adjustment, appropriate data pattern selection (and polarity), and bit synchronization to data patterns. These powerful automatic synchronization features allow the user to immediately perform a wide range of tests on systems and components.

**VERSATILE MEASUREMENT AND ANALYSIS**

The CSA 907A allows a wide range of concurrent Bit Error Rate measurements and analysis for fully characterizing and testing communication devices, subsystems, and links. In addition to total errors and error rate, the Error Detector measures errors in a programmable time, bit length, or sliding window. Report printouts are available both at end-of-test, and when exceeding a user defined error threshold.

**EXTERNAL REFERENCE DATA**

The external data reference mode in the CSA 907A allows the user to measure and analyze transmission errors for virtually any user generated data pattern. It is useful when evaluating the performance of a component or system against a user supplied reference data. Delay compensation up to 4 ns, data threshold adjust, and input termination voltage selection is also possible with the external reference data input.

**OPERATIONAL SUPPORT**

For test repeatability and programmed control, the CSA 907A supports both RS-232 and IEEE-488.2 GPIB (with Tektronix Standard Codes & Formats) remote interfaces. The battery backed-up non-volatile RAM memory provides storage of ten 16-Bit word patterns, eight 128K-Bit word patterns (optional), 10 clock frequencies, error measurements and unit setup for loss of power conditions. The Error Detector provides monitor outputs for viewing eye diagrams on the CSA 803A and CSA 404 Communication Signal Analyzers. The rear panel has specialized inputs and outputs for customized data generation and BER measurements.

## Characteristics

**CSA 907A TX PATTERN GENERATOR**

**Frequency Range: –** 150 kHz to 700 MHz (Mbit/s) with internal or external clock.

**Resolution –** 1 kHz with 10 ppm stability.

**Frequency Memory –** 10 frequencies.

**External Clock Input –** Selectable termination: (50 Ω to GND, or 50 Ω to –2 V) DC coupled, 1.4 V p-p.

**Data Output Formats –** NRZ, Normal and complement; PRBS patterns and programmable WORD.

**PRBS Patterns –** $2^{(7,15,17,20,or\ 23)}$-1.

**Maximum WORD Length –** 16-Bits (128K pattern memory optional).

**WORD Memories –** 10 x 16-Bits (8 x 128K bits optional).

**Data and Clock Outputs –** 50 Ω true and complement (differential); Amplitude: 500 mV p-p to 2 V p-p into 50 Ω; Baseline Offset: –2.0 V to +1.8 V (50 Ω to GND), –3.0 V to +0.8 V (50 Ω to –2 V), –0.5 V to 3.3 V (50 Ω to +3 V); Rise/Fall Times: 200 ps, typical at 1 V p-p.

**Internal Error Injection –** 1 x $10^{-3,4,5,6\ or\ 7}$ rate.

**External Error Injection –** 1 error injected for each rising edge, ECL.

**Auxiliary Outputs –** Clock/4 and pattern sync; 500 mV p-p into 50 Ω centered to GND.

**CSA 907A RX ERROR DETECTOR**

**Frequency Range –** Clock Input: 150 KHz to 700 MHz; Data Input: 150 Kbit/s to 700 Mbit/s.

**Error Measurements and Analysis –** Measurements: BER, total errors; Sliding BER Window: *Time* - 1 second to 24 hours, *Bits* - 1 x 108 to 1 x 1016; Error Analysis: Error Seconds, Error Free Seconds, Severely Error Seconds, Degraded Minutes, Unavailable Seconds, Loss Of Signal, Threshold Error Seconds.

**Clock, Data and Data Reference Inputs –** NRZ, RZ, Normal and complement (data only); Input Threshold: –2 V to + 4 V (50 Ω to GND), –3 V to + 3 V (50 Ω to –2 V), –1.5 V to + 4.5 V (50 Ω to + 3 V); Input Amplitude: 0.5 to 6.0 V p-p; Impedance: 50 Ω, selectable terminations (GND, –2 V, +3 V, or floating); Delay Range: 0 to 4 ns, variable.

**Monitor Outputs –** Pattern sync, clock, data, and error; DC coupled, 500 mV p-p centered on GND.

**CSA 907A TX/CSA 907A RX GENERAL SPECIFICATIONS**

**Front Panel Connectors –** SMA female.

**Power Requirements –** 90 to 132 VAC, or 180 to 264 VAC, 47 to 63 Hz, 100 VA max.

**Operating Temperature –** 0 to 50° C.

**EMI –** Complies with FCC A and VDE B specifications.

**PHYSICAL CHARACTERISTICS**

| Dimensions | mm | in. |
|---|---|---|
| Width | 366 | 14.4 |
| Height | 152 | 6 |
| Depth | 340 | 13.4 |
| **Weight ≈** | **kg** | **lb.** |
| Net | 10.9 | 24 |

## ORDERING INFORMATION

**CSA 907A**
Bit Error Rate Tester ..... **$35,990**

**Includes:** Pattern Generator, Error Detector, CSA 907A User Manual (P/N 070-8685-00), CSA 907A Programmer Manual (P/N 070-8686-00), "FrameWriter" IBM-PC compatible software frame editing package.

**INSTRUMENT OPTIONS**

**Opt. 1M** – Rackmount for one unit ..... **+$295**
**Opt. 2M** – Rackmount for both units ..... **+$590**
**Opt 2A** – 75 Ω Terminations on both units ..... **+$1,990**
**Opt 2R** – 75 Ω Terminations on Error Detector ..... **+$995**
**Opt. 2T** – 75 Ω Terminations on Pattern Generator ..... **+$995**
**Opt. 3A** – 128K Extended Pattern Memory on both units .. **+$9,000**
**Opt. 3R** – 128K Extended Pattern Memory – Error Detector ..... **+$4,500**
**Opt. 3T** – 128K Extended Pattern Memory – Pattern Generator ..... **+$4,500**
**Opt. 4T** – Delete CSA 907A Error Detector ..... **–$13,000**
**Opt. 4R** – Delete CSA 907A Pattern Detector ..... **–$15,000**
**Opt. 94** – Statement of Conformance ..... **NC**

**INTERNATIONAL POWER PLUG OPTIONS**

**Opt. A1-A5** – Available. See General Customer Information Section for additional description.
**Cart** – Order K218 ..... **$745**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The CSA 907A complies with IEEE Standard 488.2-1987, and with Tektronix Standard Codes and Formats.

# Q8383
# Q8381A
# Q8344A

# Optical Spectrum Analyzers

*These instruments analyze and display the optical spectral content of lightwave emissions from lasers and light emitting diodes operating in the 350 nm to 1750 nm wavelength band.*

**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

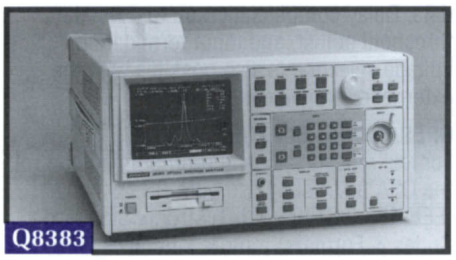
**APPLICATIONS**

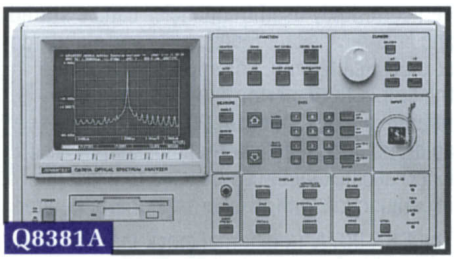
- Optical Fiber Amplifier Measurements
- Communications Laser & LED Transmitter Characterization
- Manufacturing Test of Optical Sources
- Optical Source Standards Compliance

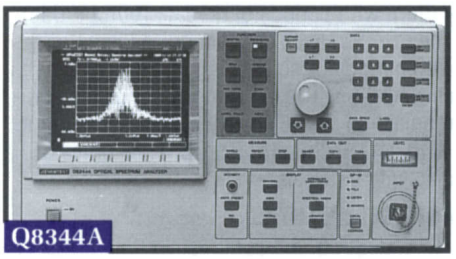
ADVANTEST

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The Q8383, Q8381A, Q8344A complies with IEEE Standard 488.1-1987.


Q8383


Q8381A


Q8344A

## 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. Additionally 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 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**



## SPECIFICATIONS

| | 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 | 0.01 to 0.83 nm max resol. (at 0.50 & 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)<br>–55 to +10 dBm (0.55 to 1.75 µm) | –85 to +10 dBm (1.1-1.6 µm)<br>–75 to +10 dBm (0.7-1.6 µm)<br>–70 to +10 dBm (0.4-1.65 µm)<br>–60 to +10 dBm (0.35-1.75 µm) | –70 to +10 dBm (0.7-1.6 µm)<br>–60 to +10 dBm (0.45-1.7 µm)<br>–45 to +10 dBm (0.35-1.75 µm) |
| | Polarization dependence | within ±0.05 dB | ≤ 0.05 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)<br>≥ 65 dB (±1.0 nm from peak) | ≥ 40 dB (±1.0 nm from peak)<br>≥ 50 dB (±5 nm from peak) | |
| **Sweep** | Measurement time | ≤ 0.8 sec ( ≤ 200 nm span) | ≤ 0.8 sec ( ≤ 200 nm span)<br>≤ 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)<br>≥ 0.1 Hz pulse rep. rate<br>Gate time: 1 ms to 10 sec | ≥ 30 µs pulse width<br>Gate time: 1 ms to 10 sec | N/A |
| | Synchronous (gated) measurement input | Synch. sig. input level: 3.5 V high, 1.5 V low, pos. logic<br>Min optical pulse width: ≥10 ns (30 µs recommended)<br>Optical pulse rep. rate: DC to 100 MHz | Synch. sig. input level: 3.5 V high, 1.5 V low, pos. logic<br>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<br>Power monitor & trend<br>Measurement cursors<br>Dual screen & superimpose display<br>Split display<br>3-D display function<br>Averaging | Auto optimum settings<br>Auto peak search<br>Measurement cursors<br>Power monitor & trend<br>Luminosity compensation<br>3-D display function<br>Superimpose & split displays<br>Averaging | Coherence analysis<br>Auto optimum settings<br>Auto peak search<br>Measurement cursors<br>3-D display function<br>Averaging |
| **Input/Output** | Optical input | FC type connector | FC type connector | FC type connector |
| | Data output | GPIB / IEEE488 control<br>Internal printer<br>Direct plotter output | GPIB / IEEE488 control<br>Internal printer<br>Direct plotter output | GPIB / IEEE488 control<br>Internal printer option<br>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 VAC, 48 to 66 Hz, ≤ 180 VA | 90 to 250 VAC, 48 to 66 Hz, ≤ 180 VA | 90 to 132 VAC , (198 to 250 VAC 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

**Q8383**
Advantest Optical Spectrum Analyzer.....*1
**Includes:** Instruction Manual, power cable (AO1402)

**Q8381A**
Advantest Optical Spectrum Analyzer.....**$35,000**
**Includes:** Instruction Manual, power cable (AO1402), printer paper (AO9075), and 3.5 inch floppy disk

**Q8344A**
Advantest Optical Spectrum Analyzer.....**$33,800**
**Includes:** Instruction Manual, power cable (AO1402)
**Opt. 01** – Built-in printer (with paper).....**+$1,950**
**Opt. 10** – 200 µm fiber input.....**+$950**
**Opt. 40** – 198 to 250 VAC power.....*1

*[1]Contact your local Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The Q8383, Q8381A, Q8344A complies with IEEE Standard 488.1-1987.

# Q8214B

# Optical Power Meter

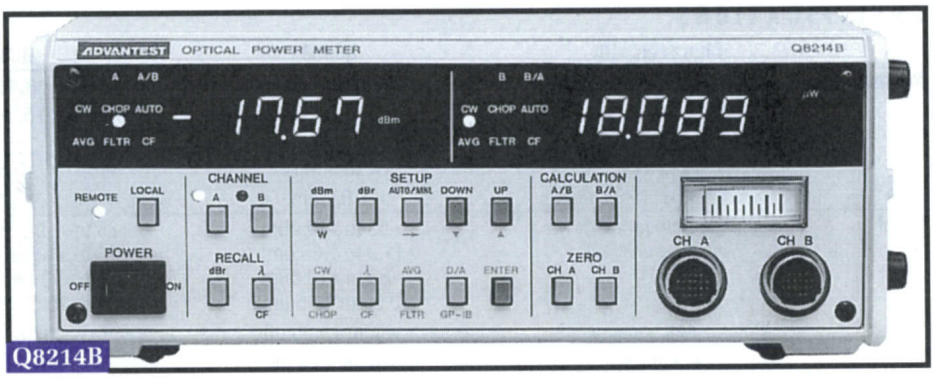
*This instrument makes highly precise and accurate measurements of average optical power in the 800 nm to 1650 nm wavelength band.*

## FEATURES

- Two Independent Channels
- Simultaneous Channel Measurements
- Wide Dynamic Range
- High Resolution
- Dual Channel Displays
- Fast Measurements
- Input Level Meter
- Analog Output
- GPIB Controllable

## APPLICATIONS

- General Optical Power Measurements
- Fiber Optic Manufacturing Test
- Optical Communications Equipment R&D
- Insertion Loss Measurements
- Optical Equipment Calibration and Service



Q8214B

## Advantest Q8214B

The Advantest Q8214B Optical Power Meter is a GPIB controllable high resolution wide dynamic range lab power meter. It is capable of very accurately measuring average optical power on one or two optical input channels over the 800 nm to 1650 nm wavelength range. Measurement data from both channels can be simultaneously acquired and displayed.

This power meter can be operated in either a single channel or dual channel mode. Because an independent A/D converter is used for each of the two channels, simultaneous sampling is made possible. The instrument's internal processor allows comparisons to be made between the two measurement channels. At the choice of the operator, these comparisons can involve computed functions such as ratios, differences, multipliers, added constants, and other computational operations on the two power channel inputs.

Optical power sensor heads are available for the Q8214B which tailor it for a range of measurement applications. The Q82032A high sensitivity sensor is a multipurpose optical power measurement head with a wide variety of applications. The Q82039 provides for the measurement of optical power in multicore fiber applications where each fiber path is terminated. For both sensors a wide selection of standard adapters are available which allow a variety of fiber optic connection types to be accommodated.

In making relative value measurements, the Q8214B can measure the relative power level and compare it to a chosen reference value with a resolution of 1/1000 dB. This makes the Q8214B a powerful instrument to measure very small changes in optical power. This is also applicable to the measurement of insertion loss due to optical fibers, connectors, and other optical components.

ADVANTEST

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The Q8214B complies with IEEE Standard 488.1-1987.

# Optical Power Meter

**Q8214B**



## Q8214B MAINFRAME SPECIFICATIONS

| | Characteristic | Q8214B |
|---|---|---|
| **Basic Capabilities** | Wavelength Range | 800 nm to 1650 nm |
| | Dynamic Range | –80 dBm to +10 dBm (using Q82032A Sensor, CW mode)<br>–80 dBm to 0 dBm (using Q82039 Sensor, Chopped mode) |
| | Sensor Input Channels | 2 independent measurement channels (A & B) |
| | Resolution | 0.01 dB (dBm readout), 0.005% to 0.1% (Watts readout) |
| | Display Resolution | Four and one half digits |
| | Sensor Wavelength Compensation | 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 | 3 measurements per sec. (approx.) |
| **Processing** | Averaging | Can be set to any value from 2 to 256 |
| | Calculations | A/B, B/A, CF (in Watts mode; multiplication of measurement and constant value, in dBm mode; offset can be added) |
| **Input/Output** | Optical Input | Connector type determined by sensor head |
| | Data Output | GPIB / IEEE488 control. Analog output |
| **General** | Operating Environment | 0 to +40°C, ≤ 85% RH (non-condensing) |
| | Power Supply | 90 to 250 VAC, 50 to 60 Hz, ≤ 35 VA |
| | Dimensions | 240 (W) x 88 (H) x 310 (D) mm, approximate |
| | Weight | Approximately 4 kg |

## PHOTOSENSOR SPECIFICATIONS

| Characteristics | | Q82032A | Q82039 |
|---|---|---|---|
| **Wavelength Range** | | 800 nm to 1650 nm. | 800 nm to 1650 nm. |
| **Photosensor Type** | | InGaAs PIN photodiode. | InGaAs PIN photodiode. |
| **Optical Input** | | FC connector. | FC connector. |
| **Dynamic Range** | CW Mode | –80 dBm to +10 dBm<br>(10 pW to 10 mW) | –60 dBm to 0 dBm<br>(1 nW to 1 mW) |
| | Chopped Mode | N/A | –80 dBm to 0 dBm<br>(10 pW to 1 mW) |
| **Power Scales** | CW Mode | 10 ranges in 10 dB steps | 7 ranges in 10 dB steps. |
| | Chopped Mode | N/A | 10 ranges in 10 dB steps. |
| **Measurement Accuracy** | | ±0.25 dB (±5%). | ±0.25 dB (±5%). |
| **Measurement Ranges** | | 10 ranges in 10 dB steps. | 10 ranges in 10 dB steps. |
| **Reference Wavelength** | | 1300 nm. | 1300 nm. |
| **Wavelength Sensitivity compensation Range** | | 750 nm to 1700 nm<br>(in 1 nm intervals) | 750 nm to 1700 nm<br>(in 1 nm intervals) |

## ORDERING INFORMATION

**Q8214B**
Advantest Optical Power Meter ..... **$2,450**
**Includes:** Instruction Manual, power cable (AO1402)

**Q82032A**
Advantest Long Wavelength Sensor ..... *1
**Includes:** Instruction Manual, FC/PC Connector Adapter (AO8081).

**Note:** The following fiber interconnection adapter is needed by the Q82032A Sensor when working with fibers not having connectors attached:
**AO8024 –** Bare Fiber Adapter ..... **$400**

**Q82039**
Advantest Long Wavelength Sensor ..... **$3,650**
**Includes:** Instruction Manual

**Note:** Depending upon the application, one or more of the following fiber interconnection adapters are required by the Q82039 Sensor:
**AO8012 –** FC/PC Connector Adapter ..... **$160**
**AO8090 –** SC Connector Adapter ..... **$400**
**AO8096 –** ST Connector Adapter ..... **$400**
**AO8020 –** Bare Fiber Adapter (requires AO8021) ..... **$400**
**AO8021 –** Adapter Cap (required by AO8020) ..... **$110**

**1 Contact your local Tektronix representative for price information.*

ADVANTEST

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The Q8214B complies with IEEE Standard 488.1-1987.

# TQ8325 Optical Wavelength Meter

*This instrument makes high accuracy, high precision, measurements of the central emitted wavelength of lightwave emissions from lasers and light emitting diodes operating in the 600 nm to 1600 nm wavelength band.*

**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

**APPLICATIONS**

- 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

## 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 5 per second thereby enabling the reliable measurement of changes in wavelength with changing temperature.

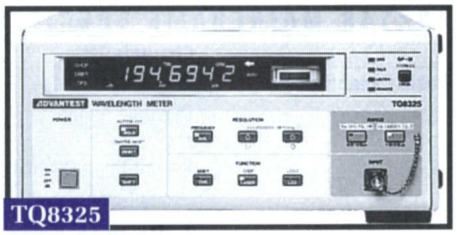
A switch selection enables measurements over the 0.6 to 1.0 µm or 1.0 to 1.6 µm wavelength bands. The TQ8325 can also measure the wavelength of modulated light sources for modulation rates of 3 MHz and above. An auto-resolution function automatically optimizes the resolution depending upon the spectral 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.

**APPLICATIONS**

The TQ8325 has the high precision necessary for it to be used a wavelength standard in the calibration of laboratory monochromators. The TQ8325 also can be used to tune dye lasers and monitor the wavelength output of tunable laser sources as these units are manufactured or used.

The TQ8325 can also be used in the automated measurement of the wavelength-temperature or wavelength-drive current characteristics of laser diodes. The TQ8325 can also be used to measure wavelength fluctuation of lasers and LEDs while those devices are under modulation. The screening of laser diodes and LEDs in the manufacturing environment is also a job for which the TQ8325 is well suited.




## 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 VAC (standard), 180 to 250 VAC (optional). 50 to 60 Hz, ≤ 52 VA.

**PHYSICAL CHARACTERISTICS**

**Dimensions –** Width: 300 mm. Height: 132 mm. Depth: 450 mm.

**Weight –** 12 kg.

ADVANTEST

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The TQ8325 complies with IEEE Standard 488.1-1987.

## ORDERING INFORMATION

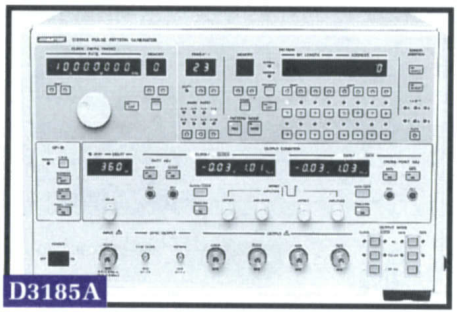
**TQ8325**
Advantest Optical Wavelength Meter ..... **$18,000**
**Includes:** Instruction Manual, power cable (A01402)

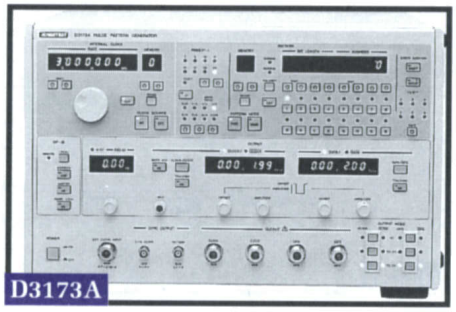
**Opt. 4D –** 180 to 250 VAC power ..... **NC**

# Pulse Pattern Generator

**D3185A**
**D3173A**






## D3173A, D3185A

The D3185A and D3173A are high performance pulse pattern generators suitable for evaluating and analyzing digital transmission equipment for Bit Error Rate, high speed logic devices, optical transmission components and receiver clock recovery performance.

The D3185A requires an external clock source such as the Advantest TR4515 Synthesized Sweeper.

### DATA PATTERNS

The D3185A can operate in the range from 500 Mbit/s to 10 Gbit/s. The D3173A can operate in the range of 50 Mbit/s to 3 Gbit/s. Both offer nine selections for pseudo random binary sequence (PRBS) patterns of $2^7$–1 to $2^{23}$–1 and programmable word patterns of up to 65,536 bits in length. Encoding is NRZ.

### OUTPUT LEVELS AND TERMINATION

Both the D3185A and D3173A offer output termination selections of AC coupled, –2 V (ECL) and 0 V (GND). Both offset and amplitude are variable.

## Characteristics

**D3185A**

**Operating Range –** 500 Mbit/s to 10 Gbit/s.

**Data Output –** Rise and Fall time (20% to 80%): ≤30 ps.

**Clock Output –** Rise and Fall time (20% to 80%); Freq ≥6 GHz: ≤30 ps; Freq <6 GHz: ≤50 ps; Variable Delay: ±400 ps.

**D3173A**

**Operating Range –** 50 Mbit/s to 3 Gbit/s.

**Data Output –** Rise and Fall time (20% to 80%): ≤70 ps.

**Clock Output –** Rise and Fall time (20% to 80%): 50 ps; Variable Delay: ±1 ns.

**D3185A AND D3173A**

**Data Output –** Encoding: NRZ; Polarity: Normal and Invert; Amplitude: 0.5 V p-p to 2 V p-p; Offset: ±2 V; Impedance: 50Ω.

**Clock Output –** Amplitude: AC and 0 V term: 0.5 V p-p to 2 V p-p, ECL term: 0.6 V p-p to 1 V p-p; Offset: AC and 0 V term: ±2 V, ECL term: –1.0 V to 0.6 V; Impedance: 50Ω.

**External Clock Input (timing source) –** Amplitude: 0.7 V p-p to 1.5 V p-p (0.9 dBm to 7.5 dBm); Waveshape: Sinewave; Impedance: 50Ω.

**Error Insertion Rate –** $10^{-N}$ (N= 4, 5, 6, 7, 8 and 9) or Single.

**Output Pattern –** PRBS:

| | | | |
|---|---|---|---|
| $2^7$–1 | CCITT V.29 | $2^{15}$–1 | $X^{15} + X + 1$ |
| $2^9$–1 | CCITT V.52 | $2^{17}$–1 | $X^{17} + X^{14} + 1$ |
| $2^{10}$–1 | X10 + X7 +1 | $2^{20}$–1 | CCITT V.57 |
| $2^{11}$–1 | CCITT 0.152 | $2^{23}$–1 | CCITT 0.151 |
| $2^{15}$–1 | CCITT 0.151 | | |

**Mark Space Ratio –** 0/8, 1/8, 1/4, 1/2, 8/8, 7/8, 3/4, and 1/2 .

**Programmable Pattern –** Variable Bit Length: 1 to 65,536 bits; Bit Length Step: if bit length ≤1024, step=1 bit, if bit length >1024, step=64 bits.

**Setting Backup after 12 hour charge (NiCd battery) –** 2 weeks.

**Power Consumption –** 600 VA max.

**Line Frequency –** 48 Hz to 63 Hz.

### PHYSICAL CHARACTERISTICS

| Dimensions | mm | in |
|---|---|---|
| Height | 260 | 10.5 |
| Width | 424 | 16.7 |
| Depth | 525 | 20.7 |
| | **kg** | **lb.** |
| Weight (mass) | 37 | 81 |

**Operating Temp –** 0°C to +40°C.

**Storage Temp –** –20°C to +60°C.

### FEATURES

- 500 Mbit/s to 10 Gbit/s with D3185A
- 50 Mbit/s to 3 Gbit/s with the D3173A
- Pseudo Random Patterns $2^7$–1 to $2^{23}$–1
- 65,536 Bits of User Programmable Patterns
- Selectable Output Terminations AC, –2 V or GND
- Complementary Clock and Data Outputs
- Master/Slave to Control Error Detector
- GPIB Programmable

*The D3173A and D3185A are pattern generators suitable for the evaluation and analysis of high speed communication components such as high speed lasers, high speed logic devices and multiplexers.*

ADVANTEST

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The D3185A and D3173A complies with IEEE Standard 488.1-1987.

## ORDERING INFORMATION

**D3185A**
Advantest Pulse Pattern Generator, 10 Gbit/s ..... *1
**Includes:** Instruction Manual, power cable (AO1402)
**Opt. 40** – 180 to 250 VAC power ..... *1

**D3173A**
Advantest Pulse Pattern Generator, 3 Gbit/s ..... **$48,500**
**Includes:** Instruction Manual, power cable
**Opt. 40** – 180 to 250 VAC power ..... *1

**TR4515**
Advantest Synthesized Sweeper (recommended for D3185A) ..... **$46,500**

*1 *Contact your local Tektronix representative for price information.*

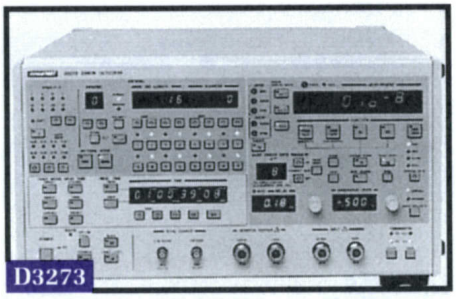
# D3285
# D3273

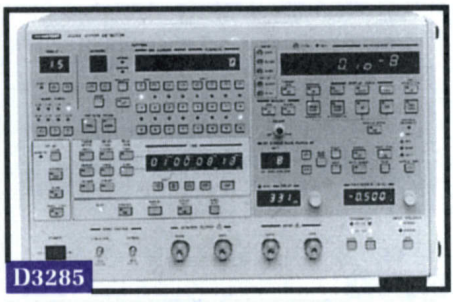
# Error Detectors

*The D3273 and D3285 are error detectors suitable for evaluation and analysis of high speed communication components. When used with the D3173A or D3285A they provide an ideal solution for high speed bit error rate (BER) testing.*

**FEATURES**

- Error Detection from 500 Mbit/s to 10 Gbit/s with D3185A
- Error Detection from 50 Mbit/s to 3 Gbit/s with the D3173A
- Measures Pseudo Random Patterns $2^7$–1 to $2^{23}$–1
- Measures 65,536 Bits of User Programmable Patterns
- Can be Slaved to Pulse Pattern Generator
- GPIB Programmable




## D3273, D3285

The D3285 and D3273 are high performance error detectors suitable for evaluating and analyzing Bit Errors in digital transmission equipment, high speed logic devices, optical transmission components and receiver clock recovery performance.

**DATA PATTERNS**

The D3285 can operate in the range from 500 Mbit/s to 10 Gbit/s. The D3273 can operate in the range of 50 Mbit/s to 3 Gbit/s. Both offer nine selections for pseudo random binary sequence (PRBS) patterns of $2^7$–1 to $2^{23}$–1 and programmable word patterns of up to 65,536 bits in length. Encoding is NRZ.

**ERROR MEASUREMENTS**

Measurement selections include Error Rate, Error Count, Error Second, Error Free Second and Frequency (of incoming clock).

## Characteristics

**D3285**

**Operating Range –** 500 Mbit/s to 10 Gbit/s.

**Frequency Measurement Range –** 500 MHz to 10 GHz.

**Error Rate Measurement Range –** $10^{-12}$ to 9.9999 $10^{-1}$.

**D3273**

**Operating Range –** 50 Mbit/s to 3 Gbit/s.

**Frequency Measurement Range –** 50 MHz to 3 GHz.

**Error Rate Measurement Range –** $10^{-14}$ to 9.9999 $10^{-1}$.

**D3285 AND D3273**

**Error Count Measurement –** Count Capacity: 9.9999 $10^{18}$ seconds; Error Display: Integer Count: 0 to 9999999, Exponential Count: 0 to $10^{16}$.

**Error Seconds Measurement –** Count Capacity: 4.2949 $10^9$ seconds; Display: % (percent): 0.0000% to 100.0000%, Seconds: 0 to $10^6$ seconds.

**Error Free Seconds Measurement –** Count Capacity: 4.2949 $10^9$ seconds; Display: % (percent) – 0.0000% to 100.0000%; Seconds: 0 to $10^6$ seconds.

**Data Input –** Encoding: NRZ; Polarity: Normal and Invert; Amplitude: 0.2 V p-p to 2 V p-p; Termination Voltage: 0 V or –2 V; Threshold Level: 0 V term: ±2 V; ECL term: –1.85 V to –0.75 V; Impedance: 50Ω.

**Clock Input –** Amplitude (AC coupled): 0.5 V p-p to 2 V p-p; Variable Delay: ±400 ps; Impedance: 50Ω.

**Measured Patterns –** PRBS:

| | | | |
|---|---|---|---|
| $2^7$–1 | CCITT V.29 | $2^{15}$–1 | $X^{15} + X + 1$ |
| $2^9$–1 | CCITT V.52 | $2^{17}$–1 | $X^{17} + X^{14} + 1$ |
| $2^{10}$–1 | $X^{10} + X^7 + 1$ | $2^{20}$–1 | CCITT V.57 |
| $2^{11}$–1 | CCITT 0.152 | $2^{23}$–1 | CCITT 0.151 |
| $2^{15}$–1 | CCITT 0.151 | | |

**Mark Space Ratio –** 0/8, 1/8, 1/4, 1/2, 8/8, 7/8, 3/4, and $\overline{1/2}$ .

**Programmable Pattern –** Variable Bit Length: 1 to 65,536 bits; Bit Length Step: if bit length ≤1024, step=1 bit, if bit length >1024, step=64 bits.

**Setting Backup after 12 hour charge (NiCd battery) –** 2 weeks.

**Power Consumption –** 600 VA max.

**Line Frequency –** 48 Hz to 63 Hz.

**PHYSICAL CHARACTERISTICS**

| | D3285 | | D3273 | |
|---|---|---|---|---|
| **Dimensions** | **in.** | **mm** | **in.** | **mm** |
| Height | 10.5 | 266 | 8.7 | 221 |
| Width | 16.7 | 424 | 16.7 | 424 |
| Depth | 20.7 | 525 | 20.7 | 525 |
| | **lb.** | **kg** | | |
| Weight (mass) | 77 | 35 | 62 | 28 |

**Operating Temp –** 0°C to +40°C.

**Storage Temp –** –20°C to +50°C.

**ORDERING INFORMATION**

**D3285**

Advantest Error Detector, 10 Gbit/s.....*1

**Includes:** Instruction Manual, power cable (AO1402)

**Opt. 40 –** 180 to 250 VAC power .....*1

**D3273**

Advantest Error Detector, 3 Gbit/s.....**$46,500**

**Includes:** Instruction Manual, power cable (AO1402)

**Opt. 40 –** 180 to 250 VAC power .....*1

**1Contact your local Tektronix representative for price information.*

ADVANTEST

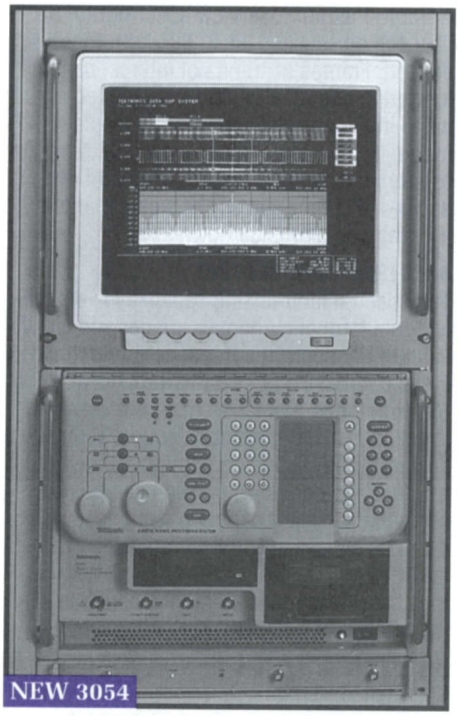
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The D3285 and D3273 complies with IEEE Standard 488.1-1987.

# Digital Signal Processing Systems

**3054**
**3052A**





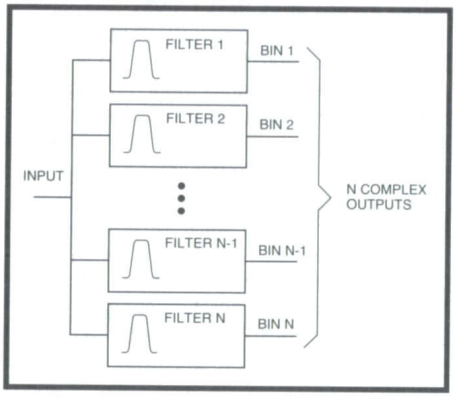

## A New Way To Look At Spectrums

When the time dimension is added to spectrum analysis, the result is a time-frequency analysis of your signal.

While time-frequency analysis is not new, its practical application to a wide range of challenging modern applications has only recently become practical. Using a parallel bank of digitally implemented filters, time-frequency analysis can now cover broad ranges of frequency span, time duration, and time-frequency resolution. This brings important new capability to applications that extend from getting new insights into dynamic signal activity to comprehensively testing high purity oscillators to capture and analyze a momentary loss of phase lock.

### THE KEY: A BANK-OF-FILTERS APPROACH

The key to implementing practical time-frequency analysis is the bank-of-filters approach to spectrum analysis used in the 3050-Series DSP Systems. The input signal is digitized and passed through a multi-stage digital down converter which provides span selection and center frequency tuning for the filter bank. This tuning enables any frequency within the instrument's input bandwidth to be analyzed by use of the filter bank.




*The filter bank consists of a number of parallel resolution filters that are equally spaced in frequency, and have slightly overlapping pass bands. The bandwidth of the resolution filters, is the frequency resolution of the filter bank.*

### FILTER BANK

The output of each filter is complex, i.e. it consists of both real and imaginary components of digital data, which are converted to power and phase in real time. The digital output from each filter is carried in a hardware register called a "frequency bin"; or just a "bin", for short. By convention, a bin is said to have a width equal to the frequency span of the filter bank divided by the number of bins that cover that span. The standard filter used in the 3050 Series has a 0.05 dB pass band that is equal to the bin width.

*See page 307 for ordering information.*

### 3054/3052A FEATURES

- DC To 10 MHz Real Time Input BW
- Continuous Real Time Output In Spans To 2 MHz
- Frame Update Intervals To 200 µs (3052A); To 12.5 µs (3054)
- Tune To RF and Microwave Frequencies With Receivers and Down Converters
- Flexible Triggering Capabilities
- Spectral Event Detection (requires Opt. 10 in the 3052A)
- Spectral Frame Processing

### BENEFITS

- Spectral Transient Analysis With High Resolution In Both Freq. and Time
- Spectrograms Covering Hours Of Signal Time
- Spectral Limit Testing In Real Time
- Post-Process Full-Integrity Spectral Output Data
- Export Spectral Data At Real Time Rates

### 3054 APPLICATIONS

- Signal Analysis and Measurement
- Communication Testing
- Doppler Radar Measurements

### 3052A APPLICATIONS

- Communications Measurements
- Fast Automated Testing
- Regulatory Testing

*Wideband, continuous, real time spectral analysis.*

*Measure spectral power over frequency and time with near-optimum resolution in both frequency and time.*

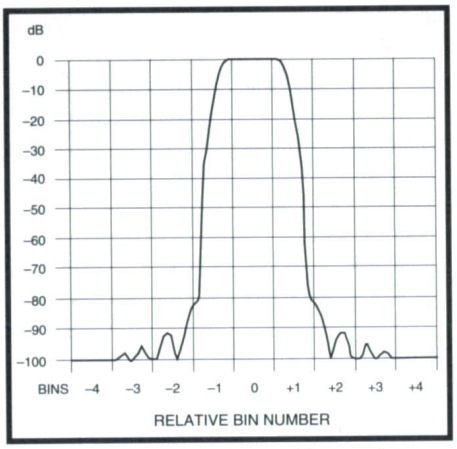
*Real time output over wide frequency spans.*

For more information, contact your local sales office (listed on the inside back cover).

GPIB IEEE-488

The 3052A Opt. 02 and 3054 comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Digital Signal Processing Systems




*The shape of the resolution-filter and its output data rate are key to several of the 3050 Series performance characteristics: frequency flatness, amplitude accuracy, spectral resolution, dynamic range, sensitivity, and the suitability of the filter bank's spectral data for post processing.*

An ensemble of simultaneous outputs from the filters in the bank represents a spectral frame. To show the signal spectrum, this frame data is plotted on a digital color monitor.

The filters in the bank are reconfigurable, which permits tailoring them to specific needs.

**ADDING THE TIME DIMENSION**

The succession of spectral frames adds the time dimension to spectrum analysis. Time resolution is determined jointly by the time interval between successive frames and the charge time of the resolution filters. The spectral frame interval is equal to the reciprocal rate at which data samples are output from each filter, and the charge time is inversely proportional to the filter bandwidth. The term "real time output" means that the complex sample rate is equal to at least twice the bandwidth of the filters.

The 3054 and the 3052A Option 10 both provide continuous real time analysis, even at their widest spans. When the spectral output is taken from the Real time Interface (RTI), the RTI streams out data continuously at the full rate (see more about the RTI below). In many cases, however, there is need to buffer high-speed signal data in a memory to accommodate slower digital processing and storage equipment down stream. When such a memory is full and has to be emptied, the result is breaks in the real time analysis. The real time data is in blocks, and we have "block real time" analysis.

The 3054 and the 3052A, in block real time operation, fill the local Frame Capture Memory with sequential frames. Then the memory stops receiving new data until its contents are processed for display, transferred to disk storage, or post processed and the memory is released again to fill with new data.

These concepts of frequency span and resolution, and of duration and time resolution are useful in differentiating the 3052A and 3054.

**BLOCK MODE, SPECTRAL FRAME PROCESSING AND OVERVIEW DISPLAY**

Both the 3052A and 3054 have a mode of operation called the Block Mode. In this mode, a block of sequential spectral frames is captured in memory and held for post processing, for transfer to the color monitor, or for transfer to disk storage. Normally the Block Mode is used for block real time analysis, but when combined with the spectral frame processing modes Peak or Average, the Block Mode can extend the duration of signal observation in the 3052A and 3054 to hours.

In doing spectral frame processing, a number of sequential frames are processed to produce a resultant frame. In Peak Mode, for example, each resultant frame contains the maximum bin values over "R" frames, where R is the number of sequential frames processed. The values of R range from 1 to 32,768. The block size is selectable when the Block Mode is also invoked, and each resultant peak frame is held in the frame memory until the block is full.

The 3052A has a frame memory that holds magnitude and phase data for 500 spectral frames. In the 3054, the frame memory holds a number of frames that depends upon how many bins are selected to cover the span. For 801 bins, the memory holds 4094 frames, and for 51 bins, the memory holds 65,534 frames.

A frame-memory overview spectrogram display can be selected when the instrument is paused. Frames or trends of interest can be located in this display, and then viewed in full detail in the normal spectrogram display mode. In the normal display, the spectrogram can be scrolled up and down (forward and backward in time) by use of signal markers and page up and page down keys.

**SPECTRAL LIMIT TESTING**

The spectral limit testing capability is equivalent to a frequency-domain trigger and allows capture of spectrums that meet pre-defined limits criteria. Every spectral frame is tested at real time rates. Detection of a limit violation is called a spectral event detection. With spectral event detection (Option 10 required for 3052A), the 3052A or 3054 can be programmed to take a variety of actions. For example, a user may trigger on a spectral event, capture a block of sequential frames, then scroll back to examine the contents of the block frame-by-frame.

**REAL TIME OUTPUT**

The Real time Interface (RTI) provides real time application capabilities (Option 10 required for the 3052A). Spectral frame data from this port can be routed directly to other DSP equipment for further processing. Also provided by the RTI is an analog drive for a high-speed oscillographic recorder or an X, Y, Z monitor.

# Digital Signal Processing Systems





### SYSTEM ARCHITECTURE AND SOFTWARE

The system architecture is based upon the VMEbus. Cards comprising the main part of the instrument are "pipelined" to a stage that interfaces with the standard VMEbus. The instrument operates under the SYSTEM V/68™ version of UNIX™. Instrument controls and functions are implemented in C language and card-modular firmware. Programmers have access to selected UNIX and C libraries via an RS-232 port for the development of application programs. Individual spectrums, blocks of spectrums, instrument setups, and keystroke macros can be stored on disk for later recall for display or off-line processing. Stored programs can be executed from the keyboard.

*SYSTEM V/68 is a trademark of Motorola. UNIX is a trademark of AT&T.*

### KEYBOARD AND DISPLAY

The integral keyboard allows quick access to system parameters. Knobs provide easy operation and basic spectrum analyzer control. In addition, a liquid-crystal display presents menus for more extensive functions and prompts the entry of parameters.

The 3050 Series features a high resolution, 16-inch color monitor that displays amplitude-versus-frequency, spectrogram (amplitude vs. frequency and time), phase-versus-frequency, waterfall, and related data. A single display can occupy the full screen for easy viewing of very small variations in the signals, or two displays can be presented on a split screen for convenient comparison.

## 3052A/3054 Comparison

### 3052A

This real time spectrum analysis system is well suited to test and measurement of signals emanating from equipment under test in the laboratory, on the manufacturing line, and in the maintenance depot. For example, the 3052A can be programmed to test wideband signal paths; the ability to detect and measure low-level signals is greatly speeded by the bank of 801 filters. Similarly, phase noise of a high-purity oscillator momentarily perturbed by temperature, shock, or vibrations can be measured in real time. The 3052A is also useful in monitoring spectrums at various points in high-energy machines.

The 3052A has numerous options available to tailor performance and price to a variety of applications.

### 3054

The 3054 has added performance for real time analysis of communications and electronic signals (doppler radar signals, for example). The number of filters in the filter bank is selectable to allow nearly optimum time and frequency resolution in each span to analyze a given signal. It has time resolution to 12.5 ms, which may be used to analyze the frequency-shift-keying of a 1200-baud modem for example. The frame capture memory in the 3054 is longer than that in the 3052A, which permits the duration of blocks of real time spectrums to be longer by eight times.

*See page 307 for ordering information.*

| | 3052A | 3054 |
|---|---|---|
| **Frequency Span** | 1 KHz to 10 MHz<br>100 Hz to 10 MHz<br>with Option 06 | 100 Hz to 10 MHz |
| **Resolution Bandwidth** | Span/800 | Span/800, 400, 200, 100, 50, and 25 |
| **Frame Update Interval** | To 200 µs for spans of 500 KHz and wider | 12.5 µs for spans of 500 KHz and wider and resolution bandwidths of Span/500 and narrower |
| **Duration for Sequential Spectrums** | 100 ms for 200 µs update interval | 800 ms |

*When the value of the Spectral Frame Rate divided by the Resolution Passband is at least 2, the spectral output has a real time sample rate.*

# Digital Signal Processing Systems



## 3052A Characteristics

The following characteristics and features apply to the 3052A DSP System after a 30-minute warm-up period unless otherwise noted. The characteristics provided below apply to instrument operation with the Standard Filter Shape. The terms Bin Width, Resolution Bandwidth, and Shape are used interchangeably for the Standard Filter Shape.

**FREQUENCY RELATED**

**Range –** DC to 10 MHz.

**Span –** Standard: 1 kHz to 10 MHz in a 1, 2, 5 sequence.
Option 06: Add 100 Hz, 200 Hz, 500 Hz spans.

**Resolution Passband (Standard Filter 0.05 dB Bandwidth) –** Displayed bins: 801. Passband: Span/800.

**Bin Width –** For the Standard Filter shape, bin width is the same as passband.

**Center Frequency Tuning Increments –** In the 10 MHz span, the center frequency is fixed at 5 MHz. For spans narrower than 10 MHz, tuning is finer than one bin width.

**Center Frequency (CF) Accuracy –** ±CF reading x $10^{-7}$.

**Marker Readout (Frequency) Accuracy –** ±(0.5 x bin width + CF Accuracy).

**Signal Resolution with Standard Filter –** ≤3 bin widths (also holds for one signal at Reference Level and the other at ≤70 dBc).

**10 MHz Frequency Standard Drift –** ≤1x$10^{-9}$ per day and ≤1x$10^{-7}$ per year.

**AMPLITUDE RELATED**

**Reference Level Range –** +33 to –140 dBm.

**Accuracy –** ±0.2 dB at 12.5 kHz; ±0.53 dB at all frequencies, with error correction.

**Post Filter Gain Range –** 0 dB to 48 dB in 1 dB steps.

**Flatness Across Span –** ±0.85 dB normalized to 12.5 kHz; ±0.33 dB, with error correction. ±1.0 dB when Max Input is set below –32 dBm.

**Resolution Filter Shape –** From bin center, 0.05 dB over ±0.50 bin, –3 dB points at ±0.75 bin, and –80 dB points at ±1.25 bins.

**Marker Resolution –** 0.03 dB at reference level.

**Display Dynamic Range –** 84 dB.

**Sensitivity –**
–150 dBm/Hz ( 7 nV/$\sqrt{\text{Hz}}$ ) at 2 MHz; 1/f noise corner at 100 kHz.

**Aliased Products –** ≤–70 dB for signal amplitude equal to Max Input.

**A/D Converter –** 25.6 Megasamples/second, 10-Bits.

**Max Input Range –** +33 to –57 dBm. (Note: signals above Max Input level are clipped by the A/D converter.)

**Harmonic Distortion (2nd and 3rd order with signal 6 dB below Max Input) –** 65 dBc, DC to 1 MHz; 58 dBc, 1 MHz to 10 MHz.

**IM Distortion (2nd and 3rd order with two signals 6 dB below Max Input) –** 65 dBc, DC to 1 MHz; 60 dBc, 1 MHz to 10 MHz.

**Residual Responses –** For 600 Hz and above, –70 dB below Max Input or –115 dBm, whichever is greater. Residuals below 600 Hz are ≤–100 dBm.

**Zero-Frequency Spur –** 4 dB below Max Input, DC coupled.

**Phase Noise –** –80 dBc in 1 kHz span with 2.5 Hz offset.

**PHASE RELATED**

**Display Range –** +180° to –180° (modulo 360°).

**Resolution –** 0.01°.

**TIME RELATED**

**Input Sampling Rate –**
25.6 Megasamples/second.

**Frame Capture Memory –**
Number of stored Bins: 801.
Spectral Frame Capacity: 1022 spectral frames.

NOTE: Stored spectral frames may be composites of "R" preceding frames processed by Spectral Frame Processing.

**Frame Update Interval –** The following table lists the update intervals for different spans:

| Span | Spectral Frame Interval | Spectral Frame Rate |
|---|---|---|
| 10 MHz | 200 µs | 5 kHz |
| 5 MHz | 200 µs | 5 kHz |
| 2 MHz | 200 µs | 5 kHz |
| 500 kHz | 200 µs | 5 kHz |
| 200 kHz | 1 ms | 1 kHz |
| 100 kHz | 1 ms | 1 kHz |
| 50 kHz | 1 ms | 1 kHz |
| 20 kHz | 5 ms | 200 Hz |
| 10 kHz | 5 ms | 200 Hz |
| 5 kHz | 5 ms | 200 Hz |
| 2 kHz | 25 ms | 40 Hz |
| 1 kHz | 25 ms | 40 Hz |
| **Option 06** | | |
| 500 Hz | 50 ms | 20 Hz |
| 200 Hz | 250 ms | 4 Hz |
| 100 Hz | 250 ms | 4 Hz |

NOTE: Update Intervals are based on real time input processing for the 10 MHz and 5 MHz spans and real time input/output processing on all other spans. When the Spectral Frame Update Interval divided by Resolution Passband results in a value of 2 or greater, the spectral output has a real time sample rate.

**Marker Resolution –** Within one frame update interval.

**SPECTRAL FRAME PROCESSING**

Spectral frame processing is done repetitively using full-rate spectral frames. The processing is done within each bin over a number (R) of frames. Resultant frames, also called processed frames, are forwarded for display and measurement by the user.

**Spectral Frame Processing Modes –** Average, Peak, Min/Max, Rth, and Weighted Filter.

**Block Mode –** All of the spectral frame processing can be applied to the Block Mode in order to increase the time represented by each displayed spectral frame, and the duration of the block.

**Spectral Event Detection (with Option 10) –** Detects events that cause any bin value to exceed or fall below user-defined limits; Log display mode only and limits must be specified in dB.

**INPUT TRIGGERING AND ACQUISITION START/STOP**

**Sources –** Internal, External, Line, Free Run.

**Continuous Mode –** One spectral frame output from the filter bank per trigger event.

**Single Frame –** One spectral frame output from the filter bank per trigger event.

**Start –** After initial trigger, indefinite number of spectral frames are output from the filter bank.

**Positioning –** Trigger sample can be time positioned anywhere in the acquisition window for the first spectral frame.

**Start/Stop –** External control line provides on/off switching of spectral frame output from the filter bank; requires a control signal input to the Trigger Connector.

**INTERNAL FREQUENCY REFERENCE I/O**

**Output –** The internal 10 MHz Standard frequency is available for external reference. Output at TTL levels.

**External Input –** 100 kHz ±20 Hz; 1 MHz ±200 Hz; 5 MHz ±1 kHz; 10 MHz ±2 kHz. Input at TTL levels.

# Digital Signal Processing Systems





**DISPLAY MODES**
**Log Display Mode –** 1, 2, 5, and 10 dB/div; 1 to 15 dB/div selectable in 1 dB steps.

**Linear Display Mode –** Reference level/10.

**FRONT CONNECTORS**
**Analog Signal Input –** Connector: BNC.
Impedance: Selectable, 50 Ω or 1 MΩ.
Coupling: Selectable, AC or DC.
Maximum Rated Input (50 Ω): 5 V RMS (+27 dBm) continuous; 50 V RMS for 10 ms.
Maximum Rated Input (1 MΩ): 500 V DC, 17 V RMS (+25 dBv).

**Triggers –** Time-domain triggering on the input signal.
External: ±5 V range.
Start/Stop: responds to TTL levels.
Gate: responds to TTL levels.
Connectors: BNC.

**REF I/O –** BNC connector. This is an output unless an input signal is selected.

**REAR CONNECTORS**
**RS-232 Ports –** Three.

**AUX DIGITAL I/O –**

Clock: 25.6 MHz.
Data In: Accepts 12-Bit digital signal for application to the Digital Down Converter.
Data Out: Provides 10-Bit digital signal from the Analog to Digital Converter.

**TIME DOMAIN DIGITAL I/O –**

Clock: 25.6 MHz.
Data In: For input to the Parallel Filter Bank.
Data Out: Data from the Digital Down Converter.

**GPIB PORT (Option 02) –** Complies with Tektronix Protocol and IEEE Std. 488.2 talker, listener, and controller functions. Includes GPIB interface cable.

**REAL TIME INTERFACE (Option 10) – Rear-Panel Connectors.**
Real Time Data: Two parallel RS-422 connectors with push-pull TTL levels. 5.12 MHz maximum clock rate. 16-Bit, complex component of spectral data on each connector with event detection included on one of the lines.
Event Detect Output: TTL levels.
Analog Display Output: X, Y, and Z outputs to drive a monitor, an oscilloscope, or an oscillographic recorder.

**PARALLEL PRINTER PORT –** Driver software provides compatibility with Tektronix 469xDX-series color printers. Also ASCII output device compatible with Centronics printers.

**RGB INTERFACE –** BNC connectors (R, G, B) for output to an RGB monitor. Compatible with Tektronix RGB-series color printers.

**SCSI PORT –** Complies with Small Computer System Interface, ANSI X3T9.2 standard.

**ETHERNET PORT –** Opt. 18 Ethernet/LAN enables remote control and data access of the system via an Ethernet network. (NOTE: Also available as a retrofit kit.)

**MONITOR**

**Type –** Bitmapped, raster scan.

**Display Size –** 16 in. diagonal.

**Color –** RGB, 256 concurrent colors.

**Resolution –** 1024 pixels horizontal, 768 lines vertical.

**Scan Rate –** 48 kHz horizontal, 60 Hz non-interlaced vertical.

**Synchronization –** Green.

**Electrical Levels –** RS-343 standard.

**Input Connectors –** Three BNC connectors.

**Controls –** Brightness, contrast, focus, and power.

**ENVIRONMENTAL**
**Temperature –**

Instrument and Monitor Units: 5° to 40° C operating, –40° to 60° C non-operating.
Keyboard Unit: 0° to 50°C operating, –20° to 60° C non-operating.

**Humidity (noncondensing) –**

Instrument Unit: 5% to 95% (±5%) over a temperature range of 10° to 30° C, operating and non-operating.
Monitor Unit: 20% to 80% operating, 5% to 95% non-operating.
Keyboard Unit: 90% operating, 95% non-operating.

**Altitude –** Instrument and Monitor Units: 10,000 ft. operating, 15,000 ft. non-operating.
Keyboard Unit: 20,000 ft. operating, 40,000 ft. non-operating.

**Vibration –** Instrument Unit (except disks): 2 G over 5 to 55 Hz operating and non-operating.
Monitor Unit: 0.83 G over 5 to 50 Hz non-operating.
Keyboard Unit: 2 G operating and non-operating.

**Shock –** Instrument Unit: Operating, 5 G with disks or 10 G without disks; 10 G non-operating.
Monitor Unit: 5 G operating, 30 G non-operating.
Keyboard Unit: 50 G operating and non-operating.

**SAFETY**
**CAN/CSA –** C22.2 No. 231.

**ANSI/ISA –** S82.02 IEC 348 (2nd edition), UL 1244 (2nd edition).

**POWER REQUIREMENTS**
**Line Voltage –** 90 to 132 V AC or 180 to 230 V AC.

**Line Frequency –** 47 to 63 Hz.

**Input Power –** Instrument Unit (keyboard connected): 1000 W maximum operating power; 12 A maximum operating current.

Monitor Unit: 150 W maximum operating power; 2.4 A maximum operating current.

## PHYSICAL CHARACTERISTICS

| Instrument Unit | mm | in. |
|---|---|---|
| Width: | 450.9 | 17.75 |
| Height: | 355.6 | 14.0 |
| Depth: | 635 | 25.0 |
| **Weight** | **kg** | **lb.** |
| Net | 55.34 | 122 |

| Keyboard Unit | mm | in. |
|---|---|---|
| Width: | 426.7 | 16.8 |
| Height: | 98.1 | 7.8 |
| Depth: | 25.4 | 1.0 |
| **Weight** | **kg** | **lb.** |
| Net | 0.91 | 2.0 |

| Monitor Unit | mm | in. |
|---|---|---|
| Width: | 450.9 | 17.75 |
| Height: | 400.0 | 15.75 |
| Depth: | 482.6 | 19.0 |
| **Weight** | **kg** | **lb.** |
| Net | 35.4 | 78.0 |

**WARRANTY**
On-site 90 days parts and labor. The standard system includes Option Q1, which supplements the 90-day warranty with an additional nine months of warranty-like comprehensive support. This support includes remedial hardware service, software subscription service, and access to the DSP Hot Line for technical assistance on service matters.

NOTE: This is only an overview of the 3052A. For complete specifications, ask your local Tektronix Sales Representative for a copy of the 3052A data sheet.

*See page 307 for ordering information.*

# Digital Signal Processing Systems



## 3054 Characteristics

The following characteristics and features are unique to the 3054 DSP System. All other characteristics are the same as for the 3052A.

**FREQUENCY RELATED**

**Span –** 100 Hz to 10 MHz in a 1, 2, 5 sequence.

**RESOLUTION PASSBAND (Standard Filter 0.05 dB Bandwidth) –**

| Displayed Bins | Number of Filters | Passband |
|---|---|---|
| 801 | 1024 | Span÷800 |
| 401 | 512 | Span÷400 |
| 201 | 256 | Span÷200 |
| 101 | 128 | Span÷100 |
| 51 | 64 | Span÷50 |
| 25 | 32 | Span÷25 |

**TIME RELATED**

**Frame Capture Memory –**

| Number of Displayed Bins | Spectral Frame Capacity |
|---|---|
| 801 | 4094 |
| 401 | 4094 |
| 201 | 16,382 |
| 101 | 16,382 |
| 51 | 65,534 |
| 25 | 65,534 |

## Other Characteristics

**GPIB Capability –** Standard in the 3054.

**Real Time Interface –** Standard in the 3054.

**WARRANTY**

On-site 90 days parts and labor. The standard system includes Option W1, which supplements the 90-day warranty with an additional nine months of warranty-like comprehensive support. This support includes remedial hardware service, software subscription service, and access to the DSP Hot Line for technical assistance on service matters.

NOTE: This is only an overview of the 3054. For complete specifications, ask your local Tektronix Sales Representative for a copy of the 3054 data sheet.

*See page 307 for ordering information.*

**FRAME UPDATE INTERVAL**

Spectral frame update interval depends on filter bank length and selected span. The following table is a summary listing of the shortest and longest update intervals for different filter lengths:

| Number of Displayed Bins | Number of Filters | Span | Update Interval (Standard) | Update Interval (Turbo) |
|---|---|---|---|---|
| 801 | 1024 | 10 MHz to 500 kHz | 200 µs | 200 µs |
| | | 100 kHz | 1 ms | 203.13 µs |
| | | 10 kHz | 5 ms | 234.38 µs |
| | | 1 kHz | 25 ms | 781.25 µs |
| | | 100 Hz | 250 ms | 7.8125 ms |
| 401 | 512 | 10 MHz to 500 kHz | 200 µs | 200 µs |
| | | 100 kHz | 1 ms | 203.13 µs |
| | | 10 kHz | 5 ms | 234.38 µs |
| | | 1 kHz | 25 ms | 781.25 µs |
| | | 100 Hz | 250 ms | 7.8125 ms |
| 201 | 256 | 10 MHz to 500 kHz | 200 µs | 200 µs |
| | | 100 kHz | 1 ms | 54.69 µs |
| | | 10 kHz | 1.25 ms | 78.13 µs |
| | | 1 kHz | 6.25 ms | 781.25 µs |
| | | 100 Hz | 62.5 ms | 7.81 ms |
| 101 | 128 | 10 MHz to 500 kHz | 50 µs | 50 µs |
| | | 100 kHz | 250 ms | 54.69 µs |
| | | 10 kHz | 1.25 ms | 78.13 µs |
| | | 1 kHz | 6.25 ms | 781.25 µs |
| | | 100 Hz | 62.5 ms | 7.81 ms |
| 51 | 64 | 10 MHz to 500 kHz | 12.5 µs | 12.5 µs |
| | | 100 kHz | 62.5 ms | 15.63 µs |
| | | 10 kHz | 312.5 ms | 78.13 µs |
| | | 1 kHz | 1.56 ms | 781.25 µs |
| | | 100 Hz | 15.63 ms | 7.81 ms |
| 25 | 32 | 10 MHz to 500 kHz | 212.5 µs | 12.5 µs |
| | | 100 kHz | 62.5 ms | 15.63 µs |
| | | 10 kHz | 312.5 ms | 78.13 µs |
| | | 1 kHz | 1.56 ms | 781.25 µs |
| | | 100 Hz | 15.63 ms | 7.81 ms |

# Digital Signal Processing Systems



## S2MG100 Frequency Enhancement Software

- Fine Frequency Resolution of Carrier
- Enhanced Marker Readouts
- Post-Processing of Single or Multiple Frames

S2MG100 Frequency Enhancement Software operates with the 3052A and 3054 DSP Systems to provide enhanced frequency resolution. It postprocesses data to gain typically a 10-times higher precision over the systems normal capability to measure separated tonal-signal frequencies. A 3-bin measurement method is used to enhance frequency resolution. This software consists of five programs, each one executable from the front panel of the instrument.

## ORDERING INFORMATION

**3052A**
Digital Signal Processing System.....**$99,500**
**Includes:** Operators manual, programmers manual, assembly level service manual, one blank 160 MB tape cartridge.

**Opt. 02** – GPIB interface .....**+$2,995**
**Opt. 06** – Enhanced frequency response .....**+$5,950**
**Opt. 10** – Real time interface .....**+$9,950**
**Opt. 11** – Color printer interface .....**+$1,100**
**Opt. 15** – 170 MB removable system hard disk .....**+$1,100**
**Opt. 16** – 400 MB system hard disk.....**+$2,260**
**Opt. 18** – Ethernet/LAN (not orderable with Opt. 20) .....**+$5,950**
**Opt. 20** – 8 MB CPU.....**+$2,050**
**Opt. 22** – Add 400 MB user hard disk.....**+$3,250**
**Opt. 30** – Add 400 MB removable user hard disk .....**+$4,450**

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. Q0** – Installation.....**+$350**
**Opt. 1N** – Deletes 9-month Supplement.....**–$4,000**
**Opt. Q2** – Two years Warranty-Plus.....**+$6,525**
**Opt. Q3** – Three years Warranty-Plus.....**+$12,825**
**Opt. Q9** – One year software updates.....**+$2,365**

**3054**
Digital Signal Processing System with GPIB Interface, enhanced frequency response, Real time Interface and Color Printer Interface.....**$129,315**
**Includes:** Operators manual, programmers manual, assembly level service manual, one blank 160 MB tape cartridge.

**Opt. 15** – 170 MB removable system hard disk .....**+$1,100**
**Opt. 16** – 400 MB system hard disk.....**+$2,260**
**Opt. 18** – Ethernet/LAN (not orderable with Opt. 20) .....**+$5,950**
**Opt. 20** – 8 MB CPU.....**+$2,050**
**Opt. 22** – Add 400 MB user hard disk.....**+$3,250**
**Opt. 30** – Add 400 MB removable user hard disk .....**+$4,450**

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. Q0** – Installation.....**+$350**
**Opt. 1N** – Deletes 9-month Supplement.....**–$6,415**
**Opt. W1** – One year Warranty-Plus .....**+$6,415**
**Opt. W2** – Two years of Comprehensive Support .....**+$8,550**
**Opt. W3** – Three years of Comprehensive Support .....**+$17,110**

**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1** – Universal Euro 220 V/16A, 50 Hz.....**NC**
**Opt. A2** – UK 240 V/13A, 50 Hz .....**NC**
**Opt. A3** – Australian 240 V/10A, 50 Hz .....**NC**

**S2MG100**
Frequency Enhancement Software .....**$5,000**

For more information, contact your local sales office (listed on the inside back cover).

GPIB IEEE-488

The 3052A Opt. 02 and 3054 comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# RF160
# RF162

# Down Converters

*Intermediate frequency down converters enable real time analysis of IF signals with the 3052A and 3054 DSP System.*

**RF160/RF162**

- RF160 Accepts 160, 110, or 25 MHz Wide-Band IF Signals From Tektronix RF Spectrum Analyzers And Popular Receivers
- RF162 accepts 21.4 and 321.4 MHz Wide-Band IF Signals From Tektronix RF Spectrum Analyzers And Popular Receivers
- Down Converts IF Signals For Modulation Analysis On Tektronix 3050-Series DSP Systems
- Effective Component In Complex Processing Systems

**APPLICATIONS**

- RF and Microwave Signal Monitoring And Analysis
- Manufacturing ATE







## Real Time Spectrum Analysis At RF And Microwave Frequencies

These down converters combine the signal analysis capabilities of the Tektronix 3050-Series DSP Systems with popular receivers and Tektronix Spectrum Analyzers. Housed in a rugged rackmountable module, the Down Converters are designed to mount below the 3050-Family DSP system.

Down Converters take the Intermediate Frequency (IF) output from a receiver or Tektronix Spectrum Analyzer and mix the signal to the analysis range of the companion 3050-Series. Full capabilities of the 3050-Family may be used to analyze the signal (spans limited to 5 MHz and narrower with RF160 and RF162). A microwave signal ranging up to 40 GHz in coax, or 325 GHz using waveguide mixers (Tektronix Spectrum Analyzers only), may be fully examined.

## RF160/RF162

The RF160 and RF162 work directly with the IF output from spectrum analyzers and receivers. The RF160 operates at IF frequencies of 160 and 110 MHz; 25 MHz with Option 25. The RF 162 operates on the military IF frequency of 21.4 MHz; 321.4 MHz with Option 03.

## Microwave Applications

A typical application makes use of the 2784 Opt. 04 Spectrum Analyzer, RF160 Down Converter, and a 3052A DSP System to analyze a microwave signal with a 38 GHz carrier. By tuning the 2784 to the carrier frequency and applying its wideband IF output, the RF 160 down converts the carrier to the analysis range of the 3052A. The 3052A (with Opt. 10) may then be employed to compare the incoming signals against spectral event detection masks, alerting the user to the presence, absence, or changing amplitude of the signal.



*The measurement system shown here measures a microwave carrier signal. The signal is applied to a Tektronix 2784 Opt. 04 Spectrum Analyzer. The IF output of the analyzer is down converted by the RF160, effectively extending the analysis range of the 3052A.*

To order, contact your local sales office (listed on the inside back cover)

# Down Converters

**RF160**
**RF162**



## Characteristics

**INPUT SIGNALS**

**Acceptable IF Frequencies –** RF160: Standard is 160 MHz, 110 MHz; Opt. 25 is 25 MHz. RF162: Standard is 21.4 MHz; Opt. 03 is 321.4 MHz.

**SIGNAL INPUT** (50 Ω Rear Panel Connector)

**Optimum Input Power –** RF160: –30 dBm. RF162: Standard is –36 dBm; Opt. 03 is –30 dBm.

**Maximum Input Level Without Damage –** +20 dBm.

**FREQUENCY RELATED**

**Flatness –** 1 dB p-p across the 5 MHz to 10 MHz output range. Excludes host analyzer flatness.

**AMPLITUDE RELATED**

**Third Order Intermodulation Distortion –** –70 dBc for two input signals at –36 dBm. Specifications exclude host analyzer distortion.

**Harmonic Distortion –** –70 dBc for a single tone at nominal input power.

**Other Single Tone Spurious Responses –** –80 dBc below any single input signal within the nominal input frequency range.

**Residual Responses (5 MHz to 10 MHz with No Input Signal) –** –110 dBm at the output.

**Noise Figure –** Standard: 15 dB. Opt. 25: 9 dB.

**REFERENCE INPUT**

**Rear Panel Connectors –** Two BNC 50 Ω inputs direct coupled to each other and AC coupled to the RF160, or RF162 circuitry. Reference applied to one connector at a time only. Required input power is –10 to +20 dBm, or TTL. Required frequency accuracy is 10 MHz ±2 PPM.

**OUTPUT SIGNALS**

**7.5 MHz IF Output –** 50 Ω BNC connector located on the front panel. Nominal output power is –20 dBm.

**Maximum Reverse Power Without Damage –** +22 dBm.

**POWER REQUIREMENTS**

**Line Frequency –** 60 Hz.

**Line Voltage –** 90 to 132 VAC; 180 to 264 VAC.

**Input Power –** Operating power is 16 W (25 W maximum). Operating current is typically 0.25 A, 0.42 A maximum.

**PHYSICAL CHARACTERISTICS**

| Dimensions | mm | in. |
|---|---|---|
| Width | 425.5 | 16.75 |
| Height | 44.5 | 1.75 |
| Depth | 527 | 20.75 |
| **Weight** | **kg** | **lb.** |
| Net | 4.2 | 9.25 |

**WARRANTY**

One Year parts and labor.

**MAINTENANCE**

**Calibration Period –** 1 year.

**Service Support –** Component Level Repair at Tektronix designated service centers.

## ORDERING INFORMATION

**RF160**
Down Converter (Standard 160, 110 MHz IF Input) ..... **$9,950**
**Includes:** Instruction and Service Manual.
**Opt. 25 –** 25 MHz IF input exclusively ..... **NC**

**RF162 Down Converter –** (Standard 21.4 MHz IF input)
**Includes:** Instruction and Service Manual ..... **$9,950**
**Opt. 03 –** 321.4 MHz IF input ..... **+$1,950**

**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1 –** Universal Euro 220 V/16A, 50 Hz ..... **NC**
**Opt. A2 –** UK 240 V/13A, 50 Hz ..... **NC**
**Opt. A3 –** Australian 240 V/10A, 50 Hz ..... **NC**

To order, contact your local sales office (listed on the inside back cover)

# Systems, Controllers, Software

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## The Five S's of Selection

Judge your VXI Vendor not just on today's needs, but also those needs created one, two, or three years after your initial purchase:

**SOURCE**
Depth of product line, both in hardware and software is critical to your long term success.

**SYSTEM ARCHITECTURE**
Any vendor can force you to his locked architecture – Note Tektronix' open architecture offers the best solution.

**SUPPORT**
Not only before, but after the sale! Tektronix' support center is the best.

**SERVICE**
Worldwide, of course.

**SYSTEM INTEGRATION SERVICE**
Your VXI vendor must be able to pitch in when you need it – without constraints or big prices.

# Systems, Controllers, Software



## VXI: An Instrument Standard

VXI ("VME Extensions for Instrumentation") is a recognized standard for card-modular automated electronic instrumentation. It has become the preferred architecture in applications that demand uncompromized throughput and performance in a compact package. Whether testing circuit boards in the factory, avionics subsystems on the flightline, or system-level end-user products, a VXI solution offers high reliability, ease of use, and cost-effectiveness.

### TOWARD OPEN SYSTEMS IN VXI

When configuring a system, the test problem, not the constraints of a particular vendor's VXI product line, must dictate the choice of instruments.

Recognizing that no single manufacturer can fulfill every possible test requirement, Tektronix has chosen to pursue an Open Systems approach. Tektronix is committed to providing customers a broad range of instrument choices and an open architecture that supports multi-vendor system configurations. Tektronix' strict compliance with the VXI Specification, support for a diversity of workstation, PC, and software platforms, and its commitment to supporting open software standards and packages for programming environments ensures compatibility with hundreds of VXI products.

### PERFORMANCE WHERE YOU NEED IT

Tektronix VXI instruments take full advantage of the company's proven expertise in analog and digital signal acquisition, advanced semiconductor processes, and data display. Many Tektronix VXI instruments apply new technologies developed at Tek Labs, the company's renowned research arm.

In addition, certain Tektronix VXI instruments are equipped with architectural enhancements like Fast Data Channel (a unique shared memory protocol) and local pass/fail processing. These supplement the standard VXI capabilities and provide improved throughput without sacrificing compatibility with other VXI products.

**Products Summary/Order Information is on page 334.**

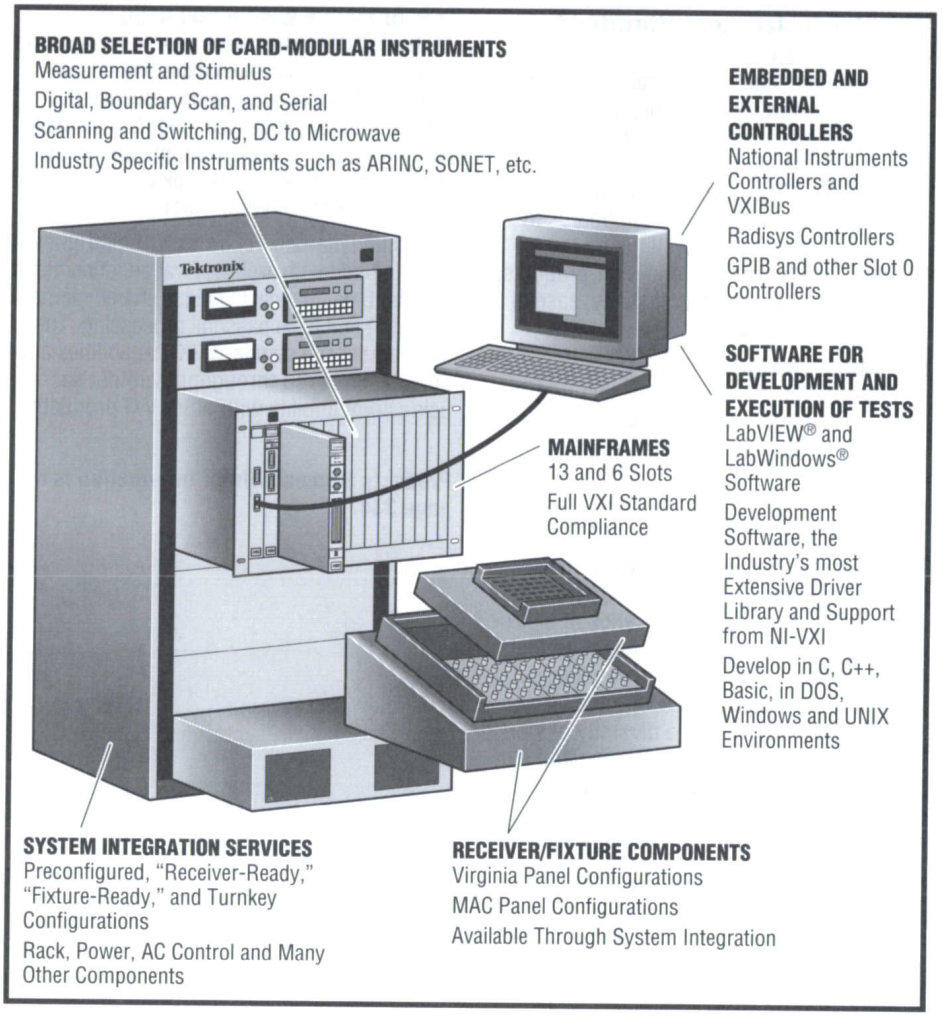
*Tektronix' VXI Architecture is a statement of commitment to openness – your best guarantee that your investment truly has the backing of many instrument and software vendors.*

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

# Systems, Controllers, Software



Tektronix' VXI Architecture is a statement of commitment to openness — your best guarantee that your investment truly has the backing of many instruments and software vendors.




For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

# Systems, Controllers, Software





## Open Systems Architecture

Open systems architecture gives you the means to create an uncompromized system for you 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 perfect software package, and the specific instruments that best suit your application.

Single-supplier, closed architectures limit your choices. With Tektronix' architecture, they're practically unlimited.

### OPEN YOUR OPTIONS

This open measurement environment is an approach to doing business, not a product or a specific group of instruments.

It means that Tektronix goes the extra step to make sure that we are easy to do business with. We have also established strategic partnerships with industry leaders to make sure that you can tap into their products and expertise. As well, Tektronix is deeply involved with industry standards efforts to help make the world of Test and Measurement a truly open environment. It includes a universe of industry standard components from various manufacturers, so the range of options available to you is in fact much, much greater.

### MORE INSTRUMENTS TO CHOOSE FROM

The Tektronix Architecture includes over 100 VXI components including modular instruments, mainframes and controllers. You'll find a broad selection of GPIB instruments as well, giving you what you need to create a high performance solution for almost all applications. You can also include instruments from other manufacturers in your systems. We're working throughout the industry to maintain open standards, ensuring cross-compatibility and ease of integration.

### 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, UNIX workstations 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 and LabWindows.

Component compatibility and connectivity is simplified by the wide variety of hardware and software drivers available for various computer platforms, software packages, and instruments from Tektronix and other manufacturers.

### 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.

### COMBINE INDIVIDUAL COMPONENTS

We've created partnerships with many of the leading technology companies in test and measurement, such as National Instruments, Compaq, RadiSys, and Sun MicroSystems. We're working cooperatively, creating common standards that ensure our components work together.

### WORLD-WIDE SUPPORT NETWORK

Tektronix offers you the resources of a global service-and-support network. Tektronix and its third-party partners can provide the support you need for a successful completion of your systems project. We can help you assess your requirements, planning strategy and help integrate your system. Tektronix service includes calibration and servicing of third-party products, with response time ranging from three-day depot turnaround to four hour on-site service.

# Standard Products and System Integration Services

## Source

Tektronix is committed to VXI. This commitment means that we provide a broad line of all the components you will need to integrate your own system. And not only are the specs of each of these components carefully developed, they are also strongly influenced by our own system engineering efforts – in other words, Tektronix has invested in not just "knowing" the components, Tektronix knows systems as well.

## System Integration Services

Tektronix provides strategic alliances to benefit your test and measurement system configurations.

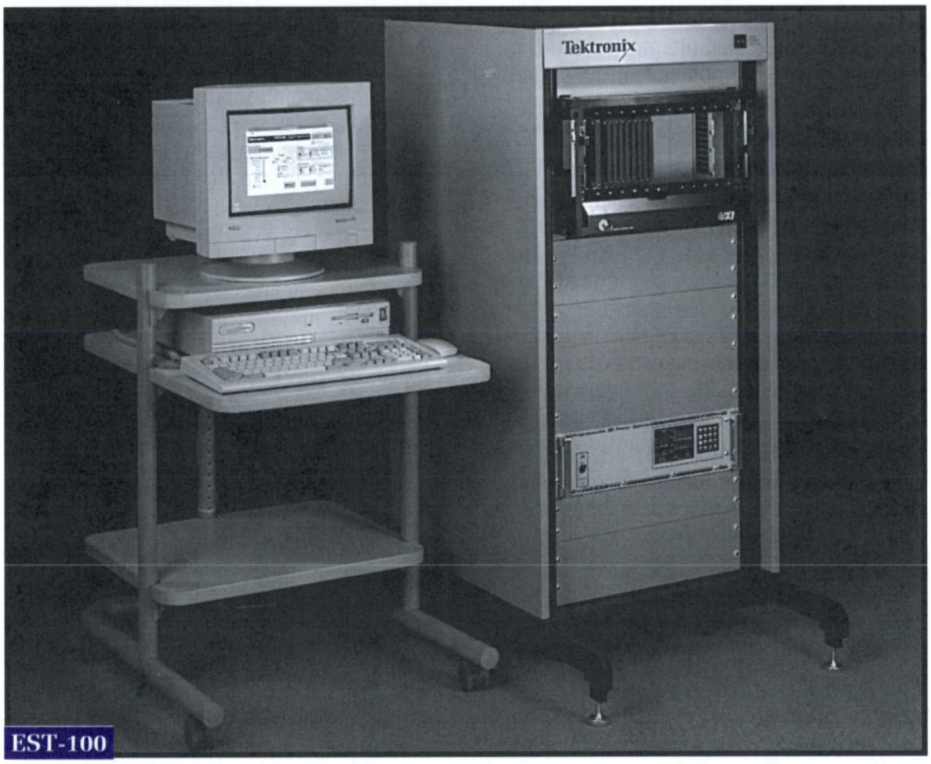
### EXPERIENCE SYSTEM SPECIALISTS

For many test problems, "catalog shopping" is not the right approach. Configuring the system, selecting components, and integrating the test system are 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.

Tektronix will integrate your selection of components to three levels of integration:

- Receiver Ready, or "Racked"
- Fixture Ready
- Turnkey, with test program

Since the job of most test engineers is to create test strategy and test programs – and not to build test systems, Tektronix can provide substantial economic savings. A typical system can require three months of development by several to many people. Tektronix will do this for you at nominal handling and racking charges.




EST-100

Tektronix offers a wealth of alternatives for system integration services. Working with the Tektronix Integration Center or with a Synergy partner, you can create a system exactly matched to your test requirement.

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.



Test Fixture and Interface

### THE SYNERGY PROGRAM

The Synergy program is a strategic partnership between Tektronix and select system integrators, value-added resellers, and independent hardware and software vendors. This relationship combines the "insider" expertise of proven industry specialists with the worldwide service and support resources of Tektronix. Each Synergy partner is verified and endorsed by Tektronix.

When a system is needed to solve your specific Test and Measurement problem, Tektronix can identify a qualified partner who has the capability to provide you with a system that will do the job for you. Generally, you will interface directly with the Synergy partner while Tektronix is available to help identify the proper instrumentation, software platforms, etc. to make your system work to meet your needs optimally.

**Products summary/ordering information is on page 334.**

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

# Software
## Selection Guide



### SELECTION GUIDE

**Tektronix Instruments**

| Model | Description | LabVIEW | LabWindows |
|---|---|---|---|
| 11300 | Digitizing Oscilloscope | | √ |
| 11400 | Digitizing Oscilloscope | √ | √ |
| 11800 | Digitizing Oscilloscope | √ | |
| 2220 | Digitizing Oscilloscope | | √ |
| 2221 | Digitizing Oscilloscope | | √ |
| 2224 | Digitizing Oscilloscope | | √ |
| 2230 | Digitizing Oscilloscope | √ | √ |
| 2232 | Digitizing Oscilloscope | | √ |
| 2252 | Oscilloscope | √ | √ |
| 2430 | Digitizing Oscilloscope | √ | √ |
| 2432 | Digitizing Oscilloscope | √ | √ |
| 2440 | Digitizing Oscilloscope | √ | √ |
| 2465A | Analog Oscilloscope | √ | |
| 390AD | Digitizer | √ | |
| 7612D | Digitizer | √ | |
| 7D20 | Digitizer | √ | |
| 7854 | Digitizer | | √ |
| 7912 | Digitizer | | √ |
| AA 5001 | Distortion Analyzer | √ | √ |
| AFG 5101 | Prob. Arb./Function Generator | √ | √ |
| AFG 5501 | Prob. Arb./Function Generator | √ | |
| CG 5001 | Calibration Generator | √ | |
| CG 551AP | Calibration Generator | √ | |
| CSA 803 | Communications Signal Analyzer | √ | |
| DC 5004 | Counter/Timer | √ | |
| DC 5009 | Counter/Timer | √ | |
| DC 5010 | Counter/Timer | √ | |
| DM 5010 | Digital Multimeter | √ | |
| DM 5110 | Digital Multimeter | √ | |
| DSA 600 | Digitizing Analyzer | √ | √ |
| FG 5010 | Function Generator | √ | √ |
| HFS 9003 | Stimulus System | √ | √ |
| MI/MX 5010 | Multifunction Interface | | √ |
| PS 5004 | Power Supply | √ | √ |
| PS 5010 | Power Supply | √ | √ |
| RTD 710 | Digitizer | √ | √ |
| RTD 720 | Digitizer | √ | |
| SCD 1000 | Digitizer | √ | |
| SCD 5000 | Digitizer | √ | |
| SG 5010 | Oscillator | √ | √ |
| SI 5010 | Scanner | √ | √ |
| TDS 420 | Digitizing Oscilloscope | √ | √ |
| TDS 460 | Digitizing Oscilloscope | √ | √ |
| TDS 520 | Digitizing Oscilloscope | √ | √ |
| TDS 540 | Digitizing Oscilloscope | √ | √ |
| TDS 620 | Digitizing Oscilloscope | √ | √ |
| TDS 640 | Digitizing Oscilloscope | √ | √ |
| TDS 644 | Digitizing Oscilloscope | √ | √ |
| TDS 820 | Digitizing Oscilloscope | | √ |

**Tektronix Instruments**

| Model | Description | LabVIEW | LabWindows |
|---|---|---|---|
| 222 | Hand-Held Digitizing Oscilloscope | √ | √ |
| VX4223 | Universal Counter/Timer | √ | √ |
| VX4234 | Digital Multimeter | √ | √ |
| VX4236 | 6.5-Digit Multimeter | √ | √ |
| VX4240 | Waveform Digitizer/Analyzer | √ | √ |
| VX4250 | Waveform Tester | √ | |
| VX4286 | 32-CH Analog/Digital Input Module | √ | √ |
| VX4332 | 40-CH 2-Wire Reed Relay Scanner Master | √ | √ |
| VX4334 | 24-CH 4-Wire Reed Relay Scanner Master | √ | √ |
| VX4353 | 32-CH SPST Relay Switch | √ | √ |
| VX4355 | 24-CH DPST Relay Switch | √ | √ |
| VX4356 | 20-CH DPDT Relay Switch | √ | √ |
| VX4357 | 32-CH SPDT Relay Switch | √ | √ |
| VX4363 | 32-CH SPST Relay Switch | √ | √ |
| VX4365 | 24-CH DPST Relay Switch | √ | √ |
| VX4366 | 20-CH DPDT Relay Switch | √ | √ |
| VX4367 | 32-CH SPDT Relay Switch | √ | √ |
| VX4372 | 48-CH 2-Wire Reed Relay Scanner Slave | √ | √ |
| VX4374 | 24-CH 4-Wire Reed Relay Scanner Slave | √ | √ |
| VX4385 | Matrix Switch | √ | √ |
| VX4428 | Quad ARINC Transmitter/Receiver | √ | √ |
| VX4491 | Serial Test Module | √ | √ |
| VX4610 | SD/SONET Generator Receiver | √ | √ |
| VX4730 | 12-CH, 16-Bit D/A Converter | √ | √ |
| VX4750 | Function Generator | √ | √ |
| VX4790A | Arbitrary Waveform Generator | √ | √ |
| VX4801 | 40-Line Isolated Digital I/O | √ | √ |
| VX4802 | 80-Line Digital I/O | √ | √ |
| VX4820 | Digital Test Module | √ | √ |
| VXOA41 | Optical Attenuator | √ | √ |

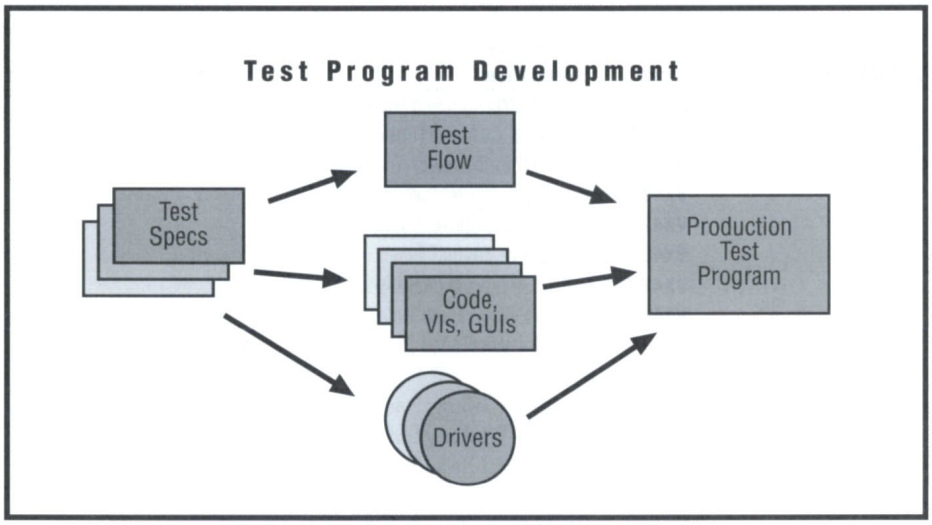
**Tektronix/CDS Instruments**

| Model | Description | LabVIEW | LabWindows |
|---|---|---|---|
| 73A-243 | Arbitrary Waveform Generator | | √ |
| 73A-256 | 12-CH 16-Bit D/A Converter | √ | √ |
| 73A-270 | Arbitrary Pulse Pattern Generator | √ | √ |
| 73A-308 | Relay and High Voltage Logic Driver | √ | √ |
| 73A-332 | 40-CH 2-Wire Reed Relay Scanner Master | √ | √ |
| 73A-334 | 24-CH 4-Wire Reed Relay Scanner Master | √ | √ |
| 73A-342 | Dual Programmable Resistance | √ | √ |
| 73A-353 | 32-CH SPST Relay Switch | √ | √ |
| 73A-355 | 24-CH DPST Relay Switch | √ | √ |
| 73A-356 | 20-CH DPDT Relay Switch | √ | √ |
| 73A-357 | 32-CH SPDT Relay Switch | √ | √ |
| 73A-372 | 48-CH 2-Wire Reed Relay Scanner Slave | √ | √ |
| 73A-374 | 24-CH 4-Wire Reed Relay Scanner Slave | √ | √ |
| 73A-411 | 40-Line Isolated Digital I/O | √ | √ |
| 73A-412 | 80-Line Digital I/O | √ | √ |
| 73A-453 | 1-CH MIL-STD-1553A/B Bus Simulator | √ | √ |
| 73A-455 | 2-CH MIL-STD-1553A/B Bus Simulator | √ | √ |

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

LabWindows®
LabVIEW®

# System Software Solutions




## National Instruments' Software

It takes more than a few pretty pictures to create a high performance test program. It takes a proven development platform, including debugging tools, run time executives, and robust driver library to bring development schedules in on time.

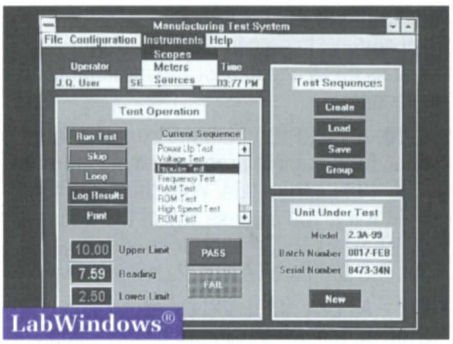
Tektronix provides National Instrument's LabWindows and LabVIEW software packages, operating on a variety of operation systems, as the software in our architecture because both packages offer not only the libraries, tools, and executives needed, but also the sturdiness and robustness needed by Test Engineers who cannot afford to waste time finding and working around bugs in lesser used software.

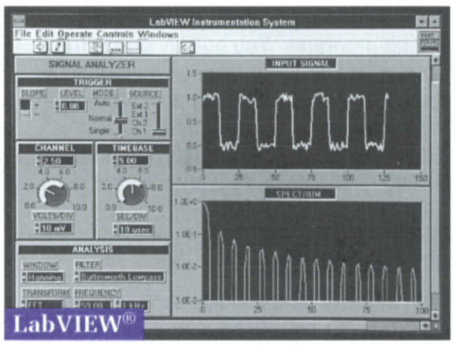
**Products summary/ordering information is on page 334.**

# System Software Solutions

## LabWindows®/CVI for Windows and Solaris






### LabWindows®/CVI for Windows and Solaris

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 IN 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.
- **RS-232 –** The RS-232 Library has functions for performing serial communication using multiple RS-232 ports under interrupt control.
- **Instrument Library –** The Instrument Library over 300 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 on the next page.

#### LabWindows/CVI

- Interactive C Program Development
- Automatic Code Generation
- Acquisition, Control, and Analysis Libraries
- GUI Development Tools
- Instrument Driver Library

#### LabVIEW

- Graphical Programming for Instrumentation
- Modular Program Development
- Acquisition, Control, and Analysis Libraries
- Test Executive
- Instrument Driver Library

*Reduce system development time and improve functionality.*

*Innovative programming without sacrificing performance.*

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# System Software Solutions
## Windows, Windows NT, and Solaris



- **Data Analysis** – The LabWindows/CVI Analysis libraries include over 150 functions for signal processing, filters, windows, statistics, curve-fitting, array manipulations, and matrix algebra.
- **Interprocess Communication** – To communicate with other applications, you can use DDE under Windows and TCP/IP under Solaris.
- **External Libraries** – You can load external object modules, libraries, or dynamic-link libraries (DLLs) into LabWindows/CVI to expand the function.

**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.

### LabVIEW® for Windows, Windows NT, and Solaris

LabVIEW is a graphical programming system for data acquisition and control, data analysis, and data presentation. LabVIEW 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 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 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 offers over 300 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, 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, the block diagram is the actual program, so you avoid the time-consuming task of converting ideas into traditional code.

The LabVIEW 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 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 hierarchy, you can easily ad your own VI's 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 TEST EXECUTIVE TOOLKIT**
The LabVIEW Test Executive Toolkit automates the sequencing of the test programs you develop in LabVIEW. The toolkit comes with a full-function Test Executive that can incorporate you 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 VI LIBRARIES**
The LabVIEW has a complete set of VI Libraries for all of your test and measurement operations.

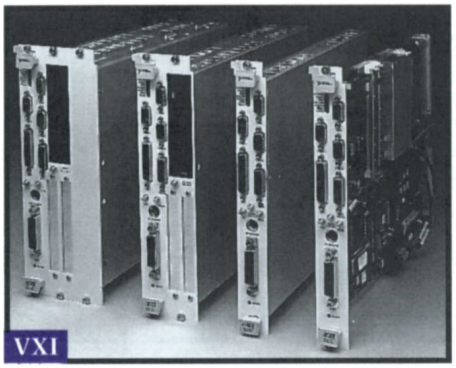
- **GPIB** – The GPIB VI Library contains functions for complete programmatic control of IEEE 488 instruments. With the GPIB 488.2 VI LIbrary, you can use any of the National Instruments IEEE 488.2 Controller boards and the standard NI-488.2 device driver.
- **VXI** – As part of the VXI Development System, 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 300 GPIB, VXI, and RS-232 devices. The drivers consists of intuitive, high-level functions that make it easy for you to control your instruments. A list of the drivers for Tektronix instruments is shown below.
- **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; and TCP/IP under Windows NT, and Solaris.

**Products summary/ordering information is on page 334.**

# Instrument Controllers and Interfaces

VXI
NI
RIC386
EPC7




VXI


RIC386


EPC7

## The Right Choice

Certainly no single architecture will be right for all users. Tektronix provides a wide choice of controllers and interface products. Let us work with you to guide you through the choices and assist you in arriving at the right choices for your situation.

### INSTRUMENT CONTROLLERS AND INTERFACES

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.

### SYSTEM 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 configurable. 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.

### EXTERNAL CONTROLLERS

Tektronix offers a range of external controllers with different price and performance levels and physical formats. For example, the Tektronix RIC386 instrument controller is a PC-compatible controller featuring a built in GPIB port. Its compact rack-mountable enclosure lends itself to system applications.

### EMBEDDED CONTROLLERS

Tektronix offers the widest choice of embedded controllers of any vendor. Again demonstrating "openness" in the industry, Tektronix System architecture supports:

- National Instruments Controllers and MXIbus products
- Radisys EPC2 and EPC7 products

### CONTROLLER INTERFACE PRODUCTS

Tektronix controllers interface to instruments in one of several ways. Among the most common interfaces are GPIB and MXI. Tektronix offers interface cards in each of these formats. The card and its software must be matched with the operating system, and computer bus format which is desired. MXI is often chosen when the system controller is in the workstation class. This combination offers the highest possible performance available in an instrument system.

### SYSTEM SOFTWARE

System software includes several kinds of software packages. Use 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.

## Planning a Test System Configuration

Tektronix wants to help you make the right choices in planning your test system. If you are designing a configuration now, a Tektronix systems specialist is available to discuss your plans. Contact Tektronix at the phone number below to begin defining the solution to your testing problem.

Before selecting a configuration you should be prepared to answer these questions.

- How many systems of this type will be needed?
- How many years will these systems be in use?
- Is the ability to upgrade and expand important?
  - When?
  - By how much?
- What are the mandatory functions and requirements of the system?
  - Now?
  - In the future?
- What information must be provided by the system to whom?
  - How often?
  - How fast?
- What information must be provided to the system by whom?
  - How often?
  - How fast?
- What skill levels are available to develop, operate, troubleshoot, and maintain these systems?
- What types of instruments will be used?

**Products summary/order information is on page 334.**

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

# EPC-2 EPC-7 73A-151B VXIpc-486 Embedded Controllers

## Slot-0 Series

### Resource Manager

The Resource Manager is a message based instrument (commander) located at logical address 0. Following a five second delay after power-on or system reset (to allow individual modules to perform required setups and self test), the Resource Manager performs these functions:

- Identifies all VXIbus devices (plus any 73A-852 Adapters) in the system and performs dynamic configuration.
- Manages system self test and diagnostic sequences.
- Configures A24 and A32 address maps.
- Configures system commander/servant hierarchies.
- Builds a configuration table (slot location using the MODID lines, Manufacturer ID, Model Code, etc.).
- Initiates normal operation.
- Identifies VXIbus Commanders to allow devices to use signaling rather than interrupts for sending events and responses to the 73A-151B.

The Resource Manager also provides the following system services:

- System hierarchy information.
- Programmable module reset.
- System diagnostics.
- Programmable modification of system hierarchies.
- Programmable assignment of interrupt handlers and interrupters.

**SLOT 0 FUNCTIONS**

The Slot 0 functions required by the VXIbus Specification are supplied, including CLK10 (A 10 MHz differential ECL clock driver for the backplane) and transceivers for the MODID lines.

**IEEE-488 INTERFACE DEVICE**

The IEEE-488 Interface Device is a message based commander that converts IEEE-488 protocol to VXIbus instrument protocol. The Interface allows the Resource Manager to assign each module a unique 488 primary address (multiple primary addressing), or to give the overall system a single 488 address and assign each IAC module a unique secondary address (single primary with multiple secondary addresses).

The Interface Device also includes a built-in IEEE-488 Bus Analyzer that allows the user to single step and display each character of an IEEE-488 data transfer on the Module's front panel hexadecimal display. This feature allows single stepping of the IEEE-488 bus even if the instrument addressed is not in the VXIbus Card Cage.

**FAST HANDSHAKE MODE**

The 73A-151B Module supports the Fast Handshake mode of data transfer. In this mode, a module must accept data or commands within a 20 microsecond window defined by the VXIbus Specification. Fast Handshake Mode is designed to facilitate communication with high speed IAC modules using the minimum amount of VXIbus backplane overhead.

**BITE**

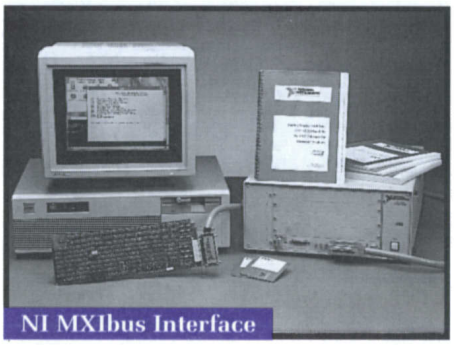
The 73A-151B executes self test at power-up, when a hard reset occurs, or upon command. Errors reported include invalid command received, failed internal self test, bus errors, failed self test in one or more modules, and assertion of SYSFAIL*. Internal self test includes on-board memory and peripherals. LED indicators are used to indicate Power, assertion of the VMEbus signal SYSFAIL*, backplane cycles, VMEbus activity, and IEEE-488 bus activity, including talker, listener, SRQ, attention, and remote enable. In addition, two hexadecimal displays provide a readout of IEEE-488 bus data when in single step mode.

**VXIpc-486 SERIES EMBEDDED CONTROLLERS**

- Complete 486 PC/AT functionality:
  - Model 566 – 66 MHz 486DX2
  - Model 500 – 50 MHz 486DX2
  - Model 200 – 20 MHz 486DX2
- Up to 32 M RAM, 1.2 GB hard disk.
- Industry standard ISA slots for plug-in PC expansion board.
- Complete Slot 0 VXI Resource Manager.
- Supports multi-frame VXI-MXI systems.
- Complete NI-VXI bus interface software:
  - DOS, Windows, Windows NT, LynxOS, or UNIX.
- Built-in IEEE-488.2 compatible AT-GPIB port:
  - Industry standard software
- Advanced TIC (trigger interface controller) ASIC.

**GPIB-VXI/C SLOT 0 MODULE**

- GPIB-controlled VXI Slot 0 Resource Manager.



NI MXIbus Interface

**NI MXIbus INTERFACE**

- Translates GPIB protocols to/from VXI protocols:
  - Control message-based VXI instruments with IEEE-488 controllers and software.
- Extensive built-in local command set accessible from GPIB or RS-232 port:
  - Access Resource Manager and Slot 0 operations
  - Read and write system memory
  - Control Register-Based and VME devices
  - Control VXI TTL and ECL trigger lines.
- High performance GPIB operation:
  - NAT4882 and Turbo 488 ASICs
- Enhanced trigger capability: – CustomTIC ASIC
- High reliability: – MTBF over 55,000 hours.

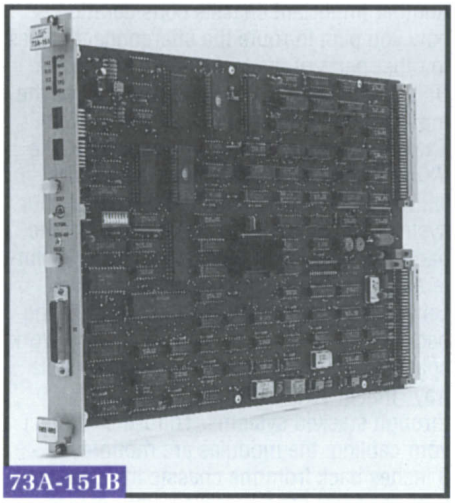
**MXIbus INTERFACE KITS**

- Interfaces external computers directly to VXIbus:
  - Embedded VXI performance
  - External computer flexibility
- Locate your computer directly next to VXI mainframe or up to 20 m away.
- Complete Slot 0 Resource Manager capability.
- Easily multiple mainframes.
- Wide variety of platforms:
  - PC/AT, EISA (DOS, Windows, Windows NT, UNIX)
  - PS/2 (DOS, Windows, OS/2)
  - Macintosh
  - Sun SPARCstation
  - IBM RISC System/6000
  - DECstation 5000.
- Complete NI-VXI Bus Interface Software:
  - Software compatible across platforms
  - software compatible with embedded VXIpc-486 Series.

# Embedded Controllers
## Slot-0 Series

**73A-151B** **VX4521** **EPC-2** **EPC-7**





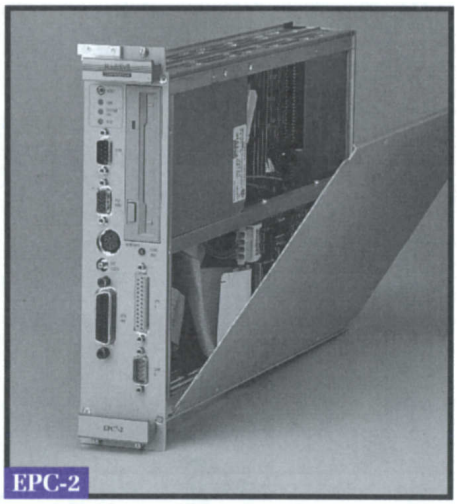

### 73A-151B Enhanced Slot Module

- VXIbus Slot ) module with resource manager and high speed IEEE-488 port.
- Controls Version 1.2 and/or Version 1.3 VXIbus instruments.
- Extensive command set to allow comprehensive control over VXIbus System.
- In-depth system and module status and error reporting.
- Built-in IEEE-488 bus and analyze.
- GSA item.




### VX4521

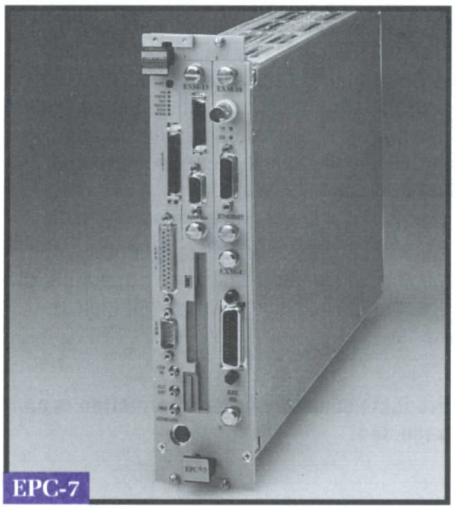
- Fast through-put Slot 0 that accommodates both Version 1.2 and 1.3 instruments and devices.
- Provides complete Slot 0 functions.
- Sophisticated triggering and control.
- VXIbus Communications include Word Serial Protocol, Fast Handshake, and VME Read & Write.
- IEEE-488.2 Talker/Listener.




### EPC-2 System Controller

- MS-DOS compatible 386 based CPU.
- Available with a range of options.
- Complete Slot 0 device.
- Controls Version 1.2 and 1.3 VXIbus instruments.
- Ethernet available.

**Products summary/order information is on page 334.**



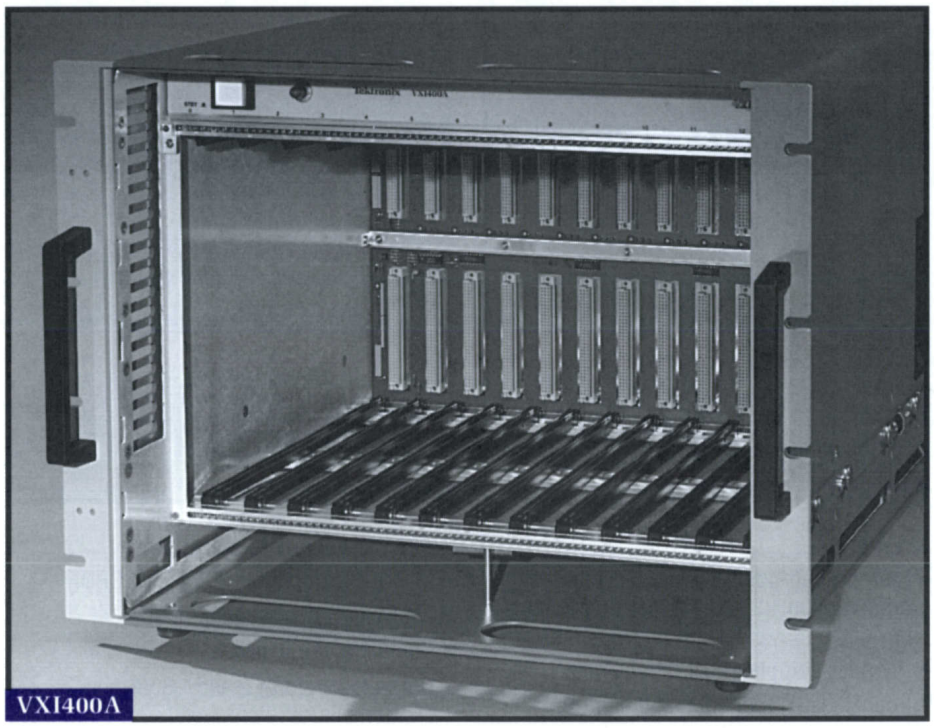

### EPC-7 VXIbus 'C' SIZE 486 EMBEDDED CONTROLLER

- MS-DOS compatible 486 based CPU.
- Available with a wide range of options.
- Complete Slot 0 device.
- Controls version 1.2 and 1.3 VXIbus instruments.
- Optional expansion modulated offer application specific configurations.

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

# VX1400A
# VX1401
# VX1405

# Mainframes


VXI400A

## Mainframes

The mainframe is probably the most overlooked component in a VXIbus system. All VXIbus users understand it is the "home" that the instruments reside in and that it supplies the power for the instruments. When you select a mainframe for your VXIbus system there are several capabilities and features you should consider to maximize your total system efficiency.

The mainframe should be the last component of a VXIbus system selected. When designing a VXIbus test system, the designer must first define the tests or functions the system is required to perform. The next step is to select instruments that can perform the tests or functions as defined. The selection of the slot 0 device controller comes next. Then last but far from least, select the mainframe to house the system.

The major sub-elements of a VXIbus mainframe are the chassis itself, the backplane, the power supplies and the cooling system. The test system designer needs to consider each element in order to select a mainframe that maximizes system efficiency.

### CHASSIS

From your instrument and slot 0 selection you can easily determine the chassis size and number of slots required to house your defined test system. The possibility of system growth and requirement changes should be considered early in the mainframe selection process. Will new functions be added in the future that require more slots? Will functions be added that require higher performance and larger card sizes? Another point to consider is that with larger chassis sizes you can always adapt to smaller card sizes but cannot adapt upward from a smaller size chassis to larger card sizes without another chassis. Tektronix has the chassis sizes most often specified and adapters to allow you to include "A" and "B" size VXI or VME cards in your system.

Another important chassis consideration is how you plan to route the interconnect cables to other parts of the test system and to the Unit Under Test (UUT). Cables tend to be the most fragile part of the overall test system. The most popular Tektronix card cages, the VXI400A and the VXI401 have cable trays allowing cables to be run to the back of your system. Running inter-system cables to the back of your system presents a clean, uncluttered test set that is less prone to broken cable problems and moves the cables to the back of your test bench away from your work space. Another feature is the "vertical cable tray" that allows cables to run vertically through stacked systems. To further protect your cabling, the modules are mounted 3 inches back from the chassis front panel. With the front panel installed, your cables are not exposed to physical contact and abuse during operation.

Is your system going to be rack mounted or used in a bench top configuration? Tektronix mainframes give you the option of rack mounting rails for mounting in standard 19 inch racks or trim strips for a clean appearance when used on a bench top.

Tektronix also offers a compact "C" size mainframe. The VXI405 is a 5 slot "C" size mainframe that is highly portable for those configurations that require the test system to be frequently moved from one test site to another.

Other chassis considerations are ease of use and maintenance. The VXI401 allows easy removal of the air filter from the side of the chassis for periodic preventive maintenance. The normal system configuration is not disturbed allowing the system to be brought back on line rapidly.

The front panel of the VX1401 is hinged for quick access to the installed modules and it has a Lexan window that allows operators to observe the activity of instrument indicator lights.

**Products summary/order information is on page 334.**

# Mainframes Summary

**VX1400A**
**VX1401**
**VX1405**



### BACKPLANE

The backplane of your system must meet the VXIbus specification to insure complete compatibility with all VXIbus manufacturer's modules. Backplanes in Tektronix mainframes exceed the VXIbus specification. All required VME terminations are built in to insure signal integrity and reliability. Tektronix uses positive lock jumpers for bypassing empty slots. Mechanical switches can fail or be accidentally bumped causing expensive system troubleshooting and down time. The positive lock jumper system insures your configuration of the IACK and BUS GRANT lines remain the way you intended them to be.

### POWER

Is your system going to be used world wide or on AC power from sources other than standard "wall current?" Tektronix mainframes operate on AC power from 100 to 130 VAC or 200 to 250 VAC and line frequencies of 47 to 63 Hz. The VX1401 will operate at line frequencies as high as 440 Hz which is useful for airborne applications.

To determine the total current requirements for each voltage required in the system, use the configuration worksheet in this catalog. Add the current for each voltage and match the requirements to the mainframe specifications to insure required power is available. Good engineering practice dictates VXIbus power supplies should be loaded to approximately 50% of capacity to insure power supply noise is within VXIbus specifications. The VXIbus specification requires manufactures to test power supply noise at a 50% loading factor.

| | Module Size | Number Slots | Total Power | Total Cooling | Cooling Per Slot |
|---|---|---|---|---|---|
| VX1400A | C | 13 | 1000 watts | 702 watts | 55 watts |
| VX1401 | C | 13 | 700 watts | 520 watts | 54 watts |
| VX1405 | C | 5 | 426 watts | 450 watts | 45 watts |

Tektronix offers two 13-slot "C" size mainframes with different total power output. For systems requiring maximum power the VX1400A could be the answer. Total system power available in the VX1400A is up to 1000 watts. For systems with lower total power requirements look at the VX1401. The VX1401 has a total of up to 700 watts which should exceed the requirements of most test systems. Whether your application requires heavy duty or standard power supplies, Tektronix has the VXI mainframe for you.

### COOLING

Several factors should be considered when determining the total system cooling requirements. One factor is the ambient temperature of the environment the system will be used in. The other factor is based on the amount of air the cooling system can move through each slot of the mainframe. Mainframe specifications rate these factors in a cooling curve. Module specifications will give you the back pressure of the module and the airflow required to keep the total temperature rise (over ambient temperature) under the maximum specified operating temperature. Bear in mind not all module power is dissipated in the chassis.

An example would be instruments supplying stimulus to a UUT. The power of the stimulus signal would be dissipated in the UUT. Tektronix mainframes offer exceptional cooling specifications to meet most system requirements.

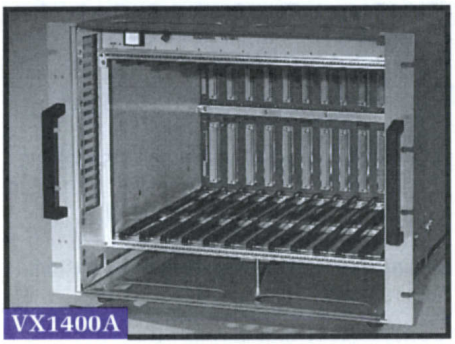
For systems operating in environments where acoustic noise might be a factor, Tektronix offers mainframes with variable speed fans. Fan speed in the VX1400A is determined automatically by the internal air temperature in the mainframe providing for efficient removal of heat without objectionable noise levels. A feature of the VX1405 allows the user to select either variable fan speed as a function of temperature or force the fans to run at full or half speed.

**Products summary/ordering information is on page 334.**

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

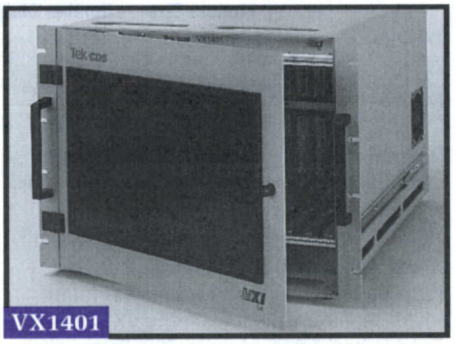
# VX1400A
# VX1401
# VX1405

# Mainframes Summary



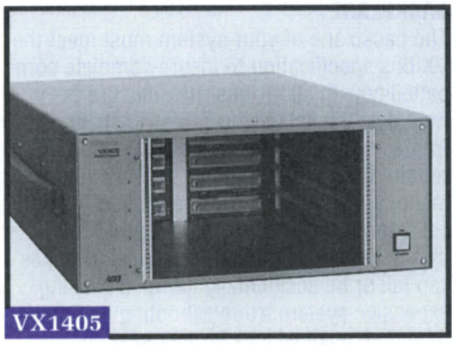

## VX1400A "C Size Mainframe

- Built-in cable trays
- Up to 1000 Watts of available DC power
- Runs on 115 or 220 V AC from 47 to 63 Hz
- Variable speed, low noise fans
- 55 Watts per slot cooling
- Accommodates "A" and "B" VXIbus modules with adapters




## VX1401 VXIbus Card Cage

- Low cost, high performance "C" size chassis
- 700 Watt power supply
- 54 Watt cooling capacity per slot to +55°C
- Rugged mechanical housing
- Quiet fans (56 dBA @ 25°C)




## VX1405 "C" Size MainFrame

- 5-slot "C" size VXI mainframe operates in either vertical or horizontal orientation
- Carrying handle for portability or may be optionally rackmounted
- Prototype access panel
- Low noise fans provide up to 45 Watts of cooling per slot
- Fan speed is user selectable or a function of temperature
- GSA item

**Products summary/order information is on page 334.**

# Digital Test Instruments

**73A-270 VX4801 VX4802 VX4820**



## Digital

Tektronix digital test instruments are found in modern test applications ranging from manufacturing process control to aerospace and telecommunications. Like all of our instruments, they are designed to provide the maximum of instrument reliability and maximum flexibility in test system design.

Digital signal testing comes in several different forms such as parallel stimulus and response, serial and high speed I/O. Many process control applications require the application of a parallel pattern and the readback of a digital response pattern. Some aerospace applications require stimulus with real time response capability. Other applications call for the generation of serial test patterns.

### STIMULUS AND RESPONSE

The extensive array of programmable features of these instruments makes them flexible and easy to use. For example, with the VX4801 or VX4802 Programmable Digital I/O Module, each of the 8-Bit bytes can be independently configured under full program control to be either input or output. In addition to selection of any byte as either input or output, the VX4801 and VX4802 also provide definition of masks for input and output data, and the ability to define logic sense of input, output and handshake lines. User-defined masks can be overlaid on the data prior to output. Masks may also be applied to individual input bytes before they are returned to the system controller to improve data post-processing speed and ease of data interpretation. The data output can be controlled as bits, as individual bytes, and as groups of bytes. All I/O lines are both TTL and CMOS compatible, with up to 24 ma of sink current provided for each output. External (handshake) control signals are available for output and input data control.

In addition, for the VX4801, the I/O section of the module is fully isolated from system ground using opto-isolators and an isolated power supply contained on the module. The VX4801 is especially useful in applications which require isolation between the UUT and the test equipment. This is often the case when the possibility exists of a ground loop between the UUT and the test station ground. This can occur when the UUT has its own floating power source, as is often the case in spacecraft components or sub-assemblies.

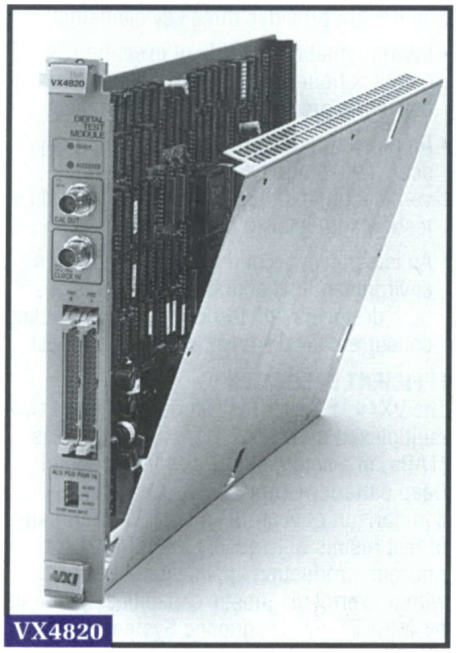
### SERIAL

Both channels of the 73A-270 Serial Pulse/Pattern Generator Module can be individually programmed, and each channel contains a 1600-word by six-decimal digit high-speed memory. Since the module allows programming of 1600 duration values (not just 1600 1's and 0's), very complex pulse trains of very long duration may be programmed. After initial programming, these duration values may be updated while the 73A-720 is transmitting. The 73A-270's ability to output short pulses repeatedly, or short pulses delayed by long intervals, make it ideal for triggering other VXIbus instruments, using either front panel connectors or the VXIbus backplane TTLTRG lines 0 through 7.

Reading serial patterns can be accomplished with measurement instruments such as digitizing counters like the 73A-541. The 73A-541 is a two channel digitizing counter with time tagging ability that allows analyzing each transition of the signal by absolute time. The 732A-541 measures signals up to 10 MHz, making it the perfect companion to the 73A-270 Serial Pattern Generator.

### HIGH SPEED I/O

In many applications the digital pattern you are testing is like a parallel communication link. You must be able to send and read on the same pins at a fairly fast rate. The VX4820 Digital Test Module provides digital stimulus and real time response compare for up to 64 I/O pins per module and up to 12 modules (768 pins) can be accommodated in a single mainframe. Each pin of the VX4820 Digital Test Module can be programmed for drive HI, drive LO, compare HI, compare LO, drive HI and compare HI, drive LO and compare LO, inhibit ( high impedance). These are programmable for each test vector to support testing of bi-directional bus structures and multi-master systems.



VX4820

### VXI ADVANTAGE

The VXI modular architecture makes it easy to design and maintain an application-specific test system. You can choose only the features you need, instead of paying for capabilities that are not required. And when the time comes to expand or modify your system, the modular structure makes it easy to incorporate new capability without having to do a complete redesign or scrap existing components.

All of the Tektronix digital instruments are message-based to insure compatibility with the widest range of systems controllers and to ease the programmer's task. The ease of programming message-based instruments also shortens the time required for system expansion or modification. Many of these instruments allow you to save and recall several different test program setups for different applications. This reduces operating costs, since upgrading programming is quicker and easier, and operator skill requirements are less restrictive.

Whatever your application calls for, Tektronix has the solution for your digital instrument requirements. For more information on how these instruments can solve your application needs, consult your Tektronix representative or call our factory application specialists.

**Products summary/order information is on page 334.**

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

**VX4491**
**ASSET™VXI**

# Boundary Scan
## IEEE 1149.1

*Boundary scan restores testability access in today's complex digital designs.*

*ASSET™ VXI software tools allow engineers to efficiently control and observe scan activity, recovering the full benefit of including boundary scan.*

*VXI provides a platform suitable for both development and production, maximizing team collaboration and success.*

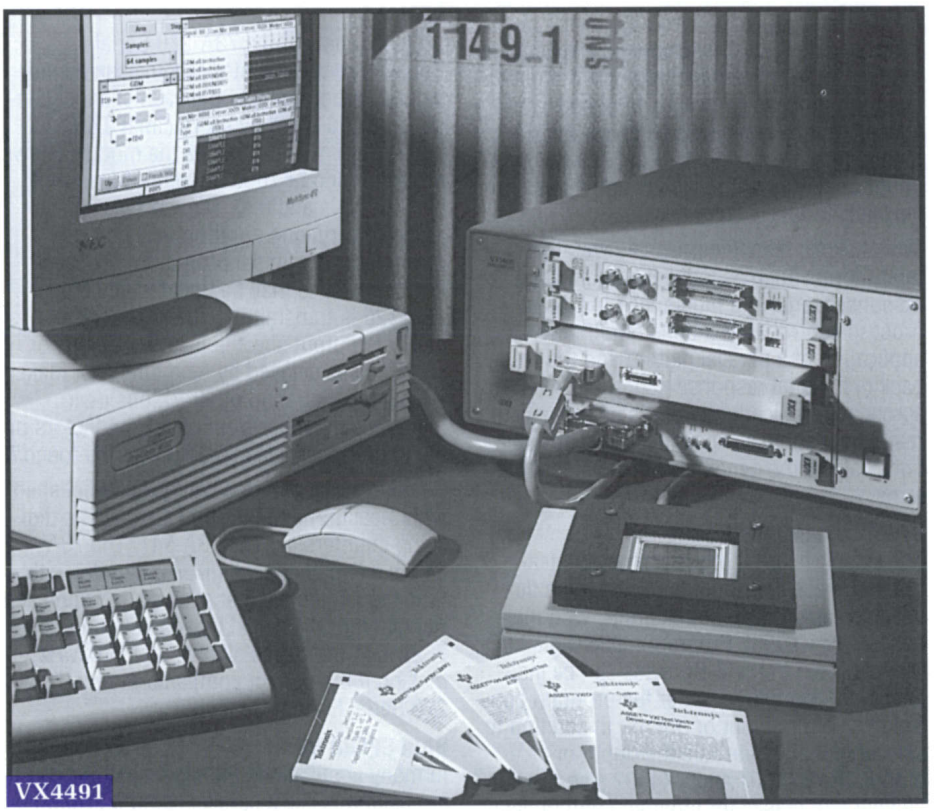
For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

### ASSET™ VXI BOUNDARY SCAN DIAGNOSTIC SYSTEM

- Automatic Generation of Interconnect Tests With Fault Diagnostics
- Interactive Control and Observation With Debugger and Scan Analyzer
- Macros and C++ Scan Function Library Enable Development of Complex Tests
- Compatible With TI's ASSET™ and Teradyne's VICTORY™ Software Through SVF File Format

### VX4491 SERIAL TEST MODULE

- Two IEEE 1149.1 Ports Supporting TCK Rates to 25 MHz
- Optional 16 MB Memory Stores Up to 128 Mbits of Scan Chain Information
- Built-in Force, Compare, Mask and Response for Real Time Pass/Fail Testing
- Tandem Serial/Parallel Patterns With VX4820 Digital Test Module




The Tektronix Integra-series of embedded test products provide a solution that makes boundary scan testing effective and economical. Integra provides three key elements:

- Instrumentation capable of executing complex boundary scan tests efficiently, delivering production-test performance.
- An open architecture VXI-based boundary scan test solution suitable for design verification, test development, production testing and detailed diagnostics.
- An integrated, second-generation software environment that addresses the needs of both designers and test engineers, promoting concurrent development of design and test.

### EFFICIENT EXECUTION

The VX4491 Serial Test Module provides two multiplexed IEEE 1149.1 Test Access Ports (TAPs) in a single-slot C-size VXI module. Deep pattern memory, built-in real time comparison of vectors and on-board storage of test results fully qualify the VX4491 for rigorous production applications. Coupled with powerful diagnostic capabilities provided by ASSET™ VXI Diagnostic System, the VX4491 is also the right vehicle for design verification and repair station applications.

### DEEP PATTERN MEMORY

Boundary-scan applications often involve large serial vector files so deep pattern memory is essential for maintaining throughput and fault coverage. The VX4491 contains 1 MB of pattern memory with Option 10 increasing this to 16 MB, storage for over 100 MB of scan chain information.

Pattern memory can also be partitioned to store multiple tests. Up to twenty separate tests can be stored and executed in any order, reducing host interaction and providing rapid test sequencing.

### PASS/FAIL TESTING

The VX4491 pattern memory can include expected results and mask data for performing real time comparison within the module. Results are available immediately following a test rather than requiring transfer and analysis by host computer, simplifying host software and minimizing test time.

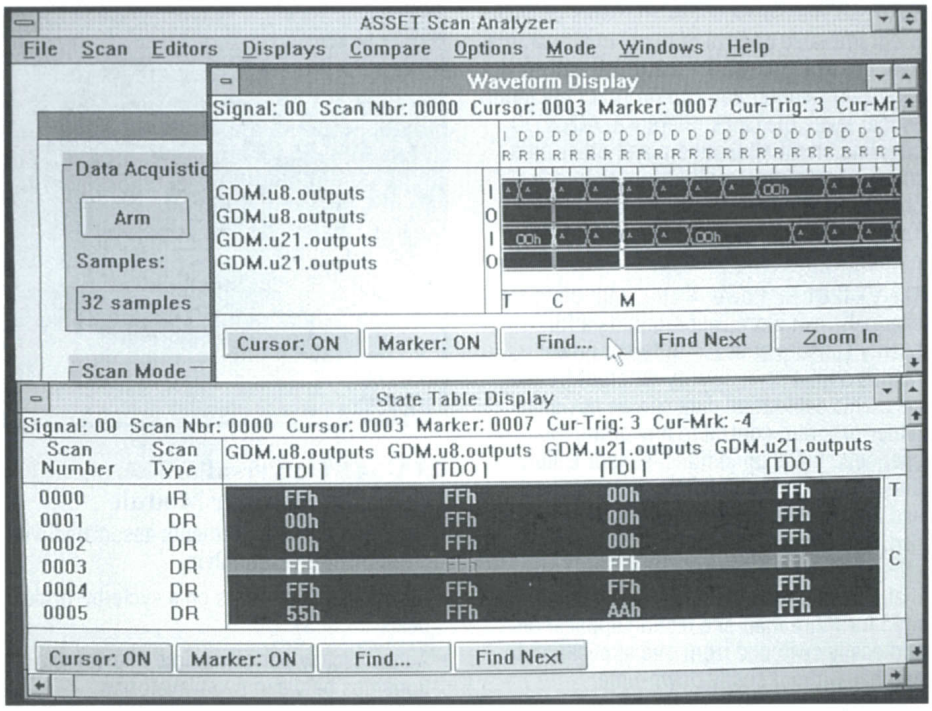
### OPEN VXI-ARCHITECTURE ENSURES PERFORMANCE

The VX4491 provides an open-architecture VXI-based solution that can easily be integrated with other VXI elements to address a multitude of testing requirements. For example, the VX4820 Digital Test Module can be included with the VX4491 to provide parallel vectors in tandem with serial test activity. VXI backplane triggers synchronize activity between modules for efficient operation.

# Boundary Scan








### HIGH LEVEL SOFTWARE TOOLS

Boundary scan testing is software intensive. Without high level tools a user is forced to manipulate and interpret varying segments of binary data, much like programming in machine language.

Tektronix offers a full range of software packages to address the needs of engineers seeking to utilize the testability access provided by boundary scan. The packages are built on common formats and standards that allow full interplay between tools maximizing the exchange of information and reuse of work.

### SERIAL TOOLBOX SOFTWARE

The Serial Toolbox software package is included with each VX4491 providing an execution environment for tests primarily furnished in Serial Vector Format (SVF). SVF is an emerging standard supported by Tektronix ASSET™ VXI, TI's ASSET™ 2.0 and Teradyne's VICTORY™ family.

### ASSET™ VXI SOFTWARE FAMILY

ASSET™ VXI surrounds the VX4491 Serial Test Module with a family of software applications that address test generation, vector translation and interactive control and observation through the boundary scan TAP.

### ASSET™ VXI TEST VECTOR DEVELOPMENT SYSTEM

This package provides core functionality including vector development and application of the vector set to the UUT. Translators are also provided to facilitate migration of simulation vectors to the test environment.

### ASSET™ VXI DIAGNOSTIC SYSTEM

ASSET™ VXI Diagnostic System presents a hierarchical approach to managing boundary scan activity at the chip, module or system level. The user graphically interacts with boundary scan using mnemonic instructions and graphical displays rather than specifying TAP states and tediously counting TCK's. User's control and observe scannable signals at the bit, register, pin or bus level.

### ASSET™ INTERCONNECT TEST PRODUCT (AIT)

AIT automatically generates interconnect tests for boundary scan nets. This is the Virtual Interconnect Test (VIT) portion of Teradyne's VICTORY™ software. AIT produces fault reports to the net/pin name. Further diagnostics may be conducted by using the Diagnostic System to single-step tests and display results.

### ASSET™ SCAN FUNCTION LIBRARY

This library provides an interface between ASSET™ VXI and C++ compilers permitting more complex applications to be developed. Applications can leverage ASSET™ VXI's hierarchical/ mnemonic approach to scan and incorporate additional function libraries to control other test equipment.

### SOFTWARE ENVIRONMENT

All ASSET VXI applications and Serial Toolbox run under Windows 3.1 on 100% DOS-compatible embedded controllers and external PC controllers.

**Products summary/order information is on page 334.**

# 73A-541 VX4281 VX4223 VX4236 VX4240 Measurement Instruments

## Measurement

Measurement is one of the most important functions of an automated test system. Tektronix offers a complete line of measurement instruments, including waveform digitizers, waveform analyzers, digital multimeters. power meters, and digitizing counters. These instruments are widely used in applications in the aviation industry, the automotive industry, manufacturing process control, telecommunications and others.

In a typical measurement cycle, stimulus condition is set and the measurement is initiated. The data is collected, stored, and analyzed, and the results presented for final decision. A given application may require a number of different signals to be measured, stored, and analyzed. By combining multiple instruments in a single chassis, your test system can be configured to provide exactly the capability you require, with the flexibility which results from an integrated modular system of programmable instruments.

### CAPTURE

Depending on the particular instrument, data capture can be initiated with software command or be hardware triggered. Most Tektronix VXIbus instruments offer exceptional flexibility in triggering options.

Hardware triggering can originate from other VXIbus instruments, the UUT or the system controller.

After the data is collected, it is stored in on-board memory where it is available as raw data or it can be reduced through built in data analysis routines that are standard features of many of the measurement instruments.

Tektronix measurement instruments provide programmable control of many input parameters. For example, on the 73A-541 Universal Digitizing Counter you can program the input trigger level, the clock reference, AC or DC coupling, input attenuation, and other parameters. Instruments with more than one channel, such as the VX4250 Waveform Tester, allow completely independent programming of each channel.

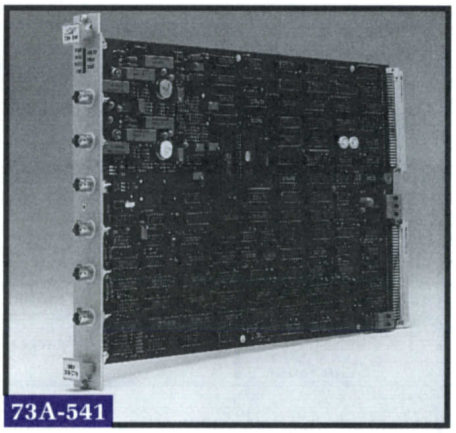
The VX4281 RF Power Meter, with up to four channels, can store calibration data for twenty sensors at seven different power ranges and at up to twenty different frequencies. This calibration data can be assigned under program control to any of the four channels. Initial conditions, sensor calibration data, trigger conditions, delay values, and other operating parameters can be specified, and one or more of these setup configurations saved for repeated use. This means that a single instrument can easily be configured for more than one testing application, and easily switched from one application to another without costly down-time.

### STORAGE

Captured data can be stored in on-card memory, where it is readily available in raw format after a test sequence. The VX4236 Digital Multimeter provides internal data storage for up to 1000 readings.

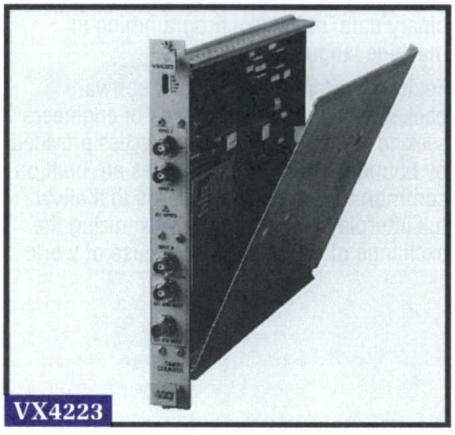
The VX4240 Waveform Analyzer can have on-card memory for up to 1 million measurements. On-card data storage further extends the system flexibility by minimizing timing constraints.

Programmable format of the stored data also increases system flexibility. The VX4286 Digital Input/Analog Comparator allows you to select the format for returned data. For example, data may be formatted to include such information as: relative or absolute time tag; channel information bit coding; channel number; and an individual "as-it-happened" or cumulative "everything-that-happened" report.




### 73A-541 Universal Digitizing Counter Module

- Performs all measurements associated with traditional timer/counters
- Allows measurements on a cycle-by-cycle basis
- Automatically performs time interval relationships between two waveforms.
- Time stamp data for in-depth analysis or reconstruction
- Access to VXI trigger lines




### VX4223 160 MHz Universal Timer/Counter

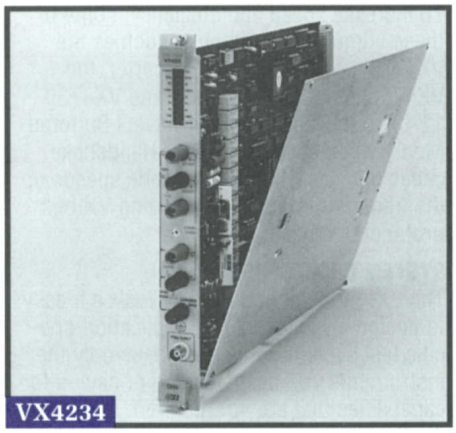
- 9-digit resolution
- 5 ns single-shot pulse width measurement
- 7 arming modes
- 1.3 GHz Channel C option available
- Message-based instrument

**Products summary/order information is on page 334.**

# Measurement Instruments

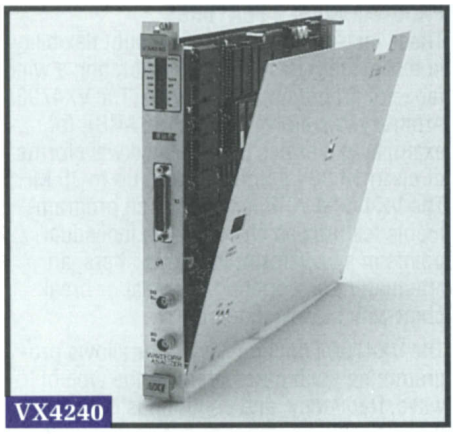
**VX4281 VX4234**
**VX4250 VX4240**
**VX4236 VX4286**





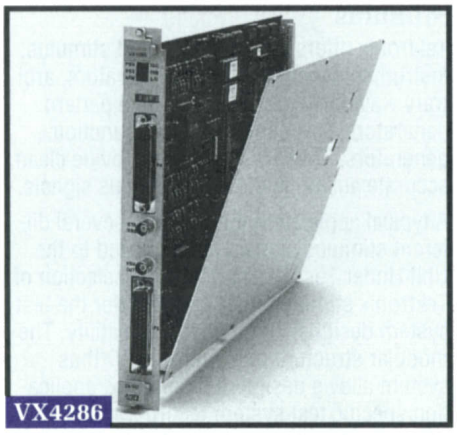

### VX4234 Digital Multimeter Module

- Fully programmable 4-1/2 digit guarded, dual slope, integrating systems multimeter.
- AC voltage and current, DC voltage and current, 2-wire or 4-wire Ω.
- 1 μVDC sensitivity with 115 dB common mode rejection.
- 15 readings per second.
- VXIbus trigger support.



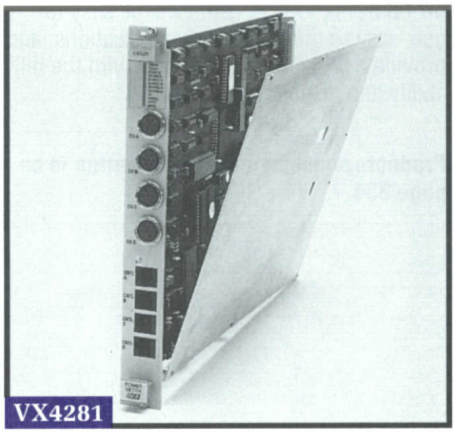

### VX4240 Waveform Digitizer/Analyzer Module

- Complete waveform analyzer.
- More than 40 built-in analysis routines.
- Unique "Virtual Ranging" circuit.
- "Record Mode" operation.
- Powerful, sophisticated, flexible triggering.
- Semi-automatic, on-board calibration and alignment.
- GSA item.



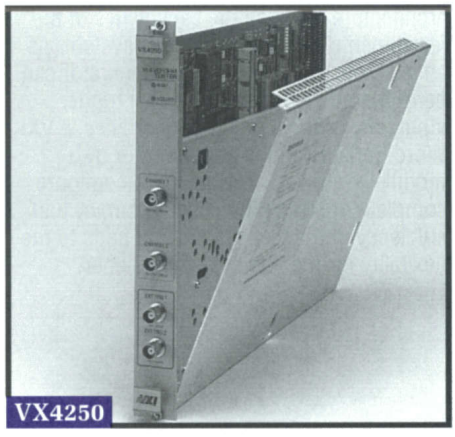

### VX4286 32-Channel Analog/Digital Input Module

- 32 independent channels with time tagging.
- Individually programmable thresholds.
- Channels may be ANDed or ORed together.
- Programmable debounce control.
- Built-in voltmeter.
- Digital input logic sense and threshold programmable.




### VX4281 RF Power Meter Module

- Measures RF levels from 1 nW (-60 dBm) to 10 mW (+10 dBm), depending upon the sensor used.
- Sensors available include coaxial models from .1 MHz to 26.5 GHz; waveguide models from 18 to 110 GHz.
- Capable of obtaining simultaneous measurements from up to four power sensors.
- Remotely locatable 50 MHz reference source VXI813.




### VX4250 Waveform Tester

- Two channels can operate completely independently.
- 100 MS/sec sampling rate.
- On-card analysis routines.
- Acquisition, measurement, and limit testing can all be performed in the instrument.
- Single wide, "C" size VXI module.
- Simple programming model.




### VX4236 Digital Multimeter

- 6.5-digit resolution (5.5 digits AC).
- Five DC ranges, five AC ranges, six resistance ranges.
- True RMS AC from 10 Hz to 1 MHz.
- 1000-reading internal buffer.

**Products summary/order information is on page 334.**

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

# Stimulus Instruments

**VX4790A** **VX4750**
**VX4730** **VX4342**
**73A-270**

## Stimulus

Tektronix offers a complete line of stimulus instruments including pulse generators, arbitrary waveform generators, digital pattern generators, D/A converters, and function generators. These instruments provide clean, accurate analog and digital stimulus signals.

A typical application may require several different stimulus signals to be applied to the Unit Under Test (UUT). The wide selection of Tektronix stimulus instruments offer the test system designer tremendous versatility. The modular structure of a Tektronix VXIbus system allows design of a complex, application specific test system incorporating several different stimulus instruments within a single mainframe. Since all the instruments in the mainframe have a single controller, it is easy to design a complex and sophisticated test system.

Tektronix stimulus instruments are widely used in applications where accuracy and reliability are critical. Typical applications where Tektronix VXIbus stimulus instruments are used include aircraft assembly and maintenance, automotive component testing and manufacturing process control.

### PROGRAMMABLE FEATURES

These instruments allow maximum flexibility in test system design by incorporating a wide range of programmable features. The VX4790A Arbitrary Waveform Generator (ARB), for example, generates user-defined waveforms of up to 16,384 points, at rates up to 25 MHz. The VX4790A ARB includes such programmable features as changing the individual points in a waveform, low pass filters, an attenuator and continuous repeat or breakpoint with steady state output.

The VX4750 Function Generator allows programming such parameters as the type of wave, frequency, and continuous output or for a specified number of cycles. Other programmable features include modulation of the output and output frequency sweeping (sweep continuous or a specified number of times) over the entire frequency range.

The ability to synchronize stimulus signals not only with the Unit Under Test, but also with other instruments in the system greatly improves test accuracy and efficiency. Most of these instruments allow you to select either an internal clock or an external timing source, which further extends the system design possibilities.

The flexible triggering resources of the VXI architecture increase the capabilities of the instruments and the overall test system. As an example VX4750 Function Generator can be triggered from the front panel trigger input, any of the VXI TTL trigger lines, a VXI Word Serial Protocol command or by a module command. The ability to configure complex triggering increases accuracy and efficiency in the test system and adds to the flexibility for the test system designer.

To increase speed and efficiency, some of these stimulus instruments, such as the VX4730 12-Channel D/A Converter, the VX4750 Function Generator, and VX4730 12-Channel D/A Converter, have a Buffered Mode which enables the Fast Handshake capability. Fast Handshake Mode speeds up the transfer of data by minimizing VXIbus protocol overhead.

### SYSTEM DESIGN

The VXI modular architecture makes it easy to design and maintain an application-specific test system. You can choose only the instruments you need, instead of paying for capabilities that are not required. And when the time comes to expand or modify your system, the modular structure makes it easy to incorporate new capability without having to do a complete redesign or scrap existing components. The ease of programming message-based instruments also shortens the time required for system expansion. This affects operating costs, since modifying the test program is quicker and easier, and operator skill requirements are less restrictive.

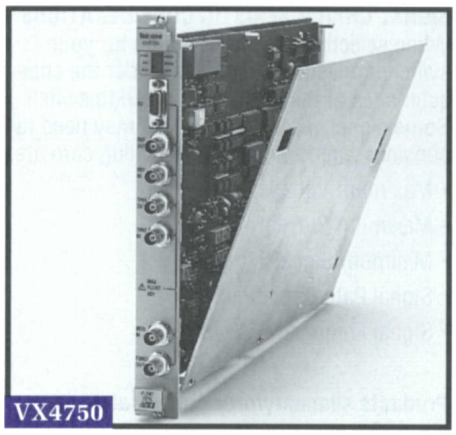
The VXIbus modular system design is also more compact and better suited to many test environments than the usual rack-and-stack configuration. A modular test system based on Tektronix VXIbus cards will be easy to use, easy to modify for new applications, and provide a cost-effective solution with the reliability and flexibility you need.

**Products summary/order information is on page 334.**

# Stimulus Instruments

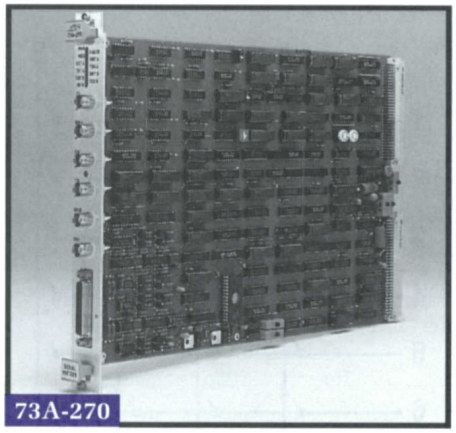
| | |
|---|---|
| VX4790 | VX4750 |
| VX4730 | VX4342 |
| 73A-270 | VX4610 |





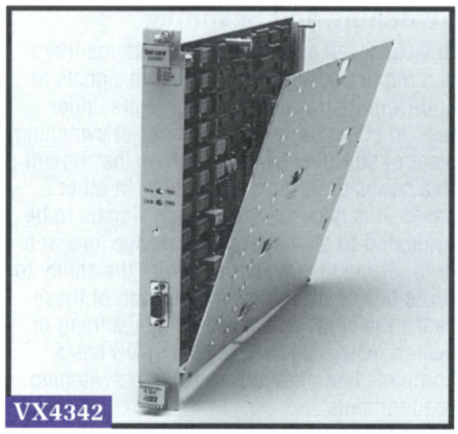

### VX4750 Function Generator

- Single slot "C" size function generator.
- Sine, triangle, ramp, square, pulse, arbitrary and DC outputs.
- Modulation available FM, AM, PM, PSK, FSK and PWM.
- Programmable frequency sweep.




### 73A-270 Arbitrary Pulse/Pattern Generator Module

- Generates arbitrary serial data patterns with up to 1600 user-defined time durations
- Two independent programmable output channels
- TTL and level-programmable bipolar outputs to ±17.4V for each channel
- Time duration values can be updated "on-the-fly"
- GSA item



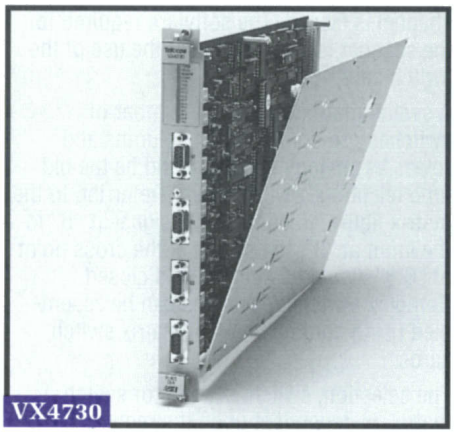

### VX4342 Dual Resistance Programming Module

- Greater than 4 decades per channel.
- Up to 200 value changes per second.
- In-line trim pot for station calibration.
- Isolated self test.
- Message-based instrument.
- MATE verified CIIL option available.




### VX4790 Arbitrary Waveform Generator Module

- 0.8 Hz to 25 MHz programmable sample rate.
- ±10.22V into 50 Ω.
- 12-Bit vertical resolution.
- Built-in sine, square, sawtooth, and triangle waveforms.
- Programmable output attenuator for precision low level signals.
- MATE CIIL option available.
- GSA item.




### VX4730 12 Channel D/A Module

- Up to ±16.3835 V output.
- 500 mV resolution.
- 2 millivolt accuracy across full temperature range.
- 720 milliamps across twelve channels.
- 410 milliamps on any single channel.
- MATE CIIL option available.
- Message-based instrument.
- GSA item.

**Products summary/order information is on page 334.**




### VX4610 SDH/SONET Generator/Receiver Module

- 52 and 155 Mb/s electrical transit and receive.
- Optional optical plug-ins for 52, 155, and 622 Mb/s.
- Complete SDH/SONET frame generation and analysis.
- Optional add-on modules for tributary testing.
- On-site firmware upgrades.

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

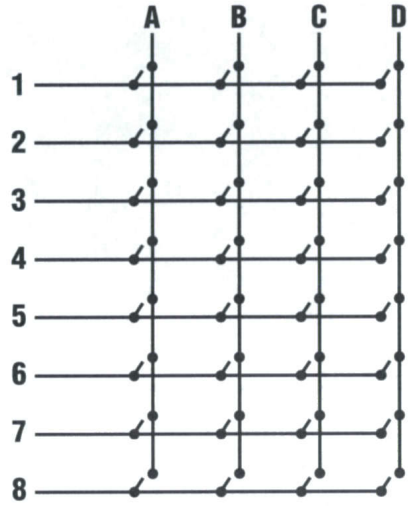
# Switching and Scanning Instruments

## Switching and Scanning

In virtually all automated test systems there is a requirement to route multiple signals to and from instruments and the units under test. In some cases it is a matter of switching a set of stimulus signals from an instrument to a series of devices under test. In other cases, it is necessary to switch signals to be evaluated to a measurement device, one at a time. Some test systems require the ability to route one or more devices. In each of these cases the solution is switching, scanning or switch matrix cards. Tektronix/CDS has a complete line of solutions to your switching requirements.

### SWITCH VS SCANNER VS SWITCH MATRIX

Understanding the difference between a switch card, a scanner card or a switch matrix card is important when selecting cards to meet a specific requirement. The switch card is the most versatile. A good analogy would be several toggle switches that you can open or close as required. You can manually configure a switch card to act much like a scanner or a matrix card. It can be programmed to have any number of switches open or closed at any given time. Each switch on the card is controlled by individual Open and Close commands.




**4 by 8 Switch Matrix (32 Relays)**

The scanner only allows one channel to be closed at a time. A good analogy for it would be a rotary switch that allows you to select one of several positions. When the command to close a channel is received, any closed channel is opened and then the commanded channel is closed. The software required for the scanner is simplified over the use of the switch card.

A switch matrix card has a number of switches pre-configured in columns and rows. An analogy for this would be the old time telephone switch board. Referring to the matrix figure, to connect the signal at "B" to the input at "3", the switch at the cross point of "B,3" would be commanded closed. Complex switching systems can be assembled using combinations of matrix switch cards.

The selection, switch, scanner or switch matrix, is dependent upon the requirements of your application. Tektronix/CDS has an extensive assortment of products to solve your switching problems. Refer to the selection guide on the next page to assist in your selection of the best solution for your switching requirements.

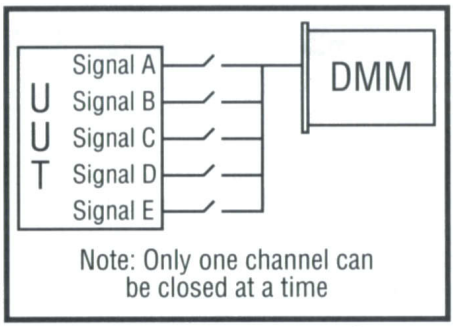
### SIGNAL CHARACTERISTIC CONSIDERATIONS

When selecting the best solution for your switching needs you must consider the characteristics of the signals you need to switch. Some signal characteristics you may need to consider when selecting a switching card are:

- Maximum Voltage
- Maximum Current
- Minimum Signal Strength
- Signal Path Impedance
- Signal Frequency

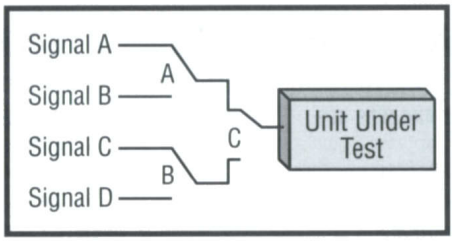
**Products summary/order information is on page 334.**

# Switching and Scanning Instruments



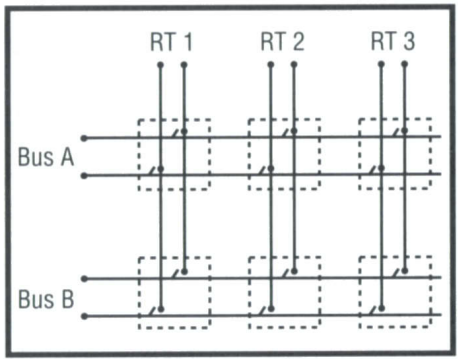

**EXAMPLE 1**
A common, typical application is switching signals to the DMM from a unit under test, one at a time for measurement. In this example a scanner seems to best fit the solution. The signal characteristics of every signal must be compared to the maximum rating of the relays.

**SOLUTION: VX4342**




**EXAMPLE 2**
Another application might be switching stimulus signals into an input of the unit under test. In this application a switch card would be the logical choice.

**SOLUTION: VX4367 OR VX4357**




**EXAMPLE 3**
The solution to switching one of two data buses into one of four terminals would be a matrix switch such as this 2 by 4, 2 wire matrix.

**SOLUTION: VX4385 OR VX4386**

**SWITCHING AND SCANNING – PRODUCT SUMMARY**

| Description | Model# | #Relays | MAXI | MAX VAC | MAX VDC | Comment |
|---|---|---|---|---|---|---|
| SPST Relay Switch | VX4353 | 32 SPST | 5A | 250 | 48 | |
| DPST or SPDT Relay Switch | VX4355 | 242 SPST/DPST | 5A | 250 | 48 | Independent Control |
| DPDT Relay Switch | VX4356 | 20 DPDT | 5A | 250 | 48 | Programmable Delay |
| SPDT Relay Switch | VX4357 | 32 SPDT | 5A | 250 | 48 | Programmable Delay |
| SPST Relay Switch | VX4363 | 32 SPST | 2A | 250 | 220 | Programmable Delay |
| DPST or SPDT Relay Switch | VX4365 | 24 | 2A | 250 | 220 | Independent Control, Lower Cost |
| DPDT Relay Switch | VX4366 | 20 DPDT | 2A | 250 | 220 | Low Cost |
| SPDT Relay Switch | VX4367 | 32 SPDT | 2A | 250 | 220 | |
| Switch Matrix | VX4385 | 128 DPST | See Ratings in SPEC | | | User Configurable |
| Switch Matrix | VX4386 | 128 DPST | See Ratings in SPEC | | | Latching Relays |
| 2-Wire Scanner Master | VX4332 | 1x40, 2x20 | See Ratings in SPEC | | | Download Sequences |
| 2-Wire Scanner Slave | VX4372 | 1x48, etc. | 2A | 120 | 200 | |
| 4-Wire Scanner Master | VX4334 | 1x24, etc. | See Ratings in SPEC | | | |
| 4-Wire Scanner Slave | VX4374 | 1x24, etc. | 2A | | 200 | |
| Relay and Logic Driver | 73A-308 | 80 OC OUTS | 300 mA | | 50 | 50 Volts (Resistive) |

**ALL MODULES ABOVE TYPICALLY SUPPORT**
- Programmable Delay between operations
- BITE-Built-in test checks states of relays before and after operation
- Readback status of relay state

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

Contact your nearest Tektronix representative for complete ordering and pricing information.

**COMPUTERS, CONTROLLERS AND IEEE-488**
**Embedded Controllers**

**VXIpc 486 Model 566** – 66 MHz 486

**VXIpc 486 Model 500** – 50 MHz 486

**VXIpc 486 Model 200** – 20 MHz 486

**EPC-7** – i486 Embedded Workstation

**EPC-2** – 80386 Embedded PC Controller/Slot 0 Resource Manager

**IEEE-488 PC Interfaces**

**S3FG210** – Standard PC-GPIB Interface plus Drivers

**S3FG220** – Turbo-AT GPIB Interface plus Drivers

**MAINFRAMES**

**VX1401** – Standard 13-slot mainframe

**VX1400** – High power 13-slot mainframe

**VX1405** – Portable 5-slot mainframe

**FIXTURING AND DUT INTERFACING**
**MAC Panel –**

- Rotary Interface Receiver
- Series 120
- ARINC 608A/F-22 CATS
- Fixturing

**Virginia Panel –**

- 90 Series Interface System
- VXI Interlocking
- Hinged Mounted
- Fixturing

**SLOT 0/RESOURCE MANAGER MODULES**

**73A-151B** – Standard Slot 0 Resource Manager Module Supports VXI fast handshake

**VX4521** – High Speed Enhanced Slot 0 Resource Manager Module

**73A-156** – MATE IAC Control Module (ICM)

**MXI Interfaces**

**VXI-AT2000** – MXI for DOS

**VXI-AT2010** – MXI for Windows

**VXI-AT2020** – MXI for SUN

**VXI-MXI** – VXI-MXI Mainframe Extender

**SOFTWARE**

**S3FG910** – National Instruments LabWindows

**S3FG912** – Advanced Library for S3FG910

**LabVIEW** – National Instruments LabVIEW for windows

**CVI** – LabWindows CVI

**DTB** – Digital Toolbox (for VX4820)

Operating systems and tools for DOS, Windows, or UNIX environments.

**MEASUREMENT AND RESPONSE**

**VX4234** – 4.5 digit Digital Multimeter

**VX4236** – 6.5 digit Digital Multimeter

**VX4223** – 160 MHz (1.3 GHz optional) Universal Timer/Counter (2 channels)

**53A-540B** – 4-CH, 12 MHz Totalizing Counter

**73A-541** – 10 MHz Time Interval Analyzer (2 channels)

**VX4286** – 32-CH Analog/Digital Comparator

**VX4287** – Differential 32-CH D/A Comparator

**VX4250** – High Throughput Waveform Tester

**VX4240** – 5 MHz, 10 M/s Waveform Analyzer

**53A-525** – 20 MHz, 40MS/s Waveform Analyzer

**53A-518** – 500 kS/s, 12-Bit Transient Digitizer

**53A-220** – 4-CH Strain Gauge Amplifier

**53A-225** – 10-CH Thermocouple Input Module

**53A-519B** – 30 kHz, 16-CH, 12-Bit Data Acquisition Subsystem

**VX1811** – 18 GHz RF Diode Sensor

**VX1812** – 26.5 GHz RF Diode Sensor

**VX1813** – Remote Calibrator Head for VX4281

**VX1814** – 18 GHz RF Thermocouple Sensor

**VX4281** – 2 or 4-CH RF Power Meter

**VX4428** – ARINC 429 4-CH TX, 4-CH RX

**VX4469** – ARINC 629 1 to 3 channels

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

Contact your nearest Tektronix representative for complete ordering and pricing information.

**STIMULUS AND SOURCES**

**VX4750** – 25 MHz Function Generator
**VX4790** – 25 MS/s Arbitrary Waveform Generator
**53A-242** – 10 MS/s, 10-Bit Arbitrary Waveform Generator
**53A-258** – Octal 12-Bit 100 mA DAC
**VX4730** – 12-CH, 16-Bit DAC
**VX4342** – Dual Resistance Programming Module
**53A-286** – Hex 50 V, 40 kHz Gain Programmable Isolated Amplifier

**DIGITAL**

**VX4440** – 192-CH Digital I/O
**VX4801** – 48-CH Isolated Digital I/O
**VX4802** – 80-CH Programmable Digital I/O
**VX4820** – 20 MHz Digital Test Module (64 channels)
**53A-412** – Programmable Digital I/O (48 channels)
**VX4491** – Boundary Scan Module
**559ADGS** – ASSET™ VXI Boundary Scan Diagnostic System
**VX4610** – SDH/SONET Generator/Receiver Module
**73A-270** – 10 MHz Arbitrary Serial Pulse/Pattern Generator
**53A-260** – 2-CH, 5 MHz Pulse Burst Generator
**53A-262** – 6-CH Programmable Rate Generator/Pacer
**53A-530** – 10 MB/s Bit Error Rate Transmitter
**53A-531** – 10 MB/s Bit Error Rate Receiver
**53A-431B** – Quad UART (RS-232/RS-422) I/O Card

**SWITCHING AND SCANNING**

**VX4385** – 128 two-wire/four-wire Relay Matrix Switch
**VX4386** – 128 two-wire/four-wire Latching Relay Matrix Switch
**VX4363** – 32 SPST 2 A Low Cost Relay Switching
**VX4365** – 24 DPST/SPDT 2 A Low Cost Relay Switching
**VX4366** – 20 DPDT 2 A Low Cost Relay Switching
**VX4367** – 32 SPDT 2 A Low Cost Relay Switching
**VX4353** – 32 SPST 5 A General Purpose Relay Switching
**VX4355** – 24 DPST/SPDT 5 A General Purpose Relay Switching
**VX4356** – 20 DPDT 5 A General Purpose Relay Switching
**VX4357** – 32 SPDT 5 A General Purpose Relay Switching
**VX4332** – 4 two-wire Reed Relay Scanner Master with Readback
**VX4372** – 48 two-wire Reed Relay Scanner Master with Readback
**VX4334** – 24 four-wire Reed Relay Scanner Master with Readback
**VX4374** – 24 four-wire Reed Relay Scanner Master with Readback
**VX4440** – Relay Controller (192 TTL outputs)
**73A-308** – 80 Open Collector Relay Driver
**53A-333** – 15 three-wire Reed Relay Scanner with Full Readback
**53A-334** – 32 one-wire Reed Relay Scanner with Full Readback

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

# Accessories



## Accessories

The VX1421 Module combines a mechanical housing for a VXI "C" size module with a 68000 micro-processor based device that is the basic building block for the Development Modules. It provides an area for mounting a user-defined daughter card of up to 50 square inches.

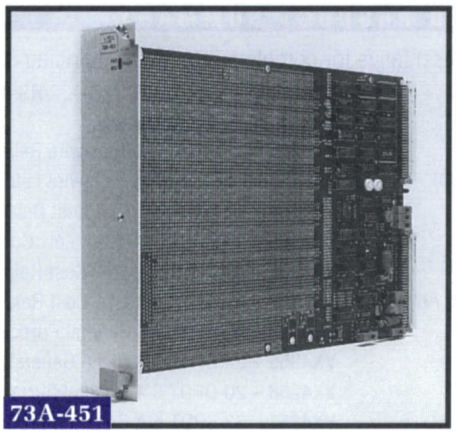
### SOFTWARE DEVELOPMENT OPTION (VX1421 ONLY)

A software development option gives the user a development environment, including VXIbus communication. The user must supply an appropriate compiler and assembler. This allows easy development of custom instrument firmware.

The software development tool kit includes a Serial I/O board, development firmware, a PC compatible floppy disk, and cables and manuals. The Serial I/O Board has two RS232 ports, 128K of EPROM, 128K OF RAM, and Abort and Reset functionality. Direct access to the 68000 micro-processor on the VX1421/1521 is provided by the Serial I/O Board. In addition, its two RS232 ports provide access to the development controller and terminal. The user has the capability of down-loading custom developed programs and is provided an interface to the PROBE debugger through the Serial I/O board.

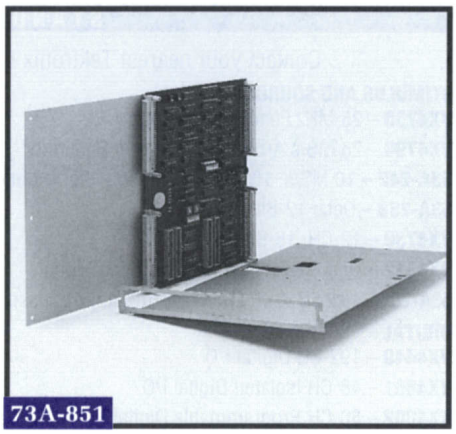
The development firmware libraries includes a VXI I/O system, PROBE debugger, down-loader, routines implementing Word Serial protocol, signal and interrupt support, diagnostics, and a sample application. Single-copy licenses of PROBE and Tektronix software are a part of the package.

**Products summary/order information is on page 334.**




### 73A-451 Wire-Wrap Module

- Includes full message based VXIbus interface.
- Simple interface allows user choice of any processor or state machine.
- 66 square inches of user space.
- VXIbus interrupt circuitry.
- Access to all P1 and P2 power pins.
- Eight layer board.
- 73A-452 "All Blank" version.




### 73A-851 VME to VXI Adapter Module

- Designed to allow "A" or "B" size VXIbus or VMEbus modules to be installed in a "C" size card cage.
- Maintains proper VMEbus environment.
- Provides EMI/RFI shielding for installed module.
- Resolves any potential pin usage conflicts between VME and VXI.

For product detail, request a VXI Catalog by completing the business reply card in the back of this catalog.

# Test and Measurement Instruments

## Test and Measurements Instruments

Tektronix Test and Measurement Instruments provide the answers to a broad range of test and measurement needs. We offer a wide variety of general purpose test instruments targeted at Benchtop & ATE system solutions. We offer products configured as modular instruments in our TM 500/TM 5000 series or as standalone instruments in our Signal Sources product families.

### STANDALONE

Our standalone Signal Sources products are designed using the latest technologies and consists of Pulse Generator, Function Generator, and our NEW Arbitrary Generator product families. These products are designed for precision, high performance applications and implement Graphics User Interfaces (GUI) for simplified operation. The interface has been designed with display menu listings and "Soft Key" selection controls placed in consistent, predictable locations. The advanced functions which extend functionality and increase operator productivity are easy to learn and use.

These powerful new products reduce test stand requirements with high levels of circuit integration. They combine many of the features typically found in automated test stands which rely on software and controllers to solve specific test problems. The result is a family platform which establishes new benchmarks in ease of use in high performance applications. Utilization of high density surface mount technologies have facilitated these highly integrated product designs.

### MODULAR

We offer a variety of general purpose test instruments for Benchtop and ATE system solutions. Our Signal Source products use the latest technologies and consist of Pulse Generators, Function Generators and Arbitrary Generator products. Scope calibration instruments are best in the world.

The Tektronix TM 500 line of manual instruments lets you create just the system you need. They can be used in TM 500 mainframes or in TM 5000 mainframes side-by-side with TM 5000 programmable instruments. This compatibility yields cost effective solutions to system applications where not all functions or measurements need to be programmable. These modular instruments function individually or as part of a computer-controlled network.

The TM 5000 programmable instruments are easy to use in manual and automated testing and measurement applications. Programming is simple because TM 5000 instruments are GPIB compatible and support Tektronix Standard Codes and Formats.

The TM 500/TM 5000 line of modular instruments is designed so connections between modules and/or external equipment can be made by the mainframe rear interface board and optional rear-panel connectors.

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# Arbitrary Generators

## Signal Sources – Standalone and Modular

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### Arbitrary Waveform Generators

At Tektronix, Arbitrary waveform generation concepts have been around for several years. Starting in the first generation as simple Digital to Analog Converters (DAC) on a card for systems applications where separate memory cards and function generation cards could extend the operational capabilities when combined with software and a system controller. Over the years, these system components have evolved into a single second generation product known today as: Arbitrary Waveform Generators, Arbitrary Function Generators, and Direct Digitally Synthesized Generators, Tektronix offers all three of these designs. Tektronix has defined these distinctive designs as follows:

**Arbitrary Generators** – Generically refers to all arbitrary waveform sources regardless of digital technologies.

**Arbitrary Waveform Generators (AWG)** – Refers to sources which convert digital information into analog waveforms. These products utilize digital memories for waveform storage and execution.

**Arbitrary Function Generators (AFG)** – Include AWG capabilities plus either standard Analog or Synthesized Standard waveforms (sine, square, triangle, ramp up or down, and DC). Some of the products also include built-in sweepers.

**Direct Digital Synthesizers (DDS)** – Optimized for generation of synthesized standard waveforms. Also offers Arbitrary Generation capability. DDS techniques enhance the resolution and accuracy and signal purity of these stimulus products.

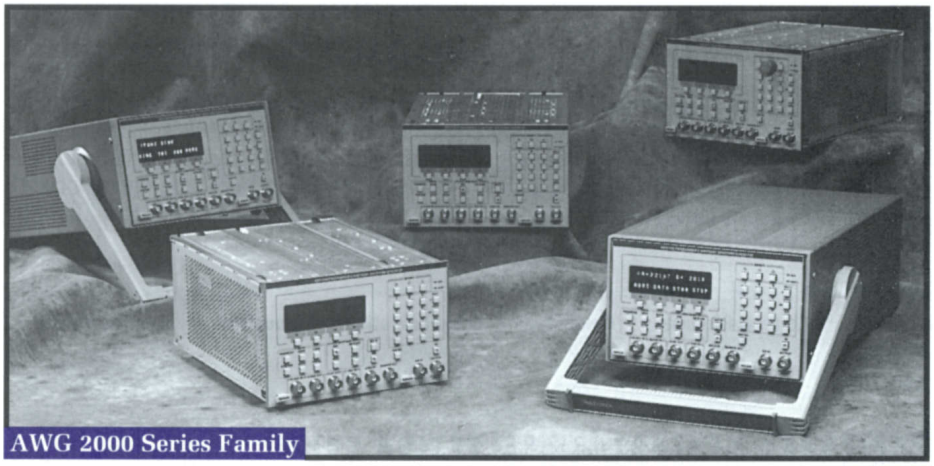
# Arbitrary Generators

## Signal Sources – Standalone and Modular



### 2000 SERIES ARBITRARY GENERATORS, PORTABLE WAVEFORM SIMULATION SYSTEMS

Tektronix is now introducing the Third Generation of these flexible signal sources which virtually remove the requirements for system controllers and software for Waveform Generation in many benchtop applications. While these products are classified as Arbitrary Generators they are truly Waveform Simulation Systems. They consist of built in High Resolution video monitors, and MS-DOS style waveform file management system, direct waveform transfers to and from Digital Storage Scopes, built-in mass data storage, and ASCII Waveform file transfers via GPIB IEEE 488.2 or by a built-in 3.5 inch floppy media and much more! Their direct waveform transfer capability optimizes these products in applications utilizing Digital Storage Oscilloscope.



AWG 2000 Series Family

### TM 5000 SERIES

Available as Plug-in (AWG 5100 or AFG 5100 Series) modules designed into the popular TM Series architecture for benchtop or systems applications.

The AWG 5000 Series Arbitrary Waveform Generators provide users with the best price/performance for applications not requiring standard analog functions or sweep generation. These products have clock rates ranging from 20 MS/s to 50 MS/s and offer external clock capabilities for phase synchronous or frequency agile applications. Dual channel outputs available with the AWG 5105 make this product ideal for 3 phase power, Automotive ABS, Communications and multi-channel Process Control applications.

The AFG 5102 Series Arbitrary Function Generator is three generators in one. They incorporate (1) an Arbitrary Waveform Generator (2) an independent Analog Function Generator for Standard waveforms (sine, square, triangle, ramp up or down, and DC) and (3) a sweep generator which provides linear, logarithmic and a unique Arbitrary sweep of the output waveform.

# Arbitrary Generators
## Signal Sources – Standalone

### Arbitrary Generators

The AWG 2020 is targeted at applications requiring long memory length waveforms (256K per CH) with 12-Bit vertical resolution at 250 MHz. Waveform editing is greatly simplified via the ICON driven Graphic Use Interface (GUI) which allows real time viewing on the high resolution display during waveform editing.

Advanced features like waveform sequencing and polynomial entry provide additional waveform flexibility not previously available.

The synthesized AFG 2020 utilizes the New, state of the art, DDS Direct Digital Synthesis method of waveform creation. The product excels in low phase noise, high frequency accuracy and resolution SYNTHESIZER applications.

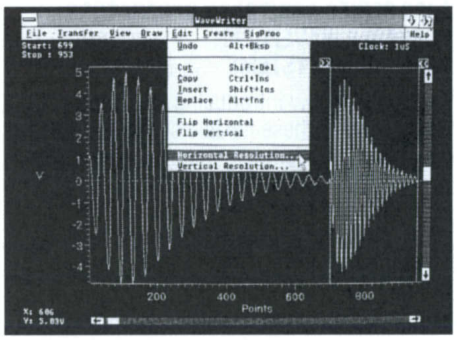
**APPLICATION TABLE**

| | General Purpose | Computer | Communication | Industrial | Semiconductor |
|---|---|---|---|---|---|
| **AFG 2020** | XXX | X | XXX | X | XX |
| **AWG 2020** | X | XXX | XXX | | XXX |

**ARBITRARY GENERATORS SELECTION GUIDE**

| Vendor/Model | AWG 2020 | AFG 2020 |
|---|---|---|
| **Sample Rate** | 250 MS/s | 250 MS/s |
| **Time Base Accuracy** | 50 ppm | 1 ppm |
| **Vertical Res. (Bits)** | 12 | 12 |
| **Sine, Sqr, Tri, Ramp, DC** | Synthesized to 2.5 MHz | DDS Technology 100 MHz Sine: <50 MHz others |
| **Execution Memory** | 256K pts/CH | 1K pts/CH |
| **Non-Volatile Memory** | 512 MB | (16)1K Wfms |
| **Memory Sequencing** | 8K Wfms 64K repeats | 256 Settings of Freq./Am/Offset/Phase |
| **Graphic Waveform Editing** | Yes, equation, STD, Draw Timing, Table.(03.FFT) | Yes, equation STD, Draw 91 |
| **Output Channels** | 1 CH | 1 CH |
| **Add a CH Option** | Opt. 02 | Opt. 02 |
| **Amplitude V p-p into 50 Ω** | 5 V to 50 mV | 10 V to 50 mV |
| **Package Format** | Monolithic | Monolithic |
| **Ext Clock** | Syst. Clk IN/OUT | Ref. Clk IN/OUT |
| **Modulation** | External AM | AM/FM/PSK/FSK Offset: 1 Hz-100 M |
| **Built-in Sweeper** | | Linear/Log |
| **Media Storage** | 3.5 in. Floppy | NA |
| **Direct DSO Transfer** | Yes, TDS, 2200, 2400, RTD | Yes, TDS, 2200, 2400, RTD |
| **GPIB Bus Monitor** | Yes | NA |
| **Word Generator** | 1212, 622 | NA |
| **IEEE Standard** | IEEE 488.2 | IEEE 488.2 |
| **Software Support** | | |
| **WaveWriter/AWE** | Yes | Yes |
| ***1 R4** | | |
| ***2 Lab Windows** | Yes | Yes |
| **Prices begin at** | **$13,495** | **$8,395** |

**1 Rapid Systems software package*
**2 National Instruments software package*




*WaveWriter allows easy creation and modification of custom waveforms.*

### Arbitrary Waveform Generation Software

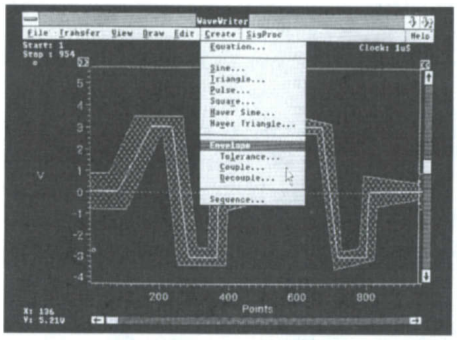
WaveWriter/AWE™ is a Windows based software package for capturing, creating and modifying arbitrary waveforms for Tektronix Arbitrary Generators. WaveWriter represents a major step forward in allowing easy creation of the complex signals which are increasingly being used to test circuit tolerances, drive vibration/shake tables, and simulate transducers other non-ideal or signal anomalies.

WaveWriter also supports Tektronix digital storage oscilloscopes with template generation for the margin testing. Therefore, with WaveWriter, the user can create the exact tolerances or templates with which to capture a differential signal or identify a failure.

# Waveform Capture
## Edit and Documentation Software








*Create the reference memory template waveform for pass/fail testing on 2400 Series Oscilloscopes.*

### WaveWriter (AWE) Arbitrary Waveform Editing Software

**WAVEFORM GENERATION**

WaveWriter™ is a new version 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 SIGNALS OSCILLOSCOPES**

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.

**AUTOMATIC SCALING TO TARGET INSTRUMENTS**

Users identify the target test instrument and the software handles details such as record length and precision, D-to-A clock rates or time base settings. WaveWriter supports a number of Tektronix AFGs, digitizers and scopes, and users can add instruments by responding to on-screen queries.

**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 *.ADIF, *.ISF, and *.CSR. 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.

**WaveWriter™ ARBITRARY WAVEFORM EDITING SOFTWARE**

- Create/Modify/Document Waveforms for DSOs and Arbitrary Generators
- Use WaveWriter Stand-Alone 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

*WaveWriter simplifies the acquisition, creation, editing and documentation of waveforms for arbitrary generators and digital oscilloscopes.*

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571).

**ORDERING INFORMATION**

**S3FT400**
Tektronix WaveWriter System Software ..... TD **$795**

WaveWriter is provided on both 1.2 MB 5.25 in. and 1.44 MB 3.5 in. diskettes.

# AFG 2020
# AWG 2020

# Arbitrary Generators
## Signal Sources – Standalone

*Best in class performance for improved simulation. Couple the 2000 Series ARB's with our Digital Scopes to form low cost acquisition and simulation systems. Create realworld signals easily and reduce or eliminate need for a computer.*

*Add our WaveWriter™ Software to complete your test application requirements. Additional flexibility with the AWG 2020 built-in 3.5 inch PC compatible disk.*

Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200

GPIB IEEE-488

The AWG 2020 and AFG 2020 complies with IEEE Standard 488.1/488. 2-1987, and with Tektronix Standard Codes and Formats.

**AWG 2020**

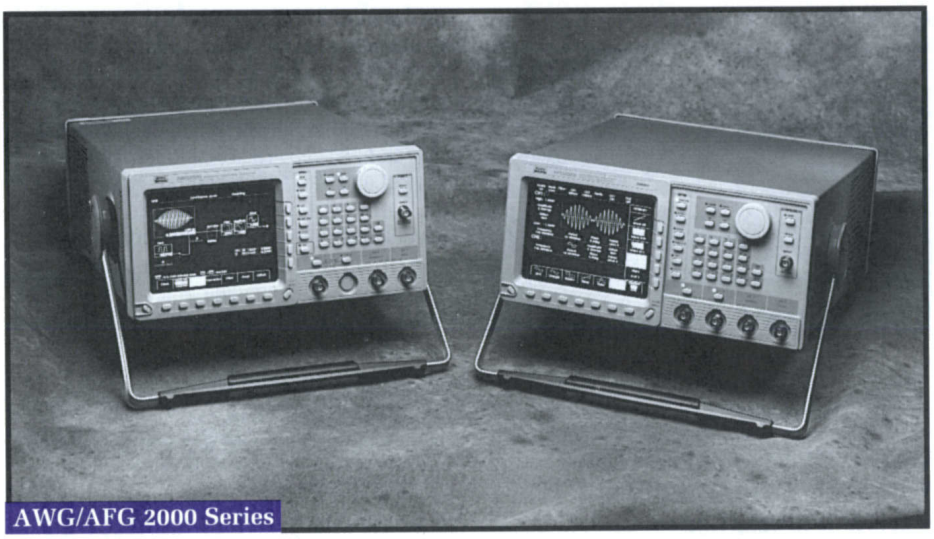
- 250 MS/s, 4.0 ns, 50 ppm Clock
- 12-Bit Vertical (4296)
- 256K (262,144 Points) Record Length
- Built-in PC-Compatible 3.5 in. 1.4 MB Floppy Disk for Storage and Transfer
- Digital Signal Processing With FFT Editing (Opt. 09)
- 12-Bit Digital ECL Output (Opt. 03)
- DOS-like Waveform File Management
- Formula Entry of Parameters for Mathematically Precise Waveforms

**AFG 2020**

- DDS Synthesized Function Generation
- 1K (1024 points) Record Length
- 100 MHz Sinewave Generation
- 50 MHz Square Wave
- 31.2 MHz Triangle, Ramp, and Pulse
- AM/FM/PSK/FSK Amplitude and Offset Modulation
- Linear/Log Sweep
- 250 MS/s, 4.0 ns, 1 ppm Clock
- External Trigger Delay 700 ns to 100 s

**APPLICATIONS**

- Magnetic Media Simulation
- Industrial and Automotive Simulation
- Computer and Peripheral Simulation
- EW and Navigation Simulation



AWG/AFG 2000 Series

### AWG/AFG 2000 Series

The GUI interface of the Tektronix AWG 2020 and AFG 2020 Arbitrary Generators combine the function of an arbitrary generator with a controller and a graphical user interface. A built-in high-resolution monitor facilitates waveform definition.

The AWG 2020 and AFG 2020 share a common user interface design and monolithic platform. While the basic operation is similar, each unit provides unique benefits. The AWG 2020 is ideal for generating complex waveforms requiring long record lengths – up to 256K. It also includes a built-in 3.5 inch floppy disk to facilitate data storage and waveform transfers. An MS-DOS compatible file management system allows waveform sequencing and transfers without an external controller for most operations.

The AFG 2020 is ideal for applications requiring both precision standard functions with arbitrary waveform generation. It uses Direct Digital Synthesis (DDS) to generate highly accurate, low distortion waveforms that can be defined in a 1K record length. It can generate standard sinewaves up to 100 MHz, square waves up to 50 MHz, and triangle, ramp, and pulse waveshapes up to 31.2 MHz.

**GENERATE ARBITRARY WAVEFORMS WITHOUT A CONTROLLER**

Standard waveshapes available include sine, square, triangle, ramp, pulse, and DC. Coupled with flexible triggering, gating, and modulation capabilities, you have complete control over waveform generation. In addition, you can precisely define waveforms using polynomial formula entry of mathematical parameters.

**GRAPHICAL USER INTERFACE SIMPLIFIES OPERATION**

A unique easy to use graphical user interface (GUI) provides a familiar user environment and simplifies operation. The icon-based GUI features soft-key menu selections. As you enter data to build your waveform, you can view the resultant signal on the integral display.

**USE STANDARD WAVEFORMS OR CREATE YOUR OWN**

You can use any of several methods to create a new arbitrary waveform. You can select one of the standard waveshapes from the library and modify it to produce the desired waveshape using the graphical waveform editing tools. Or, waveforms can be acquired with a companion digital oscilloscope (DSO) and transferred to the AWG 2020 or AFG 2020 via the GPIB – an external controller is **not** required for transfer. A series of waveforms can be executed via the internal DOS-like file manager.

Unique waveforms can be created in exacting detail using the graphical editing features to define waveshapes. Or you can use the formula entry mode to precisely define waveforms based upon mathematical equations, timing diagrams, or timing tables.

**THE PERFECT COMPANION FOR YOUR TEKTRONIX SCOPE**

The AWG 2020 and AFG 2020 feature direct communication with a variety of digitizing oscilloscopes. Waveforms acquired with these scopes can be directly transferred to the AFG 2020 or AWG 2020, edited for desired features, and used as testing sequences. All of this can be done without the need for an external controller.

# Arbitrary Generators
## Signal Sources – Standalone





**FULLY PROGRAMMABLE VIA GPIB**
The AWG 2020 and AFG 2020 are fully programmable via a GPIB interface (IEEE 488.2). As a result, they are ideal additions to provide stimulus and arbitrary waveform generation for your ATE measurement system.

### AWG2020 Characteristics

**SYNTHESIZED WAVESHAPES**
Sine, square, triangle, ramp, pulse to 2.5 MHz, arbitrary to 250 MHz, and DC.

**ARBITRARY WAVEFORMS**
**Waveform Memory –** Memory Length: 256K x 12 bits for waveform data; 256K x 2 bits for Marker data. Waveform: 64 to 256K in multiples of 8 data points.

**Sequencer Memory –** 8K waveforms.

**Scan Counter –** 1 to 64K repeats.

**Burst Counter –** 1 to 64K cycles.

**RATE CLOCK**
**Frequency Range –** 10 Hz to 250 MHz (40 ns)

**Display –** 4 digit.

**Accuracy –** +10°C to +40°C: 0.01%. +15°C to +30°C: 0.005%.

**Resolution –** 0.1% to 0.01% typical.

**Skew between CH 1 and CH 2 (Opt. 02 only) –** Within 4 ns.

**MAIN OUTPUTS**
**Amplitude (excluding ADD and Multiply Operation) –** Range: 0.05 V to 5 V p-p into 50 Ω. Resolution: 1/4096 (12 bits). 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%; T.H.D.:1.0 V, <–50 dBc, 0.5 V, <–66 dBc; Spurious: <–66 dBc.

**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.

**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.

**CHANNEL SUMMING (OPT. 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**
**Sync –** Amplitude: 1 V ±0.3 V typical into 50 Ω. Impedance: 50 Ω typical. Sync to Signal Delay: Within 15 ns.

**Markers 1 and 2 –** Amplitude: 1 V ±0.3 V typical into 50 Ω. Impedance: 50 Ω typical. Marker to Signal Delay: Within 15 ns.

**Clock –** Amplitude: 1 V ±0.3 V typical into 50 Ω. Impedance: 50 Ω typical.

**Digital Data Out (Opt. 03 only) –** 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 -** 1 sec maximum.

**AM –** Range: 2 V p-p (-1 V to +1 V) for 100% modulation. Maximum Input: ±5 V p-p, 10 kΩ typical impedance.

**System Clock –** Threshold Level: 0.3 V ±0.1 V typical. Input Swing: 0.8 V minimum. Pulse Width: 2 ns minimum. Maximum Input Voltage: ±2 V p-p. Impedance: 50 Ω typical. Frequency Range: Up to 250 MHz phase coherent.

**PROGRAMMABLE INTERFACE**
**GPIB –** IEEE-488.2-1987 compatible.

**RS-232C –** 9-Pin D connector.

### AFG 2020 Characteristics

**WAVESHAPES**
Sine, square, triangle, ramp, pulse, and arbitrary.

**FREQUENCY/PHASE (SYNTHESIZER ON)**
**Clock –** 250 MHz, 4.0 ns, 1 ppm.
**Frequency –** 10 digits. Range: Sine, 0.5 Hz to 100.00 MHz. Square, 0.500 Hz to 50.00 MHz; Other, 0.500 Hz to 31.2 MHz. Resolution: 0.5 Hz. Accuracy: ±(Reference Oscillator Accuracy + 0.12 Hz).
**Period –** 10 digits, 2.0 sec to 4.0 ns.
**Points/Cycle –** 5 digits, 250 MHz divided by frequency for <100 MHz, up to 1024 or 2048.
**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).

# Arbitrary Generators
## Signal Sources – Standalone



**Offset –** 4 digits. 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 –** Synthesizer On with 100 MHz LPF:

| | 10 V p-p | 2 V p-p, 0.4 V p-p |
|---|---|---|
| <100 kHz | –40 dBc | –60 dBc |
| 1 MHz | –40 dBc | –55 dBc |
| 10 MHz | –35 dBc | –55 dBc |
| 100 MHz | –25 dBc | –30 dBc |

Synthesizer Off with 50 MHz LPF:

| | 10 V p-p | 2 V p-p, 0.4 V p-p |
|---|---|---|
| <100 kHz | –40 dBc | –55 dBc |
| 1 MHz | –40 dBc | –55 dBc |
| 10 MHz | –35 dBc | –40 dBc |
| 100 MHz | –35 dBc | –40 dBc |

**Spurious –**

| | Synthesizer On | Synthesizer Off |
|---|---|---|
| <50 kHz | –60 dBc | –55 dBc |
| 500 kHz | –55 dBc | –55 dBc |
| 5 MHz | –45 dBc | –45 dBc |
| 31.2 MHz | –40 dBc | –35 dBc |
| 50 MHz | –40 dBc | |
| 100 MHz | –30 dBc | |

**Amplitude –** Flatness: Synthesizer On with 100 MHz LPF

| | 10 V p-p | 2 V p-p, 0.4 V p-p |
|---|---|---|
| ≥100 kHz to ≤50 MHz | ±0.5 dB | ±0.5 dB |
| ≤100 MHz | ±1.0 dB | ±0.5 dB |

Accuracy: 0.4 V p-p and 2.0 V p-p, DC accuracy ±3.0% + Flatness; 10 V p-p, DC accuracy ±5.0% + Flatness. Power: 4 digits up to 23.98 dBm.

**SQUAREWAVES**

**Amplitude –** Flatness:

| | 50 MHz LPF | Full Pass |
|---|---|---|
| ≤100 kHz to | ±2.0% | ±2.0% |
| ≤2.5 MHz | ±5.0% | ±5.0% |
| ≤15.6 MHz | ±5.0% | ±5.0% |
| ≤50 MHz | –30% | ±10% |

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 WAVES**

**Amplitude –** Flatness with 50 MHz LPF: ≤100 kHz, ±2.0%; ≤2.5 MHz, –7.0%; ≤15.6 MHz, –20%; ≤31.2 MHz, –40%. Accuracy: DC accuracy ±4.0% + Flatness.

**RAMP**

**Timing –** Rise/Fall: 4 digits, 0% to 100% of period.

**Amplitude –** Flatness with 50 MHz LPF: ≤100 kHz , ±2.0%; ≤2.5 MHz, –8.0%; ≤15.6 MHz, –25%; ≤31.2 MHz, –45%. Accuracy: DC accuracy ±4.0% + Flatness.

**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%. Accuracy: DC accuracy ±2% + Flatness.

**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.

**Points/decade (Log) –** 10 to 1000, 1-2-5 sequence; 1.0 Hz to 10 Hz, ≤10; 10 Hz to 100 Hz, <100; 100 Hz to 1 kHz, <1000; 1 kHz to 100 MHz, ≤1000.

**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.

**Points –** Sweep: 2 to 5001. Return: 1 to 5000.

**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 typical. 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%. Risetime: 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. Modulation Rate: Period, 10 µs to 1 sec every 0.2 µs; accuracy, ±0.1%. Risetime: 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.

**CLOCK**

**Reference Oscillator –** Type: TCXO. Nominal Frequency: 10 MHz. Accuracy: ±1 ppm (0°C ~ 50 °C). Stability: ±1 ppm/year (20°C ~ 30°C).

**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 typical.

**Output Protection –** The instrument is non-destructively protected against short circuits or accidental voltage of up to ±5 VDC plus peak AC applied to the main output connector.

**AUXILIARY OUTPUTS**

**Sync Output –** Positive TTL level. Min. Pulse Width: 400 ns. Output Impedance: 51 Ω nominal.

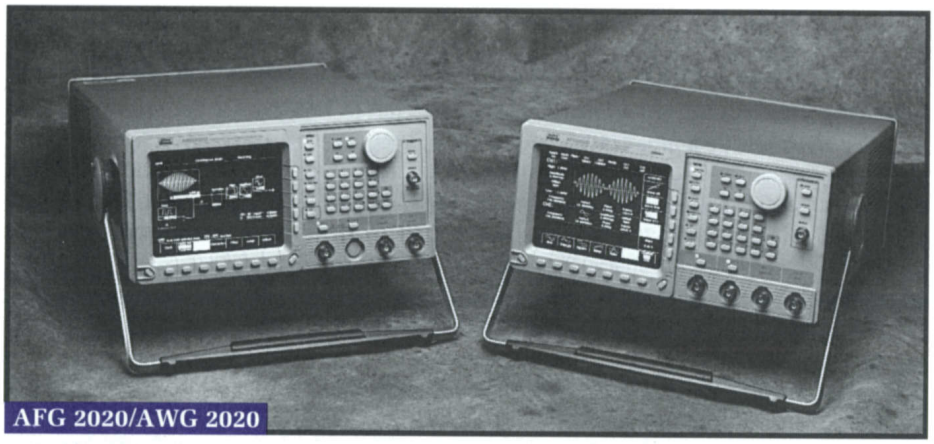
**Marker Output –** Positive TTL level. Min. Pulse Width, 100 ns. Output Impedance: 51 Ω nominal.

**10 MHz Output –** TTL level square wave. Duty Cycle: 50% to 75%. Output Impedance: 51 Ω nominal.

# Arbitrary Generators
## Signal Sources – Standalone

**AFG 2020**
**AWG 2020**




AFG 2020/AWG 2020

**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 VDC + peak AC. Threshold: Positive slope for Arming and Time Burst, and positive true for Gate. Negative slope for Arming and Time Burst, and negative true for Gate. Range: ±9.90 V. Resolution: 0.1 V. Accuracy: ±10% ±100 mV.

**AM Input –** Input Impedance: 10 kΩ ±5%. Max. Input Voltage: 10 VDC + peak AC.

**REF IN –** TTL compatible. Range: 10 MHz ±10 kHz. Input Impedance: 10 kΩ ±5%. Max. Input Voltage: 0 V to +5 V.

**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 "n" sequences or cycles.

**Output –** 3 digits, 0.4 µs to 100 sec. Accuracy: ±0.1 µs.

**External Trigger Delay –** 5 digits, 0.7 µs to 100 sec. Accuracy: Synthesizer On, ±(0.1 µs + 0.01%); Synthesizer Off, ±(0.2 µs + 0.01%).

**PROGRAMMABLE INTERFACE**

**GPIB –** IEEE-488.2-1987 compatible.

### General Characteristics (applies to both the AWG 2020 and AFG 2020)

**ENVIRONMENTAL**

**Temperature –** Operating: +10°C to +40°C. Nonoperating: –20°C to +45°C.

**Temperature Change –** Operating: ≤15°C per hour (no condensation). Nonoperating: ≤30°C per hour (no condensation).

**Humidity –** Up to 80% RH. **Altitude –** Operating: 4.6 km (15,000 ft.). Nonoperating: 15 km (50,000 ft.).

**Vibration –** 0.003 in. p-p, 5 Hz to 55 Hz (0.5g at 55 Hz).

**Shock –** 20 g (1/2 sine) 11 ms duration.

**EMC –** Within limits of FCC Regulations, Part 15, Subpart J, Class A; VDE 0871/6.78, Class B.

**Electrical Discharge –** Operating max test voltage: 15 kV (150 pF through 150 Ω).

**Safety –** UL listed 1244 and certified to CSA 22.2 No. 231-M89.

**POWER**

**Source Power –** Voltage Ranges: Selectable from 90-127 VAC or 180-250 VAC with internal jumper. Line Frequency: 48-63 Hz.

**Power Dissipation –** 300 W.

**Maximum Current –** 5 amps.

**PHYSICAL**

| Dimensions | mm | in. |
|---|---|---|
| Height | 164 | 6.4 |
| Width (with handle) | 362 | 14.25 |
| Length | 491 | 19.25 |
| **Weight** | **kg** | **lb.** |
| Net | 9.0 | 19.8 |

**OTHER**

**Display –** 7 in. diagonal, electro-magnetic deflection CRT.

**Recommended Adjustment Interval –** 12 months.

## ORDERING INFORMATION

**AWG 2020**

Programmable Arbitrary Waveform Generator ..... TD **$13,495**
**Includes:** User/Programmers Manual, Waveform Data Format Conversion Software, Sample Waveform Library Disk, Power Cable.

**Opt. 02 –** Independent, 256K Second Channel ..... **+$4,995**
**Opt. 03 –** 12-Bit Digital Out ..... **+$1,995**
**Opt. 09 –** Digital Signal Processing ..... **+$2,995**
**Opt. 1R –** Rackmount ..... **+$695**
**Opt. 1B –** Service Manual ..... **+$150**

**AFG 2020**

Programmable Arbitrary Function Generator ..... TD **$8,395**
**Includes:** User/Programmers Manual.

**Opt. 02 –** Independent, 256K Second Channel ..... **+$3,995**
**Opt. 1R –** Rackmount ..... **+$550**
**Opt. 1B –** Service Manual ..... **+$150**

**ADDITIONAL ACCESSORIES**

**Accessory Pouch –** Order 016-1159-00 ..... **$60**
**Front Cover –** Order 200-3232-00 ..... **$10**
**RS-232C Cable –** 9-Pin to 25-Pin. Order 174-1453-00. ..... **$48**
**CT-2 –** Differential Output Adapter ..... **$250**

**TEST SOFTWARE**

The following optional IBM compatible test software is available for use with the AWG 2020 and AFG 2020:

**WaveWriter/AWG –** Order S3FT400 ..... **$795**

**INTERNATIONAL POWER PLUG OPTIONS**

**Opt. A1 –** Universal Euro 220 V, 50 Hz ..... **NC**
**Opt. A2 –** United Kingdom 240 V, 50 Hz ..... **NC**
**Opt. A3 –** Australian 240 V, 50 Hz ..... **NC**
**Opt. A4 –** North American 240 V, 60 Hz ..... **NC**
**Opt. A5 –** Switzerland 220 V, 50 Hz ..... **NC**

TD
Product available through an Authorized Tektronix Distributor (listed on pages 570-571). AFG 2020 also available through TekDirect. Call 1-800-426-2200

GPIB IEEE-488
The AFG 2000 and AWG 2020 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Arbitrary Generators
## Modular

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### Arbitrary Waveform Generators

At Tektronix, Arbitrary waveform generation concepts are produced today as: Arbitrary Waveform Generators, Arbitrary Function Generators, and Direct Digitally Synthesized Generators. Tektronix has defined these distinctive designs as follows:

**Arbitrary Waveform Generators (AWG)** – Refers to sources which convert digital information into analog waveforms. These products utilize digital memories for waveform storage and execution.

**Arbitrary Function Generators (AFG)** – Include AWG capabilities plus either standard Analog or Synthesized Standard waveforms (sine, square, triangle, ramp up or down, and DC). Some of the products also include built-in sweepers.

**Direct Digital Synthesizers (DDS)** – Optimized for generation of synthesized standard waveforms which offer limited Arbitrary Generation capability.

**TM 5000 SERIES**

Available as Plug-in (AWG 5100 or AFG 5100 Series) modules for the TM Series. Recommended DSOs for optimal systems applications include: 2200 Series, 2400 Series and TDS Series products.

The AFG 5102 Arbitrary Function Generator is three generators in one. It incorporates (1) an Arbitrary Waveform Generator (2) an independent Analog Function Generator for Standard waveforms (sine, square, triangle, ramp up or down, and DC) and (3) a sweep generator which provides linear, logarithmic and a unique Arbitrary sweep of the output waveform.

**APPLICATION TABLE**

| | General Purpose | Computer | Communication | Industrial | Semiconductor |
|---|---|---|---|---|---|
| **AFG 5102** | √ | • | • | √ | • |
| **AWG 5105** | √ | √ | √ | √ | • |
| **AWG 5102** | √ | • | • | √ | • |

*√ = Highly recommended, • = Compatible*

**ARBITRARY GENERATORS SELECTION GUIDE**

| Vendor/Model | AWG 5105 | AFG 5102 | AWG 5102 |
|---|---|---|---|
| **Sample Rate** | 50 MS/s | 20 MS/s | 20 MS/s |
| **Time Base Accuracy** | 0.02% | 50 ppm Synth on | 0.02% |
| **Vertical Res. (bits)** | 12 | 12 | 12 |
| **Sine, Sqr, Tri, Ramp, DC** | Synthesized Only 3 MHz | Yes; Full Analog FG 20 MHz – .02 Hz | Synthesized Only 1 MHz |
| **Execution Memory** | 64K pts/CH | 32K pts | 32K pts |
| **Non-Volatile Memory** | 256K pts | 32K pts | 32K pts |
| **Memory Sequencing** | NA | NA | NA |
| **Graphic Waveform Editing** | Line Draw/Pre Def | Line Draw/Pre Def | Line Draw/Pre Def |
| **Output Channels** | 1 CH | 1 CH | 1 CH |
| **Add a CH Option** | Opt. 02 | NA | NA |
| **Amplitude V p-p into 50 Ω** | 15 V to 15 mV | 15 V to 15 mV | 10 V to 10 mV |
| **Package Format** | TM 5000 Plug-in | TM5000 | TM5000 |
| **Ext Clock** | Clk IN/OUT | Clk IN/OUT | Clk IN/OUT |
| **Modulation** | AM (FM variable clk) | AM/FM | AM (FM variable clk) |
| **Built-in Sweeper** | NA | Lin/Log/Arbitrary | NA |
| **Media Storage** | NA | NA | NA |
| **Direct DSO Transfer** | NA | NA | NA |
| **GPIB Bus Monitor** | NA | NA | NA |
| **IEEE Standard** | IEEE 488.2/SCPI | IEEE 488.1 | IEEE 488.1 |
| **Software Support** | | | |
| **WaveWriter/AWE** | Yes | Yes | Yes |
| ***1 R4** | | Yes | Yes |
| ***2 Lab Windows** | Yes | Yes | Yes |
| **Prices begin at** | **$4,995** | **$3,995** | **$2,995** |

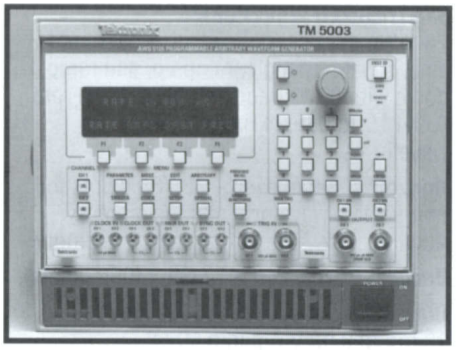
**1 Rapid Systems software package*
**2 National Instruments software package*

# Arbitrary Generator

## Signal Sources – Modular








### AWG 5105

The AWG 5105 Arbitrary Waveform Generator lets you accurately simulate complex waveform events by combining standard synthesized function generator capabilities with arbitrary waveform generation. The 64K addresses on the horizontal axis and 4096 possible levels for each address (12-Bit vertical axis) define virtually any waveshape that can be mathematically generated.

Waveforms can be defined point-by-point or you edit one of the pre-defined waveforms for the desired output.

**WAVESHAPES**

Sine, square, triangle, ramp up, ramp down, arbitrary, white noise, and DC (available in Edit Menu).

**OPERATING MODES**

**Continuous** – Output continuous at programmed waveshape, frequency, amplitude, and offset.

**Triggered** – Output quiescent until triggered by an internal, external, GPIB, or manual trigger; then generates one cycle.

**Gated** – Same as triggered mode except waveform is executed for the duration of the gated signal. The last cycle started is completed.

**Burst** – Same as triggered mode for programmed number of cycles from 2 to 999,999; 2 is the default value.

**Amplitude Modulation** – The generator can be externally modulated.

**FREQUENCY CHARACTERISTICS**

**Range** – <1 μHz (64K points) to 25 MHz (2 points).

**Resolution** – 4 digits (9,999 counts).

**Accuracy** – 0.02% of reading in continuous mode. ±3% of reading in triggered, gated, and burst modes.

**Jitter** – <0.1% RMS.

**MAIN OUTPUT**

**Amplitude Range** – 15 mV to 15 V p-p into 50 Ω (30 mV to 30 V p-p into open circuit). Open circuit values are two times the displayed values.

**Amplitude Resolution** – 3.5 digits, 10 mV from 1.5 V to 15 V p-p into 50 Ω; 1 mV from 15 mV to 1.499 V p-p into 50 Ω.

**Amplitude Accuracy** – ±2.0% of setting ±20 mV of programmed value for 1.5 to 15 V. ±3% of setting ±5 mV for 15 mV to 1.5 V output. Specified for synthesized waveform output at 1 kHz.

**AUXILIARY OUTPUTS**

**Clock Output** *2 – TTL level squarewave: 50 Ω.

**Sync Output** *2 – Positive TTL level pulse: 50 Ω.

**Marker Out***2 – Positive TTL level pulse, duration of one clock rate: 50 Ω.

**AUXILIARY INPUTS**

**Clock Input***1 – TTL compatible. Bandwidth: 50 MHz max. Input Impedance: 10 kΩ. Max Input Voltage: 15 VDC + peak AC.

**Triggering/Gating In***1 – Bandwidth: DC to 15 MHz with 25 ns, 150 mV min pulse. Input Impedance: 10 kΩ. Max Input Voltage: 15 VDC + peak AC.

**AM Input***2 – Level: 5 V p-p for 100% modulation. Bandwidth: DC to 20 kHz. Input Impedance: 10 kΩ. Max Input Voltage: 15 VDC + peak AC.

**Arbitrary Hold Input** *2 – TTL compatible HI holds arbitrary execution. Input Impedance: 10 kΩ. Max Input Voltage: 15 VDC + peak AC.

**External Summing Input***2 – Level: 1 V for full-scale output. Bandwidth: 10 MHz. Input Impedance: 1 kΩ.

**PHYSICAL CHARACTERISTICS**

| Dimensions | cm | in. |
|---|---|---|
| Height | 12.7 | 5.0 |
| Width | 20.32 | 8.0 |
| Length | 27.94 | 11.0 |
| **Weight** | **kg** | **lb.** |
| Net | 1.8 | 4.0 |

**OTHER**

**Memory** – 256K (262,144 point) non-volatile waveform memory (shared with second channel for Opt. 02). 64K (65,536) point volatile waveform execution buffer per channel.

**Display** – Two line alphanumeric, 16 character LED. Provides clear descriptive error messages.

**1 Also available at rear interface.*

**2 Available only at rear interface.*

**AWG 5105**

- Three-Wide Plug-In Module for TM 5003 and TM 5006A Mainframes
- Fully Programmable from Front Panel or Tektronix GPIB
- Arbitrary Waveform Generation from 1 μHz to 25 MHz
- 64K per Channel Executable Memory
- Non-Volatile Storage for up to 98 Front Panel Settings
- 15 mV to 15 V p-p into 50 Ω
- Simulated Analog Functions from 0.001 Hz to 3 MHz
- Convenient Creation and Modification of Waveforms with WaveWriter™ Software
- Ext Clock In/Out

*Our highest performance plug-in module with optional second channel.*

TD

WaveWriter™ available through an Authorized Tektronix Distributor (listed on pages 570-571). AWG 5105 also available through TekDirect. Call 1-800-426-2200

GPIB IEEE-488

The AWG 5105 complies with IEEE Standard 488.1/488.2-1987, and with Tektronix Standard Codes and Formats.

## ORDERING INFORMATION

**AWG 5105**

Programmable Arbitrary/Function Generator ..... TD **$4,995**

**Includes:** Instrument Manual; Reference Guide; Instrument Interfacing Guide.

**Opt. 02** – Add 2nd Channel ..... TD **+$2,200**

**SOFTWARE**

**WaveWriter™** – See page 341 for full description

Order S3FT400 ..... TD **$795**

# AFG 5102
# AWG 5102

# Arbitrary Generators
## Signal Sources – Modular

*AWG 5102 offers low cost and high performance arbitrary waveforms. AFG 5102 combines the features of the AWG with standard analog and sweep generator.*

TD
AFG 5102 available within 24 hours through TekDirect
Call 1-800-426-2200.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488
The AFG 5102, AWG 5501, and 5502 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

**AFG 5102/AWG 5102**

- Three-wide Plug-in Module for TM 5003 and TM 5006A Mainframes
- Fully Programmable from Front Panel or GPIB
- Arbitrary Waveform Generation from .02 µHz to 20 MHz
- 32K Memory for Waveform Storage
- Non-Volatile Storage for up to 98 Front Panel Settings
- 15 mV to 15 V p-p into 50Ω (AFG5102) 10 mV to 9.99 V p-p into 50Ω (AWG5102)
- .02% Accuracy (50 ppm with Synthesizer Option, AFG only)
- Sine, Square, Triangle, Ramp Up, Ramp Down, and DC
- Independent Analog Function Generator 0.001 Hz (0.02 Hz for AFG 5102/5502) to 20 MHz
- Linear, Logarithmic, and Arbitrary Sweep Capabilities (AFG only)
- Convenient Creation and Modification of Waveforms with WaveWriter™ Software
- External Clock



### AFG 5102/AWG 5102

The Tektronix GPIB compatible AWG 5102 Arbitrary Waveform Generator lets you accurately simulate complex waveform events by combining standard synthesized function generator capabilities with arbitrary waveform generation. The AFG 5102 Arbitrary Function Generators provide the same arbitrary capabilities with an accurate analog function generator. The AWG 5102 and AFG 5102 can output sine, square, triangle, ramp up, ramp down, and DC levels. Frequency capabilities range from 0.001 Hz (0.02 Hz for AWG 5102) to 20 MHz with amplitudes from 15 mV to 15 V peak-to-peak into 50Ω (AFG5102). These waveforms can be continuous, triggered, gated, or burst. Triggering can be selected from an internal, external, manual, or GPIB trigger. You can also apply amplitude or frequency modulation.

**CONFIGURATIONS**
The AWG 5102 and AFG 5102 are 3-wide plug-in modules that fit into the Tektronix TM 5003 and TM 5006 power module mainframes.

### Characteristics

The following characteristics apply to both the AWG 5102 and AFG 5102 except as noted otherwise.

**WAVESHAPES**
Sine, square, triangle, arbitrary, ramp up, ramp down, and DC.

**OPERATING MODES**
**Continuous**–Output continuous at programmed waveshape, frequency, amplitude, and offset.

**Triggered** – Output quiescent until triggered by an internal, external, GPIB, or manual trigger; then generates one cycle.

**Gated** – Same as triggered mode except waveform is executed for the duration of the gated signal.

**NBurst** – Same as triggered mode for programmed number of cycles from 1 to 9,999.

**Modulated** – The generator can be amplitude modulated.

**Increment** – Frequency, amplitude, offset, rate, and burst can be manually incremented/decremented by a selectable delta.

**SYNTHESIZED WAVEFORMS**
**Functions** – User defined, or synthesized sine, square, triangle, ramp up, and ramp down with 0.1% frequency accuracy. From 0.001 Hz to 999.9 kHz for synthesized waveforms.

**Horizontal Resolution** – 32,768 points for non-volatile waveform storage memory. Additional 32,768 point execution memory.

**Vertical Resolution** – 12 bits (4095 points).

**Output Amplitude (AWG 5102 only)** – 10 mV to 9.99 V p-p into 50 Ω.

**Output Accuracy (AWG 5102 only)** – 1.0 V to 9.99 V, ±(2.0% of setting) ±20 mV. 10 mV to 999 mV ±(3.0% of setting) ±5 mV.

**Point Duration** – 50 ns to 99.99 sec with 4 digits resolution. Accuracy better than 0.02%. Limited to 1 ns resolution.

**Risetime** – <20 ns (10% to 90%) with no filtering.

**Filters** – 4 selectable, single-pole filters. Filter 3 dB cutoff frequency from 1 MHz to 900 Hz.

**AUXILIARY OUTPUTS**
**Clock Output*1** – TTL level squarewave at point execution rate.

**Sync Output** – Positive TTL level pulse at the end of each arbitrary cycle. Output Impedance: 50 Ω.

**Marker Out*1** – Positive TTL level pulse, duration of one clock rate.

**AUXILIARY INPUTS**
**Clock Input*2** – TTL compatible. Bandwidth: 20 MHz max. Width: 20 ns min.

**Trigger In** – TTL compatible. Maximum rate: 20 MHz. Minimum width: 20 ns.

**Arbitrary Hold Input*2** – TTL compatible.

**USER DEFINED WAVEFORMS**
**Frequency** – Range: <1 µHz (32K points) to 10 MHz (2 points). Resolution:4 digits (9999 counts). Accuracy: 0.02% of reading in continuous mode; ±3% of reading in triggered, gated, and burst modes. Jitter: <0.1% RMS. Stability: ±0.2% in continuous mode for all time intervals; ±0.5% for 24 hours in other modes.

**1 Also available at instrument rear interface.*
**2 Also available at instrument rear interface.*

# Arbitrary Generators
## Signal Sources – Modular

**AFG 5102**
**AWG 5102**

### Characteristics AFG 5102

The following characteristics are unique to the AFG 5102.

**OPERATING MODES**
Same as AWG 5102 with the following additions:

**Burst –** Same as triggered mode for programmed number of cycles from 2 to 9,999.

**Amplitude Modulation –** The generator can be externally modulated.

**Frequency Modulation –** Standard waveforms can be frequency modulated by an external signal.

**Variable Symmetry –** Duty cycle of standard waveform adjustable from 10-90% up to 2 MHz.

**FREQUENCY CHARACTERISTICS**
**Range –** 0.02 Hz to 20 MHz.

**Resolution –** 3.5 digits (1,999 counts).

**Accuracy –** 0.2% of reading from 200 Hz to 20 MHz in continuous mode. ±5% of reading at all other ranges.

**Jitter –** <0.1% RMS.

**Stability –** ±0.2% in continuous mode for all time intervals. ±0.5% for 24 hours in other modes.

**OUTPUT CHARACTERISTICS**
**Amplitude Range –** 15 mV to 15.0 V p-p into 50 Ω (30 mV to 30 V p-p into open circuit).

**Amplitude Resolution –** 3.5 digits (1500 counts).

**Amplitude Accuracy –** ±2.0% ±20 mV of programmed value for 1.5 to 15 V output. ±3% ±5 mV for 15 mV to 1.5 V output. Specified for synthesized waveform output at 1 kHz.

**Sinewave Distortion –** <0.5 THD (RMS), 20 Hz to 100 kHz. 1.5 V to 15.0 V amplitude.

**Squarewave Symmetry –** ≤±0.5%, 200 Hz to 199.9 kHz; ≤±1%, 0.02 to 1.999 MHz; ≤±5%, 2.0 MHz to 20 MHz (set at 50%).

**Squarewave Risetime –** <12 ns, 10% to 90% at full output amplitude.

**Triangle Linearity –** 98% to 100 kHz measured from 10% to 90% on waveform.

**DC Mode –** –7.49 V to +7.49 V into 50 Ω (–14.98 V to +14.98 V into open circuit).

**OUTPUT OFFSET**
**Offset Range –** –7.49 V to +7.49 V into 50 Ω (-14.98 V to +14.98 V into open circuit).

**Offset Plus Peak Amplitude –** Absolute peak amplitude plus offset is limited to 7.50 V maximum into 50 Ω.

$$|\text{Offset setting}| + \frac{\text{amplitude setting}}{2}$$

must be ≤7.5 V.

**AUXILIARY OUTPUTS**
Same as AWG 5102 with the following additions:

**Sweep Output –** Same waveshape as selected sweep.

**AUXILIARY INPUTS**

Same as AWG 5102 with the following additions:

**VCO/FM Input –** Level: 0 to +5 V for a 1000:1 frequency change. Bandwidth: DC to 20 kHz.

**ARBITRARY WAVEFORMS**
Same as AWG 5102 with the following exceptions:

**Output Amplitude –** 15 mV to 15.0 V p-p into 50 Ω.

**Output Accuracy –** 1.5 V to 15 V, ±(2.0% of setting) ±20 mV. 15 mV to 1.5 V ±(3.0% of setting) ±5 mV.

**Risetime/Falltime –** –2047 to +2047 data change at maximum amplitude (9.99 V p-p) into 50 Ω. ≤20 ns (10% to 90%) at 9.99 V amplitude.

**FREQUENCY SWEEP**
**Sweep Types –** Linear, logarithmic, and arbitrary.

**Sweep Time –** 50 ns to 99.99 sec per point. 1 ns (4 digits) maximum resolution. For linear and logarithmic sweeps, one sweep equals 1000 points for the time base. Arbitrary sweeps may be defined with up to 32,767 horizontal points for the time base.

**Sweep Width –** 1000:1 maximum. Start frequency and stop frequency must be in the same range.

**Safety –** UL listed 1244, certified CSA 22.2 No. 231-M89.

**Sweep Ranges –** 20 kHz to 20.0 MHz, 2 kHz to 2.0 MHz, 200 Hz to 200.0 kHz, 20 Hz to 20 kHz, 2 Hz to 2 kHz, 0.2 Hz to 200 Hz, 0.02 Hz to 20 Hz.

**SYNTHESIZER CHARACTERISTICS**
**Resolution –** 5 digits (20,000 counts max). Range: 2.01 Hz to 20 MHz.

**Accuracy –** ±0.005%. Stability: 10 ppm per °C.

**Frequency Locking Time –** <2 sec +100 cycles.

**Power Consumption –** 50 VA maximum, limited by internal fuse.

**Power Dissipation –** 60 W.

**PHYSICAL CHARACTERISTICS**

| Dimensions | mm | in. |
|---|---|---|
| Height | 12.7 | 5.0 |
| Width | 20.32 | 8.0 |
| Length | 27.94 | 11.0 |
| **Weight** | **kg** | **lb.** |
| Net | 1.8 | 4.0 |

**OTHER**
**Memory –** Non-volatile, stores up to 98 front-panel settings. 32,768-Bit arbitrary waveform memory.

**Display –** Two line alphanumeric, 16 character LED. Provides clear descriptive error messages.

**Recommended Adjustment Interval –** 1000 hours or 6 months, whichever occurs first.

## ORDERING INFORMATION

**AFG 5102**
Programmable Arbitrary/ Function Generator ..... TD **$3,995**
**Includes:** Instruction Manual.

**AWG 5102**
Programmable Arbitrary/ Waveform Generator ..... **$2,995**
**Includes:** Instruction Manual.

**ACCESSORIES**
See page 492 for cables, adapters, and terminators.

**SOFTWARE**
**WaveWriter™ –** See page 341 for full description
Order S3FT400 ..... TD **$795**

**SERVICE MANUALS**
AFG 5102 ..... *1
AWG 5102 ..... *1

**1 Please contact your local Tektronix representative for price and ordering information.*

TD
AFG 5102 available within 24 hours through TekDirect
Call 1-800-426-2200.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488
The AFG 5102, AWG 5501, and 5502 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

HFS 9003
HFS 9009
HFS 9DG1
HFS 9DG2

# Programmable Stimulus System

## Signal Sources – Standalone

*All the stimulus you need in a single instrument.*

*The Tektronix HFS 9000 Stimulus System combines the capabilities of a complete data generator, pulse generator, DC level source and switch matrix in a single instrument — it's the industry's first Data Time Generator.*

**HFS 9000 SERIES FEATURES**

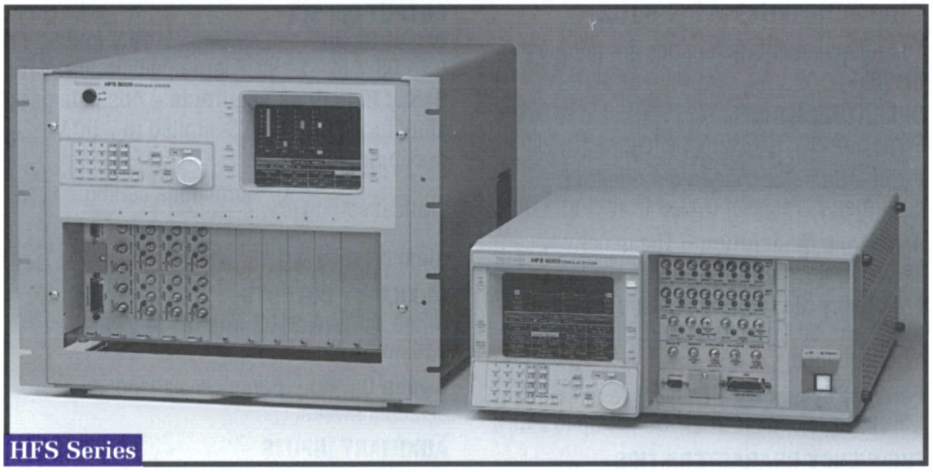
- Complete Stimulus Setup In Just Minutes
- Specify Data and Timing On Every Pin
- Up to 630 MHz Repetition Rate
- Fully Digital Implementation
- Multi-Channel Architecture – Up to 640 or more Phase Locked Channels
- Independent Edge Placement
- Channel Deskew
- Precision Channel-to-Channel Timing Alignment
- 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 – 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 4 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.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The HFS 9000 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Programmable Stimulus System

## Signal Sources – Standalone

**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 SET-UPS AND VECTORS**
Edit set-ups and vectors easily with BitWrite™ Software. With this Microsoft® Windows® based package you can build a complete test set-up, including timing parameters,voltage levels, channel assignment and test vectors on your PC. Ideal for remote test development. Individual set-ups and test vectors can be up-loaded 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 & 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 risetime. 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 stimulus 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.*

**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 |

# HFS 9003 HFS 9DG1 HFS 9009 HFS 9DG2 Programmable Stimulus System

## Signal Sources – Standalone

**OUTPUT EDGE PLACEMENT PERFORMANCE**

**Channel Deskew Range –** Minus 60 ns to 2.0 µs.

**Channel Deskew Resolution –** 1 ps.

**DELAY Adjust Range –** Zero 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 VAC to 130 VAC RMS, and 180 VAC to 250 VAC 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

**HFS 9003**
3-slot Mainframe ..... **$12,695**
**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. 01** – BitWriter™ Software ..... *1
**Opt. 1R** – Rackmount ..... **+$295**

**HFS 9009**
9-slot Mainframe ..... **$19,995**
**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. 01** – BitWriter™ Software ..... *1

**ACCESSORIES**
See page 492 for Cables, Adapters, and Terminators.

**HFS 9DG1**
Four differential data time outputs per card with <250 ps transition time, 630 MHz. ..... **$11,000**
**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. ..... **$7,900**
**Includes:** Installation instructions and two Clock Cables.
**S85HFS1** – BitWriter™ Software ..... *1

**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1** – Universal Euro: 220 V, 50 Hz ..... **NC**
**Opt. A2** – United Kingdom: 240 V, 50 Hz ..... **NC**
**Opt. A3** – Australian: 240 V, 50 Hz ..... **NC**
**Opt. A4** – North American: 240 V, 60 Hz ..... **NC**
**Opt. A5** – Switzerland: 220 V, 50 Hz ..... **NC**
See Customer Information Section for additional description.

**1 Contact your Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The HFS 9000 Series complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Function Generators
## Signal Sources – Modular

### Function Generators

Function generators stimulate devices and circuits under test by simulating typical waveforms. Stimulation can be applied to circuits ranging from a single logic device to a satellite communications system or a heart pacemaker. Waveforms simulated can range from a simple train of pulses to representations of spread-spectrum modulated RF signals or cardiac systole. All of them offer sine, triangle, and square-wave outputs. Many provide ramp and pulse outputs, obtained by varying the symmetry of triangle and square waves. That is, variable symmetry lets you take a triangle wave and increase the slew rate of its leading edge while decreasing the slew rate of its trailing edge, simulating the sweep functions used in raster-scan display devices. Varying the symmetry of square waves lets you emulate a pulse generator by giving you precise control over pulse width and duty cycle. The need for sines, ramps and pulses is easy to understand, but when do you need triangle and square waves? Triangle waves are used to characterize or verify tracking, detection, switching or trip points. They help determine the switching thresholds of comparators, Schmitt triggers, peak detectors, A-to-D converters, and hysteresis circuits. Square waves help characterize the switching response of amplifiers, gates, and level translators. They make it possible to measure risetime, slew rate, overshoot, overdrive recovery and settling time.

Frequency accuracy is three to five percent on instruments with mechanical-dial frequency input, and typically better than 0.1 percent on instruments with digital controls. This can be enhanced to better than 0.005 percent accuracy with a synthesizer mode, in which the function generator is locked to a reference crystal oscillator. On instruments such as the FG 5010, it is possible to lock the phase of the output to a reference signal while varying relative phase plus and minus 90 degrees. Except in more expensive instruments, square-wave/pulse risetimes are slower than those output by pulse generators. Typical values are 20 to 25 ns, although the Tektronix FG 504 offers 6 ns risetimes.

All function generator outputs can be triggered and gated. In triggered mode, you get one cycle of output each time a trigger signal is applied. Some function generators also provide burst mode, in which a preset number of cycles is output for each trigger. In gated mode, you get output as long as the trigger signal is asserted. The frequency of sinewave outputs can be swept, with the sweep signal available for driving the horizontal section of an oscilloscope. Generally, swept measurements are used in aligning receivers and in evaluating amplifier and filter response. In addition, frequency sweeps also simulate the "chirp" waveforms found in radar and other speed and distance measuring systems.

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# Function Generators

## Signal Sources – Modular

### FUNCTION GENERATOR SELECTION GUIDE

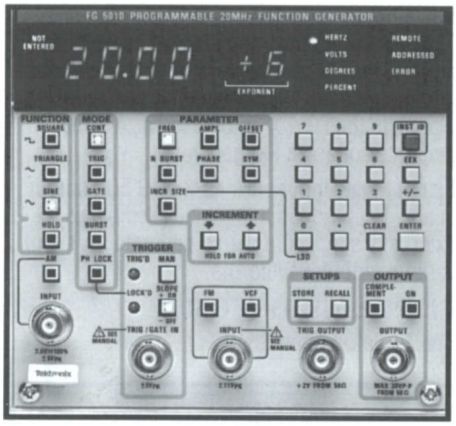
| | FG 501A | FG 502 | FG 503 | FG 504 | FG 5010 |
|---|---|---|---|---|---|
| **Sine, Square, Triangle Waveforms** | • | • | • | • | • |
| **Pulse** | • | • | | • | • |
| **Ramp** | • | • | | • | • |
| **Frequency Range (Hz)** | 0.002 to 2 M | 0.1 to 11 M | 1 to 3 M | 0.001 to 40 M | 0.002 to 20 M |
| **Amplitude (V p-p)**<br>**[Open Circuit] Into 50 Ω** | [30]<br>15 | [10]<br>5 | [20]<br>10 | [30]<br>15 | [20]<br>10 |
| **Offset (VDC)**<br>**[Open Circuit] Into 50 Ω** | [±13]<br>±6.5 | [±5]<br>±2.5 | [±7.5]<br>±3.75 | [±7.5]<br>±3.75 | [±7.5]<br>±3.75 |
| **Peak Signal + Offset (VDC)**<br>**[Open Circuit] Into 50 Ω** | [±15]<br>±7.5 | [±10]<br>±5 | [±15]<br>±6 | [±20]<br>±11.25 | [±15]<br>±7.5 |
| **Sine Wave Amplitude Flatness (Hz) (10 kHz ref, 50-Ω load)** | ±0.1 dB, 20 to 20K; ±0.5 dB, 20K to 1 M; ±1 dB, 1 M to 2 M | ±0.5 dB, 20 to 20K; ±1.5 dB, 0.1 to 11 M | ±0.5 dB, 20 to 20K; ±2 dB 0.1 to 3 M | ±0.5 dB, 0.001 to 40K ±2 dB to 40 M | ±3%, 0.002 to 1K; +3.5%, 1K to 1 M; ±5%, 1 to 5 M; +5% –10%, 5 to 20 M |
| **Sine-Wave Distortion (Hz, Maximum Output, 50-load)** | ≤0.25%, 20 to 20K | ≤0.5%, 10 to 50K | ≤0.5%, 1 to 30K; | ≤0.5%, 20 to 40K | ±0.5%, 20 to 19.99K |
| **Triangle Linearity (Hz 10 to 90%)** | ≥99%, 20 to 200K ≥97%, 200K to 2 M | ≥99%, 0.1 to 100K; ≥97%, 100K to 1 M; ≥95%, 1 to 11 M | ≥99%, 1 to 100K; ≥95%, 100K to 3 M | ≥99%, 10 to 400K; ≥95%, 400K to 40 M; ≥98%, 0.001 to 10 (typ.) | >98% to 2 M; >90% to 20 M |
| **Trigger Output (Vpeak)** | ≥+2 from 50 Ω | +2.5 to 50 Ω load | +2.5 to 600 Ω load | +2 from 50 Ω | +2 from 50 Ω |
| **External Trigger Input** | Impedance ≈2 kΩ; Trigger threshold level +1 V ±20% | Impedance ≈1 kΩ; ≥+2 V gate signal required | No | Impedance ≥10 kΩ; Sensitivity ≤1 V p-p; trigger level –1 to +10 V | 1 MΩ/50 Ω selectable; 0.0 V/0.5 V selectable |
| **Trigger** | ±90° variable start phase control | No | No | 20 MHz max., ±80° start phase control to 10 MHz | ±90° variable start phase control |
| **Gate** | ±90° variable start phase control | Fixed 0° | No | No | |
| **Phase Lock (Hz)** | | | | 100 to 40 M ±80° phase range | 20 to 20 M (Auto Scan) |
| **Counted Burst** | | | | | 1 to 9999 |
| **Internal Sweep Duration** | | | | Log or linear, separate start/stop dials 0.1 M to 100 | |
| **Voltage Controlled Frequency (FM)** | Up to 1000:1 frequency change with 10 V external signal | | | | |
| **Output Hold Mode (Hz)** | | No | | 0.001 to 400 | 0.002 to 200 |
| **Symmetry (%)** | ≤5 to ≥95 variable | 5, 50, 95 Fixed | 50 Fixed | 7 to 93 variable | 10 to 90 1% steps |
| **Triangle** | ±0.5 dB, 20 to 200K; ±2 dB, 200K to 2 M | ±3 dB ref to Sine Wave | ±1 dB ref to Sine Wave | ±2 dB, 40K to 40 M | ±2%, 0.002 to 1K; ±3.5%, 1 to 100K; +4%, –5%, 1 to 5 M; +4%, –20% 5 to 20 M |
| **Square** | ±0.5 dB, 20 to 2 M | ±3 dB ref to Sine Wave | ±1 dB ref to Sine Wave | ±0.5 dB to 20 M; ±2 dB to 40 M | ±2%, 0.002 to 1K; ±3.5%, 1 to 100K; +4%, –5%, 1 to 5 M; +4%, –20%, 5 to 20 M |
| **Square-Wave Response** | ≤25 ns rise/fall <3% p-p aberrations | ≤20 ns rise/fall ≤3% p-p aberrations | ≤60 ns rise/fall ≤3% p-p aberrations | ≤6 ns rise/fall fixed, 10 ns to 100 ms variable; ≤5% p-p +30 mV aberrations | ≤10 ns rise/fall ≤5% p-p aberrations |
| **Modulation** | FM | FM | FM | AM/FM | AM/FM |
| **IEEE STD 488.1 1987** | | | | | Yes |
| **Modules Size** | 1 wide | 1 wide | 1 wide | 2 wide | 2 wide |

# Function Generators

## Signal Sources – Modular








### FG 5010
### Programmable Function Generator

All functions are fully programmable either from the front panel or over the GPIB. The ability to store up to 10 complete front panel settings reduces programming requirements and enhances standalone capability.

The FG 5010 maintains frequency accuracy within 0.1% over its full 0.002 Hz to 20 MHz frequency range. Automatic phase lock to an external signal is possible from 20 Hz to 20 MHz. Waveform hold can freeze the output voltage of any 200 Hz or less waveform at its instantaneous value. With the output amplitude set to 0 V, the DC offset can be programmed to provide a DC voltage source of 0 to ±7.5 V in 10 mV steps.

### Characteristics (see table at left)

**Accuracy –** Continuous mode, ±0.1%; Trigger, Gate, Burst Modes, Frequency ≤200 Hz, ±0.1%; frequency >200 Hz, ±5.0%.

**Resolution –** Continuous mode, 4 digits; Trigger, Gate, Burst modes, Frequency ≤200 Hz, 4 digits; Frequency >200 Hz, 3 digits.

**Frequency Stability –** ≤0.05% of full scale for 1 hour, ≤0.05% of full scale for 24 hours.

**Output Impedance –** 50 Ω.

**Trigger Output –** 0 ±100 mV to ≥2 V from 50 Ω into an open circuit.

**TRIG, GATE, BURST, AND PH LOCK INPUT**

**Trigger Input –** 1 M Ω/50 Ω selectable; 0.0 V/0.5 V selectable.

**Amplitude Sensitivity –** ≤250 mV p-p.

**Maximum Input Amplitude –** ±5 V peak into 50 Ω, ±20 V peak into 1 MΩ.

**Burst Range –** 1 to 9999 cycles.

**Amplitude Modulation –** 100% with 5 V p-p, DC to ≥100 kHz, <2% distortion to 2 MHz at 70%, <4% to 20 MHz at 70%. Max. Amp. ±20 V.

**Frequency Modulation –** DC to ≥100 kHz, ≤2% distortion, Max. Amp. ±20 V.

**VCF Modulation –** 0 to 10 V produces >1000:1 Frequency change, DC to ≥100 kHz, ≥0.063 V/µs slew rate, Max. Amp. ±20 V.

### FG 504 Function Generator

The output of the FG 504 can be phase locked, gated, or triggered by a reference signal. This lets you convert from one waveform to another, such as pulses to sine waves, as well as adjusting phase relationships. Post-attenuator offset enables use of the full ±7.5 V offset range with small signals. The FG 504 output can be swept, or amplitude or frequency modulated by external signals. In addition, the FG 504 can supply internally generated linear – or logarithmic-swept frequencies of up to a 1000:1 range with convenient control of start and stop frequencies.

The FG 504 also provides trigger output, external voltage-control input, and sweep output.

### Characteristics

(see table at left)

**Dial Accuracy –** ≤3% to 4 MHz, ≤6% to 40 MHz.

**Custom Frequency Change –** Includes cap. for 20 Hz to 20 kHz.

**Frequency Stability –** ≤0.05% for 10 min., ≤0.1% for 1 hour, ≤0.5% for 24 hours, constant temperature.

**Attenuator in 10 dB Steps –** 0 to –50 dB.

**VAR Control –** Variable control provides up to –20 dB additional attenuation.

**External Trigger Input –** Impedance ≥10 kΩ; Sensitivity ≤1 V p-p; Trigger level; –1 to +10 V.

**Ramp Output –** 0 V to 10 V from 1 kΩ.

**Amplitude Modulation –** 100% with ≈ 5 V p-p, DC to 100 kHz; <5% distortion to 4 MHz at 70% modulation <10% to 40 MHz at 65% modulation.

**VCF –** Up to 1000:1 Frequency change with 10 V external signal. Slew rate ≥0.3 V/ms.

**FG 5010**

- 0.002 Hz to 20 MHz
- Up to 20 V p-p From 50 Ω
- Sine, Square, Triangle, Pulse, and Ramp Waveforms
- 10 ns Rise/Fall
- 10 % to 90% Variable Symmetry in 1% Steps
- Trigger, Gate, Counted Burst
- Phase Lock, with Autoscan
- AM, FM, VCF
- Waveform Complement
- Two-wide Plug-in Module for TM 5006A and TM 5003 Mainframes
- UL Listed 1244

**FG 504**

- 0.001 Hz to 40 MHz
- Three Basic Waveforms, Plus a Wide Range of Shaping with Variable Rise/Fall Times and Symmetry Controls
- Logarithmic or Linear Sweep
- Up to 30 V p-p Output
- Built-In Attenuator
- AM and FM
- Phase-Lock Mode
- External and Manual Trigger or Gate
- Two-wide Plug-in Module for TM 500 Series Mainframes

*Function Generators with superior features.*

## ORDERING INFORMATION

**FG 5010**
20 MHz Function Generator ..... **$4,700**
**Includes:** Instruction Manual (070-3467-01); Instrument Interfacing Guide (070-4613-00); Reference Guide (070-3561-00).

**FG 504**
40 MHz Function Generator ..... **$4,050**
**Includes:** Instruction Manual (070-2655-00).

**WARRANTY-PLUS SERVICE OPTIONS**

**Opt. M7 –** Calibration Service
FG 5010 ..... **+$280**
FG 504 ..... **+$225**

**Opt. M9 –** Repair Protection
FG 5010 ..... **+$380**
FG 504 ..... **+$380**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The FG 5010 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# FG 503
# FG 502
# FG 501A

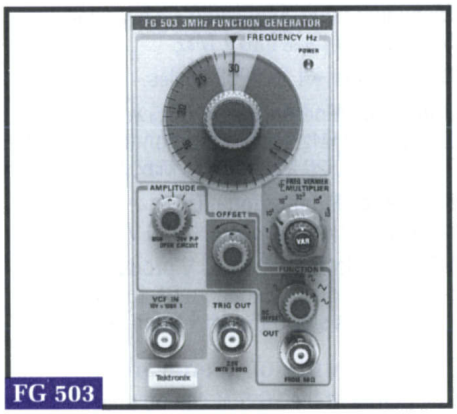
# Function Generators
## Signal Sources – Modular

*Low cost, manual, general purpose plug-in modules.*

**FG 503**
- 1.0 Hz to 3 MHz
- Three Waveforms
- Up to 20 V p-p Output
- Up to ±7.5 V Offset
- VCF
- Single-wide Plug-in Module for TM 500 Series Mainframes

**FG 502**
- 0.1 Hz to 11 MHz
- Five Waveforms
- VCF and Gated Burst
- Single-wide Plug-in Module for TM 500 Series Mainframes

**FG 501A**
- 0.002 Hz to 2 MHz
- 30 V Peak-to-Peak, 13 V Offset
- 5% to 95% Variable Symmetry
- Trigger or Gate, Slope
- 60-dB Step Attenuator
- ≤0.25% Sine-Wave Distortion
- ≤25 ns Rise/Fall
- Single-wide Plug-in Module for TM 500 Series Mainframes



FG 503

### FG 503

The FG 503 Function Generator has high-quality low-distortion sine, square, and triangle waveforms. In overlapping ranges from 1 Hz to 3 MHz. The output frequency can be swept over a 1000:1 ratio by an external voltage. A trigger output is available for controlling external devices or equipment. Amplitude up to 10 V peak-to-peak can be developed across a 50 Ω load (20 V peak-to-peak open circuit). Selectable offset up to 3.75 VDC across 50 Ω (7.5 VDC open circuit) is also featured.

### Characteristics (FG503)

See Table on page 354.



FG 502

### FG 502

The FG 502 Function Generator has low-distortion sine, square, and triangle waveforms, and positive or negative ramps and pulses. Output frequency is variable from 0.1 Hz to 11 MHz. The high-frequency range from 1 to 11 MHz permits the function generator to be extended into the medium radio frequency range. VCF input lets the FG 502 to be used as a sweep generator or as an FM generator.

External-gate input permits the FG 502 output in any of its modes to be controlled by an externally supplied pulse to generate bursts of various output waveforms.

### Characteristics (FG502)

See Table on page 354.



FG 501A

### FG 501A

The FG 501A has low-distortion outputs from 0.002 Hz to 2 MHz. It can generate five basic waveforms – sine, square, triangle, ramp, and pulse – at levels up to 30 V peak-to-peak with ±13 V offset from a 50 Ω source. Waveform triggering and gating are provided with phase control to permit up to ±90° of phase shift for generating haver-sines, sine pulses, and haver triangles. A step attenuator has 60 dB of output signal attenuation in 20 dB steps with an additional 20 dB of variable attenuation. Variable symmetry from 5% to 95% provides ramps and pulses. Pulse rise time is ≤25 ns. Audio sine-wave distortion is ≤0.25 and audio amplitude flatness is within 0.1 dB.

### Characteristics (FG 501A)

See Table on page 354.

## ORDERING INFORMATION

**FG 503**
3 MHz Function Generator ..... **$945**
**Includes:** Instruction Manual (070-1727-01).

**FG 502**
11 MHz Function Generator ..... **$1,375**
**Includes:** Instruction Manual (070-1760-01).

**FG 501A**
2 MHz Function Generator ..... **$1,225**
**Includes:** Instruction Manual (070-2957-00).

**WARRANTY-PLUS SERVICE OPTIONS**

**Opt. M7** – Calibration Service
FG 501A ..... **+$125**
FG 502 ..... **+$115**
FG 503 ..... **+$90**

**Opt. M9** – Repair Protection
FG 501A ..... **+$155**
FG 502 ..... **+$145**
FG 503 ..... **+$110**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Pulse Generators
## Signal Sources – Modular

### Pulse Generators

The selection guide below shows the broad line of products offered.

Controllable rise and fall times are also useful in determining the characteristics of edge-triggered devices.

The Tektronix PG 5110 meets an impressive range of pulse generation requirements from 0.1 Hz to 50 MHz – single or dual channel, on the bench or in a system, and under either local or programmable control. With its easily mastered, menu-driven interface, the PG 5110 delivers maximum functionality – in the hands of a line technician or design engineer.

Paired pulses can be generated at selected repetition rates with delay control capability available for determining the time between the two pulses – a useful means by which to evaluate a circuit's ability to differentiate between two closely spaced pulses.

The general purpose, yet versatile PG 508 features independently variable rise and fall times for close approximations of real world events. These multipurpose generators can also be used for stimulus of high-impedance MOS, HTL, and CMOS logic circuits.

In 50 Ω systems, the repetition rates, amplitudes, and transition times of the PG 501 and PG 502 are designed to be compatible with common TTL, DTL, and ECL circuits.

**PULSE GENERATOR OPERATING CHARACTERISTICS**

| | PG 5110 | PG 508 | PG 501 | PG 502 |
|---|---|---|---|---|
| Pulse Period | 20 ns to 10 s | ≤20 ns to ≥200 ms | ≤20 ns to ≥200 ms | ≤4 ns to ≥100 ms |
| Pulse Duration | 10 ns to 9.90000 s | ≤10 ns to ≥100 ms | ≤10 ns to ≥100 ms | ≤2 ns to ≥50 ms |
| Duty Factor | 1 to 98.9990% | ≥70% at 0.2 µs period ≥50% at 20 ns period | ≥70% at 0.2 µs period ≥50% at 20 ns period | ≥50% |
| Pulse Delay | 0 ns to 10 s | ≤5.5 ns to ≥100 ms | Fixed, 8 ns | Fixed, 17 ns |
| Double Pulse Period | 40 ns to 10 s | NA | NA | NA |
| Transition Times | Variable from ≤6 ns to 10 ms, leading and trailing | Variable from <5.5 ns to ≥50 ms leading and trailing | ≤3.5 ns, leading and trailing | ≤1 ns, leading and trailing |
| Aberrations | ≤5% + 50 mV into 50 Ω for levels between ±5 V | <5% + 50 mV into 50 Ω | ±3.5% into 50 Ω | ±5% (duration ≥5 ns) |
| Amplitude (V p-p into 50 Ω) | 10 V, ±10 V window | ≥10 V, ±10 V window | ≥5 V | 5 V, ±5 V window |
| Accuracy Period | ±1% of setting ±1 ns | | | |
| Width & Delay | ±2% of setting ±2 ns | | | |
| Jitter | ≤0.1% of setting + 100 ps | | | |
| Trigger Sensitivity | 150 mV p-p min, DC to 50 MHz | | | |
| IEEE Std 488.1 | Yes | | | |
| Complementary Outputs | | No | Yes | No |
| Pulse Coincidence | | N/A | ≤1 ns at 50% amplitude | N/A |
| Output Controls | | Independent pulse top and pulse bottom, normal or Preset | Independent for positive output and negative output | Independent pulse top and pulse bottom |
| Manual Trigger | | Yes | No | Yes |
| Duration Mode | | Yes | Yes | Yes |
| Gate Mode | | Yes | No | No |

**CONTENTS**


**PULSE GENERATORS**

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PG 5110 ..... 358
PG 508 ..... 359
PG 502 ..... 359
PG 501 ..... 359

**PROGRAMMABLE STIMULUS SYSTEM**

HFS 9003 ..... 350
HFS 9009 ..... 350
HFS 9DG1 ..... 350
HFS 9DG2 ..... 350
**Accessories** ..... 385, 424

# PG 5110

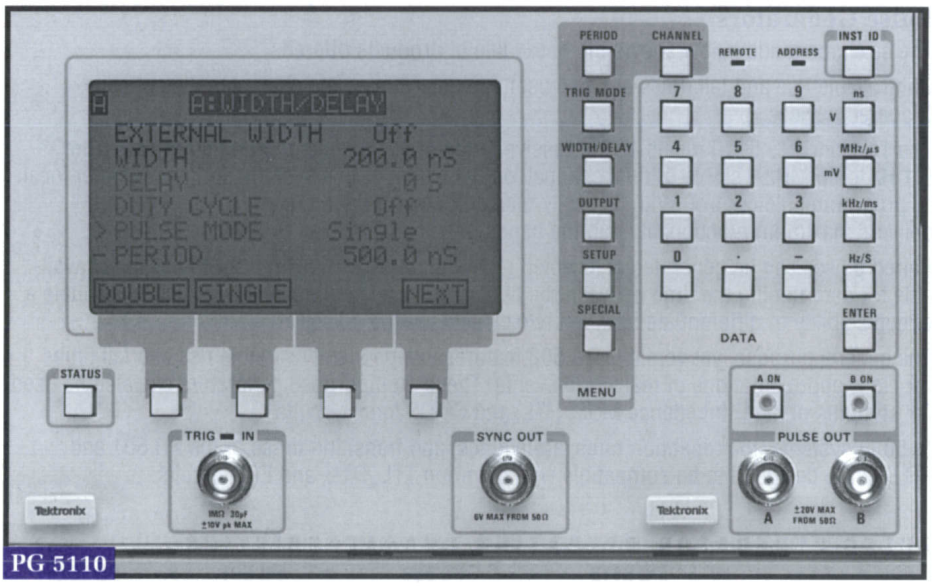
# Pulse Generator

## Signal Sources – Modular

*Our Lowest Cost 50 MHz Modular Pulse Generators.*

**PG 5110**

- Two Independent 50 MHz Output Channels
- Repetition Rates from 0.1 Hz to 50 MHz (periods from 20 ns to 10 s)
- Variable Transitions from 6 ns to 10 ms
- Clear Large Graphic Display for Convenient Operation
- 99 Stored Front-panel Settings Capability with Non-volatile Memory
- Three-wide Plug-in Module for TM 5006A and TM 5003 Mainframes



PG 5110

### PG 5110

The PG 5110 is a fully programmable pulse generator with pulse outputs from 0.1 Hz to 50 MHz in single or dual channel versions. The menu-driven front panel has storage for 99 settings.

Most of the parameters can be varied independently for each output channel. Pulse widths can vary from 10 ns to 10 s and delays from 0 ns to 10 s, both with up to 6 digits of resolution.

Predefined levels for TTL, CMOS or ECL are provided as well as adjustable levels from –10 V to +10 V with a 10 V amplitude pulse.

### Characteristics

See table on page 357.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The PG 5110 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

## ORDERING INFORMATION

**PG 5110**
50 MHz Programmable Pulse Generator ..... **$6,250**
**Includes:** Channel B, converting the PG 5110 to a dual-channel instrument, Instruction Manual (070-7740-00); Reference Guide (070-7743-00); Instrument Interface Guide (070-7742-00).

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M7** – Calibration Services ..... *1
**Opt. M9** – Repair Protection ..... *1

**OPTIONAL ACCESSORIES**
**Service Manual** – Order 070-7741-00 ..... **$50**
**Rear Interface Cable Set** – Order 118-8569-00 ..... **$250**

**ADDITIONAL ACCESSORIES**
See page 492 for cables, adapters, attenuators, and terminations.

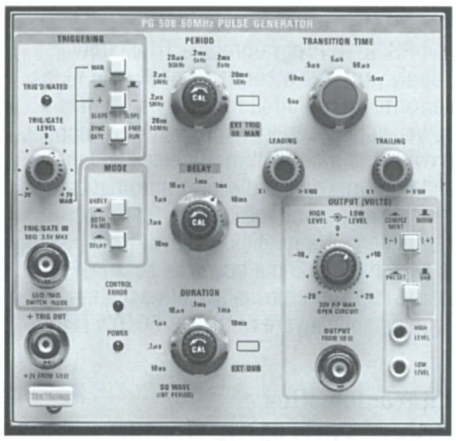
**1Contact your Tektronix representative for price information.*

# Pulse Generators

## Signal Sources – Modular







### PG 508

The PG 508 is a versatile, general-purpose, 50 MHz pulse generator.

The PG 508 features a vernier control on the rise and fall times controllable from 100 to 1. This completely overlaps the next decade range. This overlap feature can also be used to generate a ramp signal or simulate unequal slew rates in an amplifier.

Also adding to the simplicity of using the PG 508 is the capability of changing output amplitude while variable rise and fall times remain constant.

#### Characteristics

See table on page 357.




### PG 502

The PG 502 is a 250 MHz manually set Pulse Generator with rise and fall times of less than 1 ns.

#### Characteristics

See table on page 357.




### PG 501

The PG 501 is a 50 MHz manually set Pulse Generator. An optional remote manual trigger generator is available, part number 016-2597-00.

#### Characteristics

See table on page 357.

**PG 508**

- 5 Hz to 50 MHz
- Independently Variable Rise and Fall Times to 5 ns
- 20 V Output in a ±20 V Window, 10 V into 50 Ω
- Normal or Complement Output
- Wide Choice of Trigger Capabilities
- One-wide Plug-in Module for TM 500 Series Mainframes

**PG 502**

- 10 Hz to 250 MHz
- 1 ns Rise Time
- 5 V Output, ±5 V Window
- Independent Pulse Top and Bottom Level Controls
- Selectable Internal Reverse Termination
- Manual Trigger Button

**PG 501**

- 5 Hz to 50 MHz
- Simultaneous Plus and Minus Outputs
- 5 V and 3.5 ns into 50 Ω
- Independent Period and Duration Controls
- Trigger Out
- Optional Manual Trigger Generator

*Our Lowest Cost 50 MHz Modular Pulse Generator with Complementary Outputs.*

## ORDERING INFORMATION

**PG 508**
50 MHz Pulse Generator ..... **$3,325**
**Includes:** Instruction Manual (070-2044-01).

**PG 502**
250-MHz Pulse Generator ..... **$3,495**
**Includes:** Instruction Manual (070-1598-01).

**PG 501**
50 MHz Pulse Generator ..... **$995**
**Includes:** Instruction Manual (070-1361-01).

**WARRANTY-PLUS SERVICE OPTIONS**

**Opt. M7** – Calibration Services
PG 508 ..... **+$270**
PG 502 ..... **+$155**
PG 501 ..... **+$90**

**Opt. M9** – Repair Protection
PG 508 ..... **+$360**
PG 502 ..... **+$200**
PG 501 ..... **+$115**

**RECOMMENDED PROBES**

See Probes section for complete description.

**1X/10X, DC to 100 MHz** – Order P6062B ..... **$260**
**10X, DC to 100 MHz** – Order P6105A ..... **$165**
**10X, DC to 100 MHz** – Order P6122 ..... **$110**

**ADDITIONAL ACCESSORIES**

See page 492 for cables, adapters, attenuators, and terminations.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# PS 5010
# PS 503A
# PS 5004

# Power Supplies
## Modular

*Power supplies that are flexible and compact to provide a complete custom-designed test system.*

**PS 5010**

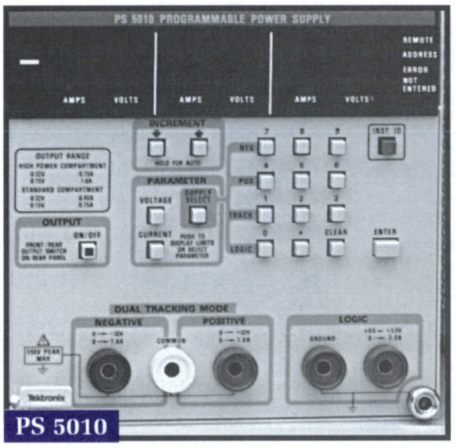
- Dual Floating Supplies 0 to 32 V, to 0.75 A (1.6 A to 15 V)
- Logic Supply 4.5 to 5.5 V, to 3 A
- 0.5% Accuracy
- Programmable Current Limits
- Three Independent Digital Displays
- Automatic Crossover
- Two Wide Size

**PS 5004**

- 0 to 20 V Floating Output
- 0.01% Accuracy
- 500 μV/0.1 mA Resolution
- Constant Voltage or Constant Current With Autocrossover
- Voltage-and/or Current-Monitoring Display
- Remote Sensing
- Single Width

**PS 503A**

- Independent Controls
- Dual Tracking Voltage Control
- 0 to +20 V and 0 to –20 V at 1 A
- Fixed Output 5 V at 1 A
- Remote Resistance Programming
- Single Wide Size



PS 5010

### Power Supplies

To ensure versatility and convenience in your test system, the TM 5000/TM 500 power supplies can be rear-interfaced with other instruments to reduce front-panel clutter.

Dual output supplies, such as the PS 5010, let you select independent series or parallel connections automatically, and, if you choose, will cause the output voltages of supplies connected in series to track together.

Critical specifications are voltage and current range, accuracy and resolution. Accuracy depends on source effect, load effect, and temperature.

Source effect deals with variations in line voltage. It may be specified as a percent of output or as a percent plus or minus a certain value. Load effect is the same as load regulation – the ability of the supply to maintain a constant voltage or current in the face of changes in loading. It is specified in terms of the maximum voltage change for given change in load current. Temperature effects are specified in terms of percents or parts per million/°C. Noise and ripple provide figure of merit, sometimes specified as PARD, for Periodic And Random Deviations. It is expressed in peak-to-peak millivolts, or milliamps.

### PS 5010

The PS 5010 Programmable Triple Power Supply provides a complete and rapid high-performance solution for many system power-supply applications. Its three supplies provide the most commonly used voltages, and the three digital displays automatically indicate all six voltage-and current-limit parameters. Automatic crossover from voltage to current limit and a powerful set of GPIB status reporting messages allow the user to be constantly aware of the PS 5010's status.

### Characteristics

**POSITIVE AND NEGATIVE FLOATING SUPPLIES CONSTANT VOLTAGE MODE**

**Voltage Range –** 0 to +32 V, 0 to –32 V.

**Voltage Accuracy –** Overall (total effect) ±(0.5% + 20 mV), Source Effect (line regulation) ±(0.01% + 2 mV).

**PARD (Ripple and Noise) –** 10 mV p-p. 20 Hz to 20 MHz.

**Load Effect (load regulation) –** 10 mV for a 1 A change in load current.

**Temperature Coefficient (typical) –** <(0.01% + 0.1 mV)/°C.

**Step Size Accuracy –** 10 mV ±10 mV to 10.0 V 100 mV ±40 mV above 10.1 V.

**CONSTANT CURRENT MODE**

**Range –** 50 mA to 0.75 A (1.60 A at 15 V and below) in high-power compartment; 50 mA to 400 mA (0.75 A at 15 V and below) in two standard-power compartments.

**POWER SUPPLIES**

**Number of Supplies –** 3.

**Maximum Voltages –** + and –32 V, Logic (+4.5 to 5.5 V).

**Maximum Amps (range) –** 1.6 A, 3A.

**Interface –** IEEE-488.

**Module Size –** 2 wide.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The PS 5010 and PS 5004 comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Power Supplies
## Modular

**PS 5010**
**PS 503A**
**PS 5004**









### PS 5004

The single-width PS 5004 Precision Power Supply provides high-resolution voltages and currents necessary in the characterization of transistor, IC, and other semiconductor and hybrid circuits and in the operation of high-performance strain gauges and other transducer systems. Its 0 to 20 V output is covered with coarse and fine adjustments to provide rapid setability and 500 μV resolution without the necessity of changing ranges. Setability resolution over the GPIB is also 500 μV. The supply output is supplied at the rear interface and the front-panel terminals. Overall accuracy is ±0.01% ±2 mV.

### Characteristics

**CONSTANT VOLTAGE MODE**

**Range –** 0 V + 20.0000 V, 0.5 mV steps.

**Overall Accuracy –** (total effect) ±(0.01% + 2 mV), Source Effect (line regulation) ±(0.01% + 2 mV).

**Source Effect (line regulation) –** ≤0.5 mV.

**Load Effect (load regulation) –** ≤1 mV.

**Temperature Coefficient (typical) –** ≤(30 ppm + 100 μV)/°C.

**Step Size Accuracy –** 500 μV, ±0.2 mV.

**PARD (Ripple and Noise) –** ≤1 mV p-p 10 Hz to 1 MHz; ≤3 mV p-p, 10 Hz to 5 MHz.

**CONSTANT CURRENT MODE**

**Range –** 10 mA to 305 mA in 2.5 mA steps.

**Overall Accuracy –** ±(2% + 5 mA).

**Isolation –** 42 V (DC + peak AC).

**GENERAL**

**Power Consumption –** 35 VA maximum.

**POWER SUPPLIES**

**Number of Supplies –** 1.

**Maximum Voltages –** 0 to 20 V.

**Maximum Amps (range) –** 305 mA.

**Interface –** IEEE-488.

**Module Size –** 1 wide.

### PS 503A

The PS 503A provides dual floating variable 20 V supplies, plus a fixed 5-V, 1-A supply. The PS 503A features superior tracking, over-voltage protection, and remote resistance programming of voltage. When operated in the high-power compartment of a TM 504, TM 506A, RTM 506, or TM 5006A mainframe, the PS 503A can provide up to 1 A from both of the 20 V supplies. A 0 to 40 V variable supply with up to 1 A of current can be configured by grounding one of the two outside terminals of the variable supplies. The two variable supplies can be set individually, then varied in a tracked mode with a single control. In addition, the plus and minus floating outputs can be programmed remotely, by either voltage programming or resistance programming via the rear interface.

### Characteristics

**±20 V FLOATING SUPPLIES**

**Ranging –** 0 to +20 V, 0 to –20 V. 0 to 40 VDC across + and – terminals.

**Stability –** Typically 0.1% +5 mV or less drift in 8 hours of constant line, load and temperature.

Isolation – 350 V (DC + peak AC).

**Current Limit High-Power Compartment –** <100 mA to 1 A.

**Standard –** <100 mA to 400 mA.

**Line Regulation –** ≤5 mV for a ±10% line voltage change.

**Load Regulation –** ≤3 mV for a 1 A load change.

**Temperature Coefficient (typical) –** <0.025%/°C.

**Step Size Accuracy –** 50 mV.

**PARD (Ripple and Noise) –** 3 mV p-p.

**+5 V SUPPLY**

**Range –** +4.75 to +5.25 VDC.

**Current Limit –** 1 A.

**Load Regulation –** ≤50 mV for a ±10% line change.

**Line Regulation –** ≤100 mV for a 1 A load change.

**PARD (Ripple and Noise) –** 5 mV p-p.

**POWER SUPPLIES**

**Number of Supplies –** 3.

**Maximum Voltages –** –20 to +20 V, +5 V.

**Maximum Amps (range) –** 1 A.

**Module Size –** 1 wide.

## ORDERING INFORMATION

**PS 5010**
Power Supply ..... **$3,450**
**Includes:** Instruction Manual (070-3391-00); Instrument Interfacing Guide (070-4610-00); Reference Guide (070-3402-00).

**PS 5004**
Precision Power Supply ..... **$2,150**
**Includes:** Instruction Manual (070-4442-00); Instrument Interfacing Guide (070-4789-00); Reference Guide (070-4596-00).

**PS 503A**
Power Supply ..... **$995**
**Includes:** Instruction Manual (070-1834-01).

**WARRANTY-PLUS SERVICE OPTIONS**

**Opt. M7 –** Calibration Service
PS 5010 ..... **+$170**
PS 5004 ..... **+$125**
PS 503A ..... **+$70**

**Opt. M9 –** Repair Protection
PS 5010 ..... **+$205**
PS 5004 ..... **+$145**
PS 503A ..... **+$90**

**ADDITIONAL ACCESSORIES**

See page 492 for cables, adapters, attenuators, and terminations.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The PS 5010 and PS 5004 comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# DM 5110
# DM 511
# DM 504A

# Digital Multimeters
## Modular

*The DM 5110/ DM 511 offers exceptional functionality and the highest performance available in a low-cost, single-width plug-in module.*

**DM 5110/DM 511**

- 4 1/2 Digit Autoranging
- Fast (3 1/2 Digit) Mode
- AC/DC Voltage, AC/DC Current, Resistance and (optional) Temperature Measurement
- AC dBm and dBV Calculations
- True RMS AC Functions
- Null and Hold Modes
- Hi/Lo/Pass Limit Testing and Compare Mode with Beeper
- Standard IEEE-488 Interface (DM 5110 only)
- Front and Rear Interfacing
- Single Wide Size

**DM 504A**

- 4 1/2 Digit Autoranging
- True RMS AC Functions
- Five Manually Selectable Voltage, Current and Resistance Ranges
- DC Volts, AC Volts, DC mAmps, AC mAmps, Ω and Temperature Functions
- Diode Test and Audible Continuity (Beeper) Modes
- Single Wide Size

**DIGITAL MULTIMETER SELECTION GUIDE**

| | DM 504A | DM 5110/DM 511 |
|---|---|---|
| Number of Digits | 4 1/2 | 4 1/2 |
| DC Volts Ranges | 200 mV to 1000 V | 200 mV to 1000 V |
| DC Volts Best Accuracy | ±0.05% | ±0.05% |
| DC Volts Best Resolution | 10 µV | 10 µV |
| AC Volts Ranges | 200 mV to 500 V | 200 mV to 500 V |
| AC Volts Best Accuracy | ±0.6% | ±0.3% |
| AC Volts Best Resolution | 10 µV | 10 µV |
| AC or DC Current Ranges | 200 µA to 2 A | 200 µA to 2 A |
| dB Ranges | N/A | +54 dB to –50 dB |
| Resistance (HI-LO) Ranges | 200 Ω to 20 MΩ | 200 Ω to 20 MΩ |
| Temperature Measurement Range | –62 to +230°C | –62 to +230°C |
| True RMS | • | • |
| Autorange | • | • |
| IEEE Standard 488 Interface | No | (DM 5110 Only) |
| Module Size | 1 wide | 1 wide |
| Mainframe Compatibility TM 5000 | TM 500 or TM 5000 for DM 5110 | TM 500/5000 for DM 511 |

### Digital Multimeters

The Tektronix TM 5000/TM 500 Modular Digital Multimeter selection includes the single-wide, programmable DM 5110 as well as the manual DM 511, and the economical DM 504A. Now there exists a selection of performance and price to match most applications.

The DM 5110 represents the optimum choice for programmability, small size, performance, features, and competitive price. The DM 511 extends the capabilities over the DM 504A by offering dBV, dBm, and rear interfacing with a new easy-to-use front panel.

### TRUE RMS MEASUREMENTS AND CREST FACTOR

All Tektronix DMMs provide true RMS readings. The crest factor of a waveform is the ratio of its peak value to its RMS value. Tektronix TM 500 and TM 5000 DMMs have a crest factor of 3, which means that they can accurately measure rectangular waveforms with duty cycles as low as 10 percent.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488

The DM 5110 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Digital Multimeters
## Modular







DM 5110



DM 504A

### DM 5110/511

The DM 5110/DM 511 offers exceptional functionality and the highest performance available in a low-cost, single-width plug-in module.

The DM 5110 is fully programmable over the IEEE-488 interface, while the DM 511 is designed for manual operation only; the units are otherwise identical.

The DM 5110 occupies one slot in any TM 5000 Mainframe, and the DM 511 can be operated in either a TM 500 or TM 5000 Mainframe.

### Characteristics

See table on page 362.

### DM 504A

The DM 504A Autoranging Digital Multimeter extends the functionality of the Tektronix TM 500 line of modular, digital multimeters with true RMS measurements, a "beeper" mode for indication of short circuits, and diode testing capability. The DM 504A also provides standard AC/DC voltage and current, and resistance measurements, and will operate in any compartment of a TM 500 or TM 5000 power module.

### Characteristics

See table on page 362.

## ORDERING INFORMATION

**DM 5110**
Programmable Autoranging Digital Multimeter ..... **$995**
**Includes:** Operators Instruction Manual (070-7478-00); Instrument Interfacing Guide (070-7560-00); Reference Guide (070-7559-00); Meter Leads, Set (196-3212-00).

**DM 511**
Autoranging Digital Multimeter. ..... **$895**
**Includes:** Operators Instruction Manual (070-7478-00); Instrument Interfacing Guide (070-7560-00); Reference Guide (070-7559-00); Meter Leads, Set (196-3212-00).

**Opt. 02** – Adds a Tektronix P6602 Temperature Probe that has been calibrated with the DM 5110/DM 511. ..... **+$285**

**Service Manual** – Order 070-7479-00 ..... **$55**

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M7** – Calibration Service DM 5110 ..... **+$160**

**Opt. M9** – Repair Protection DM 5110 ..... **+$200**

**DM 504A**
Digital Multimeter ..... **$695**
**Includes:** Instruction Manual (070-6945-00); one set of test leads.

**Opt. 02** – Adds P6602 ..... **+$285**
Temperature Probe calibrated for use with DM 504A.

**Service Manual** – 070-7135-00 ..... **$28**

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M7** – Calibration Service ..... **+$70**

**Opt. M9** – Repair Protection ..... **+$125**

**ADDITIONAL ACCESSORIES (DM 511, DM 504A)**
**PROBES**
**Temperature** – Order P6602 ..... **$335**

**High Voltage** – Order 010-0277-00 ..... **$255**

**RF** – Order P6420 ..... **$200**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488

The DM 5110 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Digital Counters
## Modular

CONTENTS

**DIGITAL COUNTERS**
General Information .....365
DC 5010 .....366
DC 5009 .....367
DC 503A .....368
**Accessories** .....385, 424

### Digital Counter/Timers

The TM 500/TM 5000 family of modular instruments includes six digital counter/timers, which provide a wide variety of price/performance features.

The 350 MHz DC 5010 and the 135 MHz DC 5009, are universal counter/timers that feature reciprocal frequency measurements and an especially wide range of other measurement functions, plus features such as autotrigger, auto-averaging, arming, probe compensation, and more. The DC 5010 and DC 5009 are GPIB programmable.

For versatility in counting, the DC 503A 125 MHz Universal Counter/Timer features eight measurement functions, including period, width, and time-interval averaging. Both input channels have the full 0 to 125 MHz frequency range, 20 mV RMS sensitivity, and separate controls for input coupling, attenuation, trigger level, and trigger slope. The 10 MHz clock provides 100 ns resolution of single-shot time interval measurements, and 10 ps resolution with averaging.

**APPLICATIONS**

Tektronix TM 5000 and TM 500 counter/timers are primarily used in environmental and production testing and on the engineering benchtop. Sometimes, they are used in field service, packaged with other Tektronix modular instruments in configurations aimed at specific testing applications.

Frequency and period measurements are straight forward, and applications abound, from RF design to manufacturing test of digital systems. On the other hand, there is a wide variety of timing measurements... not every counter/timer can make them all. The most basic timing measurements are pulse width, with which you can measure not only whole pulses, but (by adjusting trigger level) the width of aberrations, such as ringing. Some instruments will automatically measure risetimes and falltimes.

Using both input channels, you can make the time A ≥B measurement, which is used for propagation delays. You can also measure the number of events occurring on channel B during an interval on channel A.

# Digital Counters
## Modular



Tektronix modular counter/timers can totalize events on both channels and present the results as a sum, a difference, or a ratio. This can be invaluable in troubleshooting intermittent bugs in digital circuits in which a certain number of input events are supposed to produce a certain number of output events. For example, you could measure the ratio of input pulses to output pulses in a decade counter while stressing the circuit in various ways. If the ratio varied from 10 at any point, you would have localized the fault. Shaped output is a relatively uncommon feature that is provided on Tektronix counter/timers. Essentially, it is a representation of the instrument's trigger signal. Applied to one channel of an oscilloscope, with the input signal applied to another channel, it can be used to verify that the counter/timer is triggering on the correct portion of the input waveform.

### ACCURACY AND RESOLUTION

Accuracy describes how closely a measurement agrees with a standard. It depends on time base and trigger slew and jitter errors. To minimize time base errors, all Tektronix TM 500 and TM 5000 modular counter/timers use an oven-controlled-crystal time base.

In the case of the DC 5010, temperature stability is a flat $\pm 2 \times 10^{-7}$, regardless of temperature, up to an ambient of 50°C. Ideally, resolution would be plus or minus one times the least significant digit (LSD). However, resolution is also tied to the uncertainty of the length of the last event counted. That's why single-shot resolution is less than resolution with averaging. For example, on the DC 5010, single event resolution is 3.125 ns, but resolution with averaging is 1 ps.

### DIGITAL COUNTER SELECTION GUIDE

| | DC 5010 | DC 5009 | DC 503A |
|---|---|---|---|
| **Frequency Range** | 350 MHz | 135 MHz | 125 MHz |
| **Number of Digits** | 9 | 8 | 8 |
| **Ratio Architecture** | • | • | |
| **Period Averaging** | • | • | • |
| **Width Averaging (Single Input)** | • | • | • |
| **Time Interval Averaging** | • | • | • |
| **Autotrigger** | • | • | |
| **Gated Events Averaging** | B during A | B during A | A during B |
| **Ratio Averaging** | • | • | • |
| **Other** | High stability time base, trigger level and shaped outputs, self-test, phase modulated clock, probe compensation, time manual, totalize. | High stability time base, trigger level and shaped outputs, self-test, phase modulated clock, probe compensation, time manual, totalize. | High stability time base, trigger level and shaped outputs, time manual, totalize. |
| **IEEE Standard 488.1-1987** | DC 5010 only | DC 5009 only | |
| **Mainframe Compatibility** | TM 5000 only | TM 5000 only | TM 500/ TM 5000 |
| **Module Size** | 2 wide | 1 wide | 1 wide |

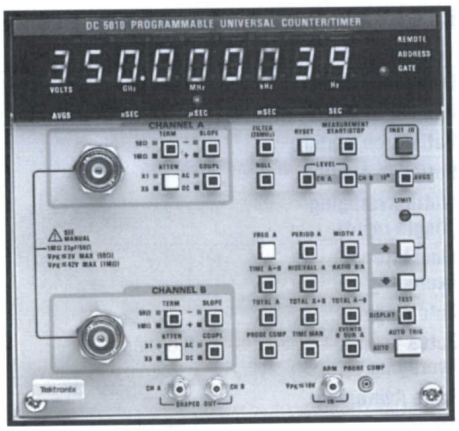
# Universal Counter/Timer
## Modular



*High resolution measurement of low frequency signals much faster than conventional counting techniques.*

**DC 5010**

- 350 MHz both A and B Channels
- 3.125 ns Single-Shot Resolution
- 9-Digit Display
- 1 ps Resolution, with Averaging
- Auto or Selected Averaging to $10^8$
- Duty-Cycle Independent Autotrigger
- DVM Mode for Displaying Trigger-Level Setting
- Shaped A and B Channel Outputs
- Hysteresis Compensation
- Probe Compensation
- High Stability Oven Time Base
- Two Wide Size




### DC 5010

The DC 5010 Universal Counter/Timer features reciprocal frequency to 350 MHz, period, ratio, events B during A measurements, and time A to B. The powerful reciprocal technique provides high resolution of low frequency signals much faster than conventional counting techniques. The pseudo-random, phase-modulated time base provides increased accuracy by eliminating synchronous errors in the time interval and width averaging modes.

Auto trigger senses the applied signal and sets trigger levels to the optimum points. In the DC 5010, trigger levels, the minimum and maximum signal voltage levels, and the trigger voltage are available over the GPIB, and can be viewed on the 9-digit display.

Other features include an arming input that allows measurement of selected inputs from complex waveforms, hysteresis compensation and probe compensation for attenuator type probes.

### Characteristics

See table on page 365.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 — The DC 5010 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

## ORDERING INFORMATION

**DC 5010**
Programmable Universal Counter/Timer ..... **$4,250**
**Includes:** Shaped Output Cable (012-0532-00); Instruction Manual (070-3897-02); Instrument Interfacing Guide (070-4611-00); Reference Guide (070-3553-00).

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M7** – Calibration Service ..... **+$155**
**Opt. M9** – Repair Protection ..... **+$260**

**CONVERSION KIT (DC 510)**
**IEEE Standard 488 Capability** – Order 040-1023-06 ..... **$215**

**ACCESSORIES**
See page 424 for probes and additional accessories.

**PROBES**
**General Purpose** – 1X, 15 MHz, 100 pF/1 MΩ, 2 m.
Order P6101B ..... **$65**

# Universal Counter/Timer
## Modular





DC 5009

### DC 5009

The DC 5009 single-width Universal Counter/Timer provides all of the measurement functions of the higher performance DC 5010 except rise time/fall time, null, and totalize A ± B.

The powerful reciprocal-frequency measurement technique allows up to eight digits of resolution of low-frequency signals in one second or less of measurement time. The DC 5009 has the same automatic averaging feature as the DC 5010; selected averaging of up to $10^8$ events provides usable time-interval resolution of 5 ps.

### Characteristics

See table on page 365.

**DC 5009**

- 135 MHz Both A and B Channels
- 10 ns Single-Shot Resolution
- 8-Digit Display
- 5 ps Resolution, with Averaging
- Reciprocal-Frequency Measurement; Period; Width; Time A – B; Events B During A; Totalize; Ratio; Time Manual; Arming
- Auto or Selected Averaging to $10^8$ in All Modes
- Duty – Cycle Independent Autotrigger
- Shaped A and B Channel Outputs
- Probe Compensation
- High Stability Oven Time Base
- Single Wide Size

*Powerful reciprocal-frequency measurements.*

## ORDERING INFORMATION

**DC 5009**
Programmable Universal Counter/Timer ..... **$2,475**
**Includes:** Tip Jack to BNC Adapter Cable (175-3765-01); Instrument Interfacing Guide (070-4612-00); Reference Guide (070-3560-01); Instruction Manual (070-3888-00).

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M7** – Calibration Service ..... **+$110**
**Opt. M9** – Repair Protection ..... **+$200**

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

**PROBES**
10X, DC to 300 MHz. Order P6106A ..... **$200**
FET, DC to 900 MHz. Order P6201 ..... **$1,550**
**General Purpose** – 1 X, 15 MHz 100 pF/1 MΩ, 2 m. Order P6101B ..... **$65**

**ADDITIONAL ACCESSORIES**
See page 424 for additional accessories.

**OPTIONAL COUNTER ACCESSORIES**
**Power Divider GR, 50 Ω** – Order 017-0082-00 ..... **$1,300**
**Adapters** – (GR to BNC male) Order 017-0064-00 ..... **$150**
**Cable Adapters** – BNC to Tip Jack. Order 175-3765-01 ..... **$65**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The DC 5009 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Universal Counter/Timer
## Modular



*Broad range of measurement features at an affordable price.*

**DC 503A**

- 125 MHz Both A and B Channels
- 10 ps Resolution in Time–Interval Average with $10^8$ Averages
- Measurement Functions include: Frequency; Period and Period Average; Width and Width Average; Time A–B; Time A–B Average; Events A During B Average; Totalize; Time Manual; Ratio A/B Average
- 40 MHz Rep Rate in Time–Interval Average
- Trigger–Level Outputs for Accurate Trigger Setting
- Shaped Outputs for Ease of Triggering
- Designed for True Probe Compatibility
- High Stability Oven Time Base




### DC 503A

The DC 503A offers a broad range of measurement features at an affordable price. The instrument has two input channels, A and B, each with 125 MHz capability. Each channel has separate triggering level, triggering slope, attenuator, and coupling mode controls. Eight measurement functions are available with the DC 503A, and an averaging feature allows averaging of 1 to $10^8$ occurrences of the signal of interest. Signals to be counted or timed can be applied to channels A and B via front-panel BNC connectors or through rear-interface connections. The DC 503A features an easy-access front panel and an LSI-based design for increased instrument reliability.

The DC 503A is equipped with a temperature-controlled 10 MHz crystal oscillator to obtain a highly stable and precise internal time base.

### Characteristics

See table on page 365.

## ORDERING INFORMATION

**DC 503A**
Universal Counter/Timer ..... **$1,895**
**Includes:** Instruction Manual (070-2971-00).

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M7** – Calibration Service ..... **+$90**
**Opt. M9** – Repair Protection ..... **+$125**

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

**PROBES**
10X, DC to 300 MHz. Order P6106A ..... **$200**
FET, DC to 900 MHz. Order P6201 ..... **$1,550**
**General Purpose** – 1 X, 15 MHz 100 pF/1 MΩ, 2 m. Order P6101B ..... **$65**

**ADDITIONAL ACCESSORIES**
See page 424 for additional accessories.

**OPTIONAL COUNTER ACCESSORIES**
**Power Divider GR, 50 Ω** – Order 017-0082-00 ..... **$1,300**
**Adapters** – (GR to BNC male) Order 017-0064-00 ..... **$150**
**Cable Adapters** – BNC to Tip Jack. Order 175-3765-01 ..... **$65**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# Modular Oscilloscopes

## Modular Oscilloscopes

The family of Modular Oscilloscopes for the TM 500/TM 5000 family provides waveform capture and viewing capability in a compact size. The SC family provides an ideal, size-conscious solution to your signal viewing needs whether mounted in a rack or on an engineering bench.

### OSCILLOSCOPE SELECTION GUIDE

| | SC 504 | SC 502 |
|---|---|---|
| **Bandwidth (MHz)** | 80 | 15 |
| **Number of Channels** | 2 | 2 |
| **Sensitivity (mV/div)** | 5 | 1 |
| **Vertical Accuracy** | ±2% | ±2% |
| **Max Input Voltage:** | | |
| **V (DC + peak AC)** | 250 | 350 |
| **V (p-p at 1 kHz)** | 500 | 700 |
| **Sweep Rate (/div)** | 50 ns to .2 s | 200 ns to .5 s |
| **With x10 Mag** | 5 ns | 20 ns |
| | 21 Steps | 20 Steps |
| | 1-2-5 Sequence | 1-2-5 Sequence |
| **Module Size** | 2 Wide | 2 Wide |
| **Step Response Aberrations** | ±4% | ±2%, ≤3% p-p |
| **AC Coupled Low-Frequency Response (Hz)** | | ≤10, 1, w/10X probe *1 |
| **Deflection Factors (V/div)** | 5 m to 10, 1-2-5 sequence; continuously variable between 11 calibrated steps | continuously variable |
| **Continuously Variable To** | 0.5 s/div | 1.25 s/div |
| **Sweep Rate Accuracy*2** | ±3%, 0.2 s to 50 ms/div; ±2%, 20 ms to 0.2 µs/div; ±3% 0.1 µs to 50 ns/div | ±3%, all rates |
| **X-Y Mode:** | | |
| **Bandwidth (Hz)** | DC to 2 M | DC to 2 M |
| **Trigger Sensitivity (min. p-p signal)** | | |
| **Coupling** | DC to 30 30 to 80 | DC to 5 5 to 15 |
| Source (MHz) | | |
| **DC** CH 1, CH 2 (div) | 0.4, 60 mV 1, 150 mV | 0.4 1 |
| Ext, Rear Interface | typ. 50 mv 100 mV to 50 MHz | 60 mV 150 mV |
| **AC** | Requirements increase below 50 Hz | Requirements increase below 50 Hz |
| **AC LF Rej.** | Requirements increase below 10 kHz | Requirements increase below 5 kHz |
| **AC HF Rej.** | Requirements increase above 50 kHz | NA |

**1 Optimum bandwidth, rise time, aberrations, and deflection-factor accuracy. Expect lower performance for other temperature ratings and attenuator settings.*

**2 Accuracy at 15 to 35°C, XI magnifier. Derate additional 1% for X10 magnifier on, and an additional 1% for operation at 0 to 15°C and 35 to 50°C.*

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MODULAR OSCILLOSCOPES

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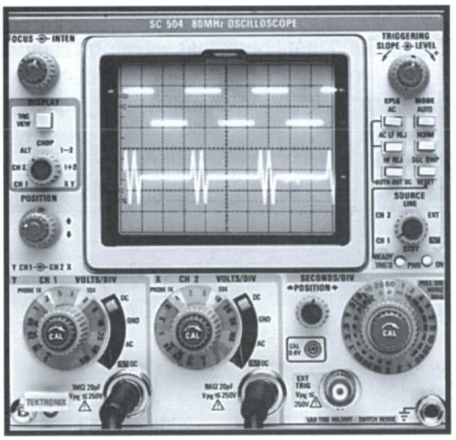
# SC 504

# Modular Oscilloscope
## 80 MHz

*Versatile and easy to use.*

**SC 504**

- 80 MHz Bandwidth
- 5 mV/div Maximum Sensitivity
- 5 ns/div Maximum Calibrated Sweep Rate
- Enhanced Automatic Triggering
- True X-Y Capability
- Switchable Rear-Interface Capability
- Two Wide Size




### SC 504

The SC 504 is a general-purpose, dual-trace, nondelayed-sweep oscilloscope. It has a high writing speed with a maximum sensitivity of 5 mV/div and a maximum sweep rate of 5 ns/div (with magnifier). This oscilloscope features Add (CH 1 plus CH 2), Differential (CH 1 minus CH 2), and "True" X-Y modes, and also includes rear-interfacing capability (switchable CH 1, CH 2, and ext trig inputs). Enhanced autotriggering, trigger view, and variable trigger holdoff make this oscilloscope very versatile and easy to use.

### Characteristics

**VERTICAL DEFLECTION**

**Bandwidth At –3 dB Points –** DC to >50 MHz to 35°C, >70 MHz to 50°C.

**Rise Time –** 4.4 ns.

**Accuracy –** ±2%, +15°C to +35°C; ±3% 0 to 50°C.

**Step Response Aberrations –** ±4% to 35°C.

**AC Coupled Low-Frequency Response –** ≤ –10 Hz, 1 Hz with X10 probe.

**Deflection Factors –** 5 mV/div to 10V/div in a 1-2-5 sequence of 11 steps plus variable.

**Input R&C –** 1 MΩ ±1%, 20 pF.

**Maximum Input Voltage –** 250 V (DC + peak AC), 500 V p-p at 1 kHz.

**CMRR (CH 1 minus CH 2) –** >50:1 at 1 MHz.

**Calibrator –** 0.6 V ±1%, ≈ 1 kHz.

**HORIZONTAL DEFLECTION**

**Time Base –** 0.2 s to 50 ns/div, 21 steps in a 1-2-5 sequence, plus X10 magnifier to 5 ns/div.

**Sweep Accuracy –** 15 to 35°C. X1, ±3%; X10, ±4%; 0.2 s/div to 50 ms/div; X1, ±2%; X10, ±3%; 20 ms/div to 0.2 µs/div; X1, ±3%; X10, ±4%; 0.1 µs/div to 50 ns/div.

**X-Y Mode Bandwidth –** DC to 2 MHz.

**TRIGGERING**

**Coupling –** DC, AC, AC LF REJ, HF REJ.

**Trigger Sensitivity (min p-p signal) DC Coupling –**

| Source | ≤30 MHz | 30 M to 80 MHz |
|---|---|---|
| CH 1 and CH 2 | 0.4 div. | 1.5 div., 150 mV |
| Ext. Rear Int. | 60 mV | 100 mV to 50 MHz |

**Triggering Level Range –** Ext ≥1.4 V.

**AVAILABLE REAR CONNECTIONS**

Z Axis In, CH 1 Trig Out, CH 1 & CH 2 In, Triggered Gate Out, Trig In, Ramp Out, Ext Gate In, Sweep Gate Out, Gate Select In, Light Out, Intensity In, Hold Off Out, Reset In.

**CRT**

**Phosphor –** GH (P31).

**Accelerating Potential –** 12 kV.

**Graticule –** 8X10 div (0.25 in./div) internal graticule lines.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

## ORDERING INFORMATION

**SC 504**
80 MHz Oscilloscope. Order 070-2296-00 ..... **$5,295**

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

**PROBES**

**Differential –** 100 MHz, Active Differential, 6 ft.
Order P6046 ..... **$2,295**

**High Voltage –**
100X, 120 MHz, 1500 V, 2.5 pF/10 MΩ, 9 ft. Order P6009 .... **$270**
1000X, 75 MHz, 20 kV, 3.0 pF/100 MΩ, 10 ft. Order P6015A.. **$950**

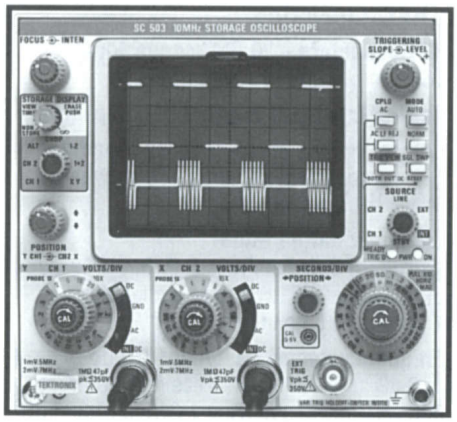
**General Purpose –**
1X, 15 MHz, 100 pF/1 MΩ, 2 m. Order P6101B ..... **$65**
10X, 100 MHz, 11.2 pF/10 MΩ, 1.5 m. Order P6122..... **$110**
1X-10X Switchable, 1X: 8 MHz, 100 pF/1 MΩ, and 10X: 100 MHz,16 pF/10 MΩ, 2 m. Order P6129B..... **$100**

**Logic –** 20 MHz, 17-Bit, Word Recognizer/Trigger.
Order P6408 ..... **$500**

**Current –**
(AC only) 120 Hz-60 MHz, 7.5A peak. Order P6021 ..... **$550**
(AC only) 935 Hz-120 MHz, 3A peak. Order P6022 ..... **$595**

# Modular Oscilloscope
## 15 MHz





### SC 502

The SC 502 is a compact general-purpose, 15 MHz dual-trace oscilloscope with high writing speed, a wide range of sweep rates, a wide range of deflection factors, and versatile triggering, including trigger view and enhanced automatic triggering.

The rear-interfacing capability of the SC 502 and all TM 500/TM 5000 instrumentation suggests exceptional applicability to systems of built-in test equipment or rackmounted installations.

### Characteristics

**VERTICAL DEFLECTION**

**Bandwidth at –3 dB –** 5 mV to 20 v/div, >15 MHz; 2 mV/div, >10 MHz; 1mV/div, >5 MHz.

**Rise Time –** 23 ns.

**Step Response Aberrations –** ±2%, ≤3 p-p.

**AC Coupled Low-Frequency Response –** ≤10 Hz, 1 Hz with X10 probe.

**Deflection Factors –** 1 mV/div to 20 V/div in a 1-2-5 sequence of 14 steps plus variable.

**Input R&C –** 1 MΩ ±1%, 47 pF.

**Accuracy –** 5 mV to 20 V/div, <2%; 1 mV to 2 mV/div, <5%.

**Maximum Input Voltage –** 350 V (DC + peak AC), 700 V p-p at 1 kHz.

**CMRR (CH 1 minus CH 2) –** >30:1 at 1 MHz.

**Channel Isolation –** ≤2% to 15 MHz.

**Displayed Noise –** ≤0.2 mV p-p at 1 mV/div.

**Calibrator –** 0.6 V ±1%, ≈ twice power-line frequency.

**HORIZONTAL DEFLECTION**

**Time Base –** Calibrated range from 0.2 µs/div to 0.5 s/div, 20 steps in 1-2-5 sequence, X10 magnifier to 20 ns/div.

**Sweep Accuracy*[1] –** ±3%, 0.5 s/div to 0.1 s/div; ±2%, 50 ms/div to 1 µs/div; ±3%, 0.5 µs/div to 0.2 µs/div

**X-Y Mode Bandwidth –** DC to 2 MHz.

**TRIGGERING**

**Coupling –** DC, AC, AC LF REJ.

**Trigger Sensitivity (min p-p signal) DC Coupling –**

| Source | ≤30 MHz | 30 M to 80 MHz |
|---|---|---|
| CH 1 and CH 2 | 0.4 div. | 1.5 div., 150 mV |
| Ext. Rear Int. | 60 mV | 100 mV to 50 MHz |

**Triggering Level Range –** Ext ≥1.2 V, Int ≥8 div.

**AVAILABLE REAR CONNECTIONS**

Ext (Delayed) Gate In, Trig Gate Out, Gate Select In, Hold Off Out, Intensity In, Ramp Out, CH 1 Trig Out.

**CRT**

**Phosphor –** GH (P31).

**Accelerating Potential –** 12 kV.

**Graticule –** 8X10 div (0.25 in/div) internal graticule lines.

*[1]Accuracy at 15° to 35°C, X1 magnifier. Derate additional 1% for X10 magnifier on, and an additional 1% for operation at 0° to 15°C and 35° to 50°C.*

**SC 502**

- 15 MHz Bandwidth, Dual Trace
- 20 ns/Div Maximum Calibrated Sweep Rate
- 1 mV/Div Maximum Sensitivity
- Delay Line
- Trigger View, Variable Trigger Holdoff
- Enhanced Automatic Triggering
- Two Wide Size

*Store and display waveforms after input signal removed with our only Analog Bi-Stable Storage Scope.*

## ORDERING INFORMATION

**SC 502**
15 MHz Oscilloscope. (070-1878-01). ..... **$3,295**
**Includes:** Instruction Manual.

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

**PROBES**

**Differential –** 100 MHz, Active Differential, 6 ft.
Order P6046 ..... **$2,295**

**High Voltage –**
100X, 20 MHz, 1500 V, 2.5 pF/10 MΩ, 6 ft. Order P6007 ..... **$165**
1000X, 75 MHz, 20 V, 3.0 pF/100 MΩ, 10 ft. Order P6015A ... **$950**

**General Purpose –**
1X, 15 MHz, 100 pF/1 MΩ, 2 m. Order P6101B ..... **$65**
1X-10X Switchable, 1X: 7 MHz, 105 pF/1 MΩ, 6 ft. and 10X: 100 MHz,14 pF/10 MΩ, 6 ft. Order P6062B ..... **$260**

**Current –**
(AC only) 120 Hz-60 MHz, 7.5 A peak. Order P6021 ..... **$550**
(AC only) 935 Hz-120 MHz, 3 A peak. Order P6022 ..... **$595**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

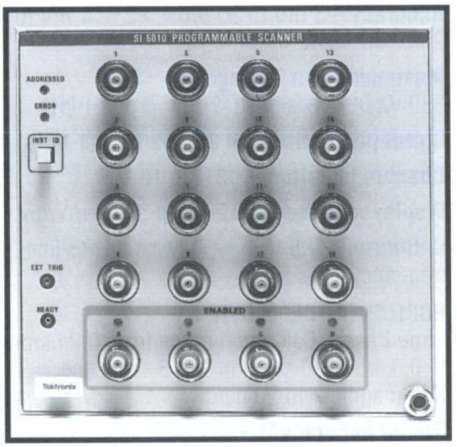
# Programmable Scanner/Multiplexer

## Modular

*An excellent choice to extend the capabilities of benchtop ATE or rack and stack systems.*

**SI 5010**

- Command Buffer for Controller-Free Operation
- Software Configurable as:
  - One Group of 16 Channels
  - Two Groups of 8 Channels
  - Four Groups of 4 Channels
- 350 MHz Bandwidth in Four-Channel Configuration
- External Handshake Lines
- Built-In Time-of-Day and Pacing Clock
- Two Wide Size
- UL Listed 1244




### SI 5010

The SI 5010 Programmable Scanner switches and routes up to 16 high-frequency input and/or output signals. It maintains a clean 50 Ω environment through the use of 50 Ω coaxial reed relays. The software-configurable basic four-channel arrangement allows the SI 5010 to be used for point-to-point switching (any connector to any other connector), or to be used in a wide variety of fan-in and/or fan-out configurations.

The SI 5010 has a built-in command buffer capable of storing up to 300 GPIB system commands and executing them in sequence. It is paced by the on-board time-of-day and pacing clock or by signals from the system under test. This requires no interference from the system controller, thus freeing the controller to direct activity elsewhere in the system. TTL compatible handshake lines are provided for externally controlling the SI 5010.

Two handshake lines are provided for externally controlling the SI 5010. An Ext Trig line is provided to allow the SE 5010 switching to be initiated by the external system under test, and a Ready line indicates to the external system when the relays have settled.

### Characteristics

**RF Connectors –** 20 BNC connectors, 16 channels and four commons.

**Control Input (Ext Trig) –** TTL compatible.

**Control Output Data Accepted (Ready) –** TTL compatible. Output goes high when relays have settled.

**Channel Configuration (Software Selectable) –** 1, 2, 3, or 4 groups of 4 channels. 2 groups of 8 channels. 1 group of 16 channels.

**Frequency Response –** Any 1 Group of 4: 3 dB at 350 MHz, decreasing to 6 dB at 500 MHz or greater. Any 1 Group of 8: 3 dB at 175 MHz or greater. Any 1 Group of 16: 3 dB at 80 MHz or greater.

**Port (Channel) Isolation –** 40 dB at 100 MHz.

**Characteristic Impedance (Each Channel) –** 50 Ω. See VSWR specification.

**Rise Time (Each Channel) –** 1 ns.

**Voltage Standing Wave Ratio (VSWR) –** Any 4 Channel Group: 1.25: 1 at 100 MHz, increasing to 1.8: 1 at 350 MHz. Any Other Combination: 1.5: 1 at 100 MHz. 2: 1 at 225 MHz.

**Insertion Loss –** 1 dB at 100 MHz.

**Channel Delay Matching –** Any Group of 4: 50 ps. Any Group of 8: 110 ps. Any Group of 16: 310 ps.

**Type of Relays –** 16 Form A, 4 Form "C". Pull-In Time: 3 ms. Release Time: 3 ms. Breakdown Voltage: 350 V (DC + peak AC). Series Path Resistance (End of Life): 0.5 Ω.

**Peak Carry Voltage –** Unterminated: 40 V maximum. 50 Ω Terminated: 12.5 V maximum.

**Peak Contact Current –** 0.25 A maximum.

**Peak Switching Voltages –** Unterminated: 15 V maximum. 50 Ω Terminated: 3.73 V maximum.

**Peak Switching Current –** 0.01 A maximum.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The SI 5010 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

## ORDERING INFORMATION

**SI 5010**
Programmable Scanner (070-3721-00) ..... **$2,750**
**Includes:** Instruction Manual; Instrument Interface Guide; Reference Guide.

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M7 –** Calibration Service ..... **+$115**
**Opt. M9 –** Repair Protection ..... **+$160**

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

**PROBES**
**Differential –** 100 MHz, Active Differential, 6 ft. Order P6046 ..... **$2,295**
**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 Opt. 25 ..... **$335**
**Current –**
(AC only) 120 Hz-60 MHz, 7.5 A peak. Order P6021 ..... **$550**
(AC only) 935 Hz-120 MHz, 3 A peak. Order P6022 ..... **$595**
(DC & AC) DC-50 MHz System. Order AM503S ..... **$2,745**
**Includes:** AM503A, Current Probe Amplifier, A6302 Current Probe, and TM502 Mainframe.

# Audio Analysis

## Audio and Communication Measurement Fundamentals

Most measurements made below 100 kHz in the audio/communications world fall into two broad categories; level (amplitude) and non-linearity (distortion).

Level measurements include: frequency response, gain/loss, noise level, or signal-to-noise (S/N) ratio, power, and crosstalk/separation/isolation.

Non-linearity measurements include: total harmonic distortion (THD, THD+N), individual distortion, intermodulation distortion (IMD; standards include SMPTE, DIN, CCIF).

The stimulus source required for all except IMD measurements is a "simple", low-distortion sinewave oscillator. The signal is simple to describe mathematically; but it is not simple to design and build sinewave sources whose undesired output products are more than 100 dB below the desired sinewave output. Tektronix makes the best low frequency sinewave oscillators in the world in the SG 505 and the programmable SG 5010.

IMD testing requires two sinewaves combined together; we have also done that best for SMPTE and DIN IMD testing in the SG 505 Options 01 and 02. The SG 5010 goes a big step further by making it possible, for the first time, to do CCIF IMD testing as easily as other audio measurements.

Level (amplitude) measurements are typically made with an AC voltmeter. A digital multimeter is built into the AA 5001/AA 501A, removing the need for a separate voltmeter.

Our AA 501A and AA 5001 work this way in dBm mode; they assume they are connected across a 600 Ω circuit. A purist would probably label our dBm mode (and other manufacturers, too) as dBu, or dB relative to 0.7745 volts. This is the voltage produced by one milliwatt being dissipated in 600 Ω, so there is no difference between dBm and dBu if you are connected across a 600 Ω circuit.

SINAD stands for the ratio of (signal + noise + distortion)/(noise + distortion), and is a technique (requiring a distortion analyzer) for measuring the sensitivity of two-way mobile radio receivers; it is promulgated by the EIA (Electronic Industries Association). The Tektronix Audio/Communications test instruments either can make measurements in accordance with certain of these "standards" specifications or we specify our own performance according to some of their specifications.

Whether the application is in the calibrating/verifying of low frequency oscillator products, base-band testing of satellite, microwave, and wire-line communications equipment, manufacturing of consumer audio products, or maintaining broadcast stations and recording studios, signal quality is of the utmost importance. Measurement standards and techniques such as those defined by SMPTE, DIN, and CCITT dictate that testing of these signals requires highly accurate and sensitive state-of-the-art equipment.

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# SG 5010
# SG 505

# Audio Oscillators
## Modular

*Precision Audio Oscillator for R and D, Manufacturing and Service.*

**SG 5010/SG 505**

- 10 Hz to 100 kHz Sine Wave Output
- Ultra–Low Distortion: 0.0008% THD (Typically 0.0003%)
- Floating or grounded Output
- 600 Ω Source Impedance
- Vernier Frequency Control
- Fully Balanced Output to 28 dBm (SG 505 Opt. 02)
- Selectable Source Impedance (SG 505 Opt. 02)
- Intermodulation Test Signal (Opt. 01 and 02)
- SG 5010 Occupies Two Compartments of a TM 5000 Mainframe
- SG 505 Occupies One Compartment of a TM 5000 or TM 5000 Mainframe
- UL Listed 1244



SG 5010/SG 505/SG 505 Opt. 2

### SG 5010/SG 505

The SG 5010 and SG 505 Oscillators generate an ultra-low distortion sine wave from 10 Hz to 163.8 kHz (SG 505 to 100 kHz) with less than 0.0008% and 0.0032% THD respectively. The THD is typically less than 0.0003% in the 20 Hz to 20 kHz range.

The SG 5010 offers the full benefits of TM 5000 configurability, GPIB compatibility, and compliance with Tektronix Standard Codes and Formats. It generates five waveforms: sine wave, square wave, SMPTE/DIN intermodulation test signal, CCIF intermodulation test signal, and sine wave burst. All of these signals may be swept in frequency or amplitude. The five-digit LED display indicates parameter values and units plus indicators for the remote and addressed states. Three source impedances are selectable and the output signal can be grounded or floating, balanced or unbalanced. Output amplitude is programmable from 0.2 mV to 21.2 V peak equivalent V RMS, supplying up to 28 dBm into a 600 Ω load.

On the SG 505, a FREQUENCY Hz dial provides frequency adjustment within each band. A FREQ VERNIER control permits extremely fine frequency adjustment within each band. A Frequency adjustment (to ≤ ±1%) range. Distortion is less than or equal to 0.0008% from 20 Hz to 20 kHz. An OUTPUT LEVEL switch, calibrated in 10 dBm into a 600 Ω load, selects eight level steps at the OUTPUT. The SYNC OUT connector provides approximately 200 mV RMS fixed amplitude and ground-referenced sin wave signal at the same frequency as the OUTPUT.

The SG 505 Option 01 adds an intermodulation test function, which mixes an internally selectable 60 or 250 Hz sine wave with the normally selected frequency in a 4:1 amplitude ratio. The composite peak-to-peak amplitude is calibrated to be identical with the peak-to-peak amplitude of the OUTPUT signal in the normal oscillator mode.

The SG 505 Option 02 adds the Option 01 (intermod) and changes the SG 505 to have a balanced output with an amplitude range of +22 dBm to –68 dBm; the variable attenuator provides a continuous adjustment from CAL. A front panel control selects a source resistance of 600, 150,or 50 Ω.

### Characteristics (SG 505)

**MAIN OUTPUT**

The following characteristics are common to the standard SG 505 and SG 505 with Opt. 01.

**Frequency Range –** 10 Hz to 100 kHz in four overlapping bands. Accurate within 3% of dual setting (with Vernier at center). Vernier Range is at least ±1% of frequency setting.

**Calibrated Output –** Selectable from +10 to –60 dBm into 600 Ω in eight 10 dB steps. Accurate to within 0.2 dB at 0 dBm and 1 kHz. Step accuracy is 0.1 dB/10 dB step. An uncalibrated control provides continuous variation from at least +2.2 dB to <–10 dB from calibrated position.

**Amplitude Response –** Level flatness ±0.1 dB from 10 Hz to 20 kHz (1 kHz ref); within 0.2 dB from 20 to 100 kHz (excluding >–60 dB output-level range).

**Harmonic Distortion –** <0.0008% (–102 dB) THD from 20 Hz to 20 kHz (typically 0.0003%); 0.0018% (–95 dB) THD from 10 to 20 Hz, and from 20 to 50 kHz 0.0032% (–90 dB) THD from 50 to 100 kHz (RL ≥600 Ω).

*Continued on next page.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The SG 5010 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Audio Oscillators
## Modular

**SG 5010**
**SG 505**



**Output Impedance –** 600 Ω ±2%; floating or grounded through ≈30 Ω. Output impedance does not change with Output On/Off selection. Maximum floating voltage ±30 V peak.

**Maximum Output Voltage –** At least 6 V RMS open circuit; 3.16 V RMS (+10 dBV or +12.2 dBm) into 600 Ω.

**SYNC OUTPUT Signal –** 200 mV RMS ±20% sine wave to 20 kHz, at least 120 mV RMS at 100 kHz.

**Frequency –** Same as main output.

**Impedance –** Nominally 1 kΩ, ground referenced and isolated from main output,

**SG 505 WITH OPTION 01 IM TEST SIGNAL**

**LF Frequency –** Internally selectable 60 Hz (±1 Hz) or 250 Hz (±3 Hz).

**Main Output –** Composite p-p output within 0.2 dB of normal oscillator mode output.

**Residual IMD –** <0.0005% from 2.5 to 10 kHz.

**Sync Output –** LF signal component only, 200 mV RMS ±20%.

**SG 505 WITH OPTION 02 BALANCED OUTPUT PLUS IM**

**Calibrated Balanced Output –** Selectable from +22 to –68 dBm into 600 Ω in ten 10 dB steps. Accurate to within 0.2 dB at +22 dBm and 1 kHz. Step accuracy is ±0.1 dB/10 dB step or 20 dB step change. An uncalibrated control provides continuous variation from <–10 to +0.3 dB from calibrated position.

**Harmonic Distortion –** <0.0008% (–102 dB) THD from 20 Hz to 20 kHz (typically 0.0003%); 0.0018% (–95 dB) THD from 10 to 20 Hz, and from 20 to 50 kHz; 0.0056% (–85 dB) THD from 50 to 100 kHz (RL ≤600 Ω).

**Output Impedance Selectable –** 600 Ω ±2%, 150 Ω ±2%, or 50 Ω ±3% floating or grounded through ≈30 Ω. Output impedance does not change with Output On/Off selection. Impedance to CT is 1/2 the selected impedance. Maximum floating voltage ±25 V peak.

**Maximum Output Voltage –** At least 21 V RMS open circuit; 19.45 V RMS (+28 dBm) into 600 Ω from 50 Ω.

**Balance –** ≤0.5% mismatch of output open-circuit voltages referenced to CT for f ≤20 kHz with output grounded.

### Characteristics (SG 5010)

**AVAILABLE FUNCTIONS**

Sine wave, square wave, SMPTE/DIN 4:1, SMPTE DIN 1:1, CCIF, Sine-Wave Burst, IHF Burst (±20 dB or OFF between bursts), External Input (Amplifier Mode).

**FREQUENCY RANGE AND ACCURACY**

**Sine Wave, Sine-Wave Burst –** SMPTE/DIN: 10 Hz to 163.80 kHz ±0.01%. CCIF Center Frequency: 2.500 to 163.80 kHz ±0.01%. Square Wave: 10 Hz to 16.380 kHz ±0.01%.

**Resolution in Above Functions –** 10.00 to 163.80 Hz: 0.01 Hz; 163.9 Hz to 1.6380 kHz: 0.1 Hz; 1.639 to 16.380 kHz: 1.0 Hz; 16.39 to 163.80 kHz: 10.0 Hz.

**SMPTE Lower Tone, CCIF Offset From Center Frequency –** Selectable From: 40, 50, 60, 80, 100, 125, 250, 500 Hz, all ±2%.

**Sine Distortion (Load 600 Ω THD Including 2nd Through 5th Harmonics) –**
20 Hz to 20 kHz: 0.001% (–100 dB).
20 to 50 kHz: 0.0032% (–90 dB).
10 to 20 Hz and 50 to 100 kHz: 0.01% (–80 dB). 100 to 163.8 kHz: 0.032% (–70 dB) any individual harmonic.

**Sine Flatness –** 20 Hz to 20 kHz: 0.05 dB; 10 Hz to 163.8 kHz: 0.2 dB.

**Square-Wave Rise Time –** 1.5 µs ±10%.

**Burst Range –** 1 to 65535 cycles On. 1 to 65535 cycles Off. Off Level either 20 dB or zero. All switching at sine-wave zero crossing. Triggered, gated, or free-running burst modes available.

**OUTPUT LEVEL RANGE AND ACCURACY**

**Balanced –** Into Open Circuit: 200 µV to 21.2 V RMS. Into 600 Ω: –72.45 to +28.05 dBm.*[1]

**Unbalanced –** Into Open Circuit: 200 µV to 21.2 V RMS. Into 600 Ω: –72.45 to +22.05 dBm.*[1]

**Resolution –** 0.05 dB in dBm mode, 0.25% or better in volts mode.

*[1]*Rs = 50 Ω. For Rs = 150 Ω, subtract 1.25 dBm; for Rs = 600 Ω, subtract 5.35 dBm.*

**Level Accuracy (Sine Wave) –** 20 Hz to 20 kHz ±2% (0.2 dB). 10 Hz to 163.8 kHz ±3% (0.3 dB).

**OUTPUT IMPEDANCE AND CONFIGURATION**

50 Ω ±3%, 150 Ω ±2%, or 600 Ω ±1%, balanced or unbalanced, floating or grounded.

**External Input –** A floating single-ended input is provided for accessing the variable-gain stage and high-level output amplifier, enabling the use of custom test signals. Input impedance is 20 kΩ; a 2 V RMS input (2.83 V peak maximum) provides a calibrated output.

**SYNC OUTPUT**

A ground referenced TTL-compatible signal is provided that allows stable oscilloscope display of all functions. In sine and square wave modes, the output is at the signal frequency. In the IM modes, the sync output is at the lower or offset frequency. In both burst modes, the sync signal follows the burst envelope.

**SWEEP MODE**

Linear or logarithmic sweep of amplitude or frequency in any function. Sweep is composed of discrete steps. The following sweep functions are programmable via GPIB or from the front panel: swept parameter (frequency or amplitude), linear or log sweep, number of steps up to 99, time per step from 0.1 to 25 s, start frequency or voltage, and stop frequency or voltage. Start and stop frequencies or voltages can be anywhere within the range of the generator, and sweep direction can be upward or downward. Pen lift and ramp outputs are available for interface to an analog plotter.

**STORED SETUPS**

Ten different complete front-panel setups can be stored in the nonvolatile internal memory and recalled from front-panel pushbuttons or via the GPIB. Additionally, the front-panel settings at power down are retained and used at power up.

**PROGRAMMABILITY**

All functions, parameters, and modes can be controlled over the GPIB using simple English-like commands. All settings can be interrogated, with the resulting response usable as a command to return the instrument to that setting (Learn mode). The GPIB address can be displayed and changed from the front panel.

## ORDERING INFORMATION

**SG 5010**
Programmable Oscillator.....**$4,995**
**Includes:** Instruction Manual (070-4331-00), Instrument Interface Guide (070-4790-00), Reference Guide (070-4330-00).

**SG 505**
Oscillator.....**$1,595**
**Includes:** Instruction Manual (070-2823-00).

**SG 505 OPTIONS**
**Opt. 01 –** IM Test Signal.....**+$225**
**Opt. 02 –** Balanced Output plus IM. Includes: Cable assembly for sync output (175-1178-00).....**+$730**

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M7 –** Calibration Service
SG 5010.....**+$260**
SG 505.....**+$115**
**Opt. M9 –** Repair Protection
SG 5010.....**+$305**
SG 505.....**+$225**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The SG 5010 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

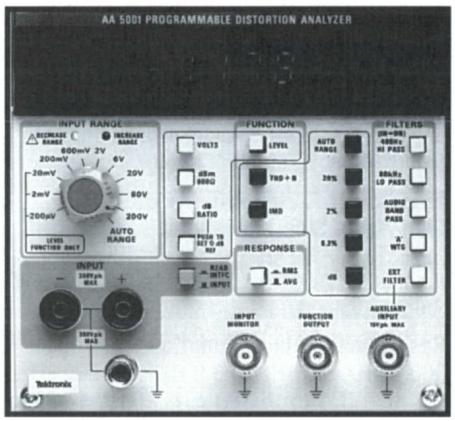
# AA 5001
# AA 501A

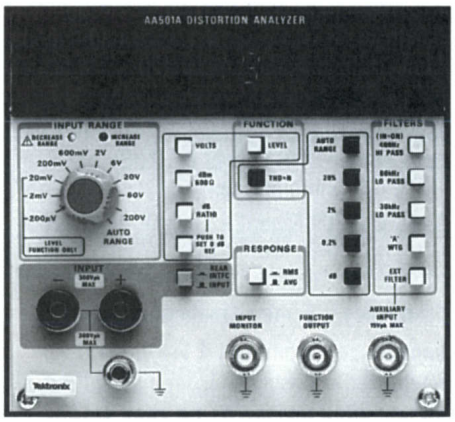
# Distortion Analyzers
## Modular

*Automatic Measurements for your analysis of audio signals.*

**AA 5001/AA 501A**

- Fully Automatic: No Level Setting, Tuning, or Nulling
- Level, Total Harmonic Distortion, and dB Ratio Measurements
- Total System Harmonic Distortion plus Noise (THD+N) 0.0025% (with Companion SG 5010/SG 505 Oscillators)
- Residual Noise ≤3.0 μV
- Digital Readout plus Analog-Like Bar Graph for Peaking and Nulling
- IMD to SMPTE, DIN, and CCIF (Standard with AA 5001; Opt. 01 Required for AA 501A)
- UL Listed 1244




### AA 5001/AA 501A

The AA 5001/AA 501A Distortion Analyzers provide fully automated measurement of level, total harmonic distortion plus noise (THD+N), and intermodulation distortion (Option 01 for the AA 501A). The AA 5001 adds GPIB compatibility plus programmability.

**FULLY AUTOMATIC**

Automatic measurement means that once the mode is selected and the test signal is applied, the operator simply reads the accurate result on the three-digit display. Functions such as level setting, tuning, and nulling are fully automatic.

The AA 501A Option 01 adds intermodulation distortion measurement capability conforming to SMPTE, DIN, and CCIF standards. Internal circuitry automatically identifies the signal being used and performs the measurement, making IMD measurements as automatic as harmonic distortion measurements. These capabilities are standard in the AA 5001.

**ADVANCED PERFORMANCE**

The AA 5001/AA 501A provides dB-ratio measurement referencing either to 774.6 mV (1 mW in 600 Ω) or to a user applied signal. The 0 dB reference memory stores the selected level, and all subsequent measurements are referenced to it. The user can choose true RMS or average response. While true RMS is generally more accurate, the averaging feature is convenient for comparison of new data with data taken on older instruments where averaging was the only mode available.

The fundamental frequency range is 10 Hz to 100 kHz, with harmonic measurements to 300 kHz. Any one of four built-in frequency-weighting filters can be switched into the signal paths for input signal preconditioning. External filters can be simply connected for special applications such as stereo pilot tone rejection, rejection of continuous tone squelch signals in mobile radio systems, or for selection of individual harmonics instead of total harmonic distortion measurements.

An Input-Monitor connector and a Function-Output connector permit oscilloscope display of the input signal or the filtered signal input used in THD+N measurement.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The AA 5001 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Distortion Analyzers
## Modular

**AA 5001**
**AA 501A**



### Characteristics

**HARMONIC DISTORTION FUNCTION**

**Fundamental Frequency Range –** 10 Hz to 100 kHz, automatically tuned to input frequency.

**Distortion Ranges –** Auto (100%), 20%, 2%, 0.2%, and dB (autoranging).

**Accuracy –** 20 Hz to 20 kHz is within ±10% (±1 dB) for harmonics ≤100 kHz. 10 Hz to 100 kHz is within +10% (+1 dB), –20% (–2 dB for harmonics ≤300 kHz. (Accuracy is limited by residual THD + N and filter selection.)

**Typical Fundamental Rejection –** At least 10 dB below specified residual THD + N or actual signal THD, whichever is greater.

**Minimum Input Level –** 60 mV (–22 dBm).

**LEVEL FUNCTION**

Autoranging digital voltmeter displays input-signal level in volts, dBm, or dB ratios.

**Modes –** Volts, dBm (600 Ω), or dB ratio with push-to-set 0 dB reference.

**Level Ranges –** 200 µV full scale to 200 V full scale in ten steps, manual or autoranging.

**Accuracy –**

| Frequency | Volts | dBm or dB Ratio |
|---|---|---|
| 20 Hz to 20 kHz | ±2% (+2 counts) | ±0.3 dB*[1] +0.5% of reading |
| 10 Hz to 100 kHz | ±4% (+2 counts) | ±0.5 dB*[1] +0.5% of reading |

*[1] *$Vi_n$ ≥100 µV, level ranging indicators extinguished. ±0.2 dB at 1 kHz only. Flatness is 0.1 dB, 20 Hz to 20 kHz, and ±0.3 dB, 10 Hz to 100 kHz.*

**Bandwidth –** ≥300 kHz.

**Residual Noise –** ≤3 µV (–108 dBm) with 80 kHz and 400 Hz filters, RMS response; (AA 5001, AA 501A and AA 501A (Opt. 01) ≤1.5 µV (–114 dBm) with "A" weighting filter, RMS response (standard instruments only); ≤5 µV (–104 dBm) with CCIR weighting filter, quasi-peak response (Opt. 02 instruments only).

**INTERMODULATION DISTORTION FUNCTION (AA 5001 and AA501A OPT. 01)**

Fully automatic SMPTE, DIN, and CCIF difference tone measurements. Minimum input level 60 mV (–22 dBm). Accuracy ±1 dB. For IM Components ≤1 kHz.

**SMPTE and DIN Tests –** Lower Frequency Range: 50 to 250 Hz. Upper Frequency Range: Usable from 3 to 160 kHz. Level Ratio Range: 1:1 to 4:1 (lower:upper). Residual IMD: AA 5001 ≤0.0032% (–90 dB) with 60 Hz and 7 kHz or 250 Hz and 8 kHz test tones; ≤0.0025% for AA 501A.

**CCIF Difference Frequency Test –** Frequency Range: Usable from 4 to 160 kHz. Difference Frequency Range: 80 Hz to 1 kHz. Residual IMD: ≤0.0018% (–95 dB) with 14 kHz and 15 kHz test tones (System specification with any SG 5010 Oscillator or passively summed SG 505 Oscillator pair).

**ALL FUNCTIONS**

**Displays –** 3 1/2-digits resolution at ≈3 readings/s.

**Detection –** Average or true RMS for waveforms with crest factors ≤3. (Opt. 02 replaces average detector with quasi-peak detector complying with CCIR Recommendation 468-2 and DIN 45405.

**Filters –** 400 Hz High Pass: –3 dB at 400 Hz ±5%; 18 dB/octave slope, at least 40 dB rejection at 60 Hz.
80 kHz Low Pass: –3 dB at 80 kHz ±5%; 18 dB/octave slope.
30 kHz Low Pass: (AA 501A only) –3 dB at 30 kHz ±5%.
Audio Bandpass: (AA 5001 only) –3 dB at 22.4 Hz and 22.4 kHz, both ±5%. Complies with CCIR Recommendation 468-2 and DIN 45405.

**"A" Weighting –** Meets specifications for Type One sound-level meters (ANSI S1.4, IEC Recommendation 179). Opt. 02 replaces "A" weighting filter with CCIR weighting filter complying with CCIR Recommendation 468-2 and DIN 45405.

**Ext –** Allows connection of external filters.

**Input Type –** Balanced (full differential).

**Input Impedance –** 100 kΩ ±2%, each side to ground.

**Maximum Input –** 300 V peak, 200 V RMS either side to ground or differentially. Fully protected on all ranges.

**Common-Mode Rejection –** ≥50 dB at 50 or 60 Hz. Typically ≥40 dB to 300 kHz.

**PROGRAMMABILITY (AA 5001 ONLY)**

**Function –** (Level or THD or IMD). Level Mode (Volts or dBm). Input Level and Distortion Ranges (Auto-range or default to range selected by front-panel switches).

**Detector Type –** (RMS or AVG; or RMS or Q-PK on Opt. 02).

**Filter Selection –** (400 Hz Hi Pass, 80 kHz Low Pass, 22.4 Hz to 22.4 kHz Band-Pass, "A" Weight (or CCIR WTG on Opt. 02, Ext Filter).

**FRONT-PANEL SIGNALS**

**Input Monitor –** Provides constant-amplitude version of signal applied to input. Output Voltage: 1 V RMS ±10% for input signals >50 mV. Source Impedance: 1 kΩ ±5%.

**Function Output –** Provides a scaled sample of selected function signal. Output Voltage: 1 V RMS ±3% for 1000 count display. Source Impedance: 1 kΩ ±5%.

**Auxiliary Input –** Provides input to detector circuit when Ext Filter button is depressed. Sensitivity: 1 V RMS ±3%=1000 count display. Impedance: 100 kΩ ±5%, AC coupled.

**POWER REQUIREMENTS**

**AA 5001 –** Occupies two compartments of a TM 5000 mainframe.

**AA501A –** Occupies two compartments of a TM 500 or TM 5000 mainframe.

## ORDERING INFORMATION

**AA 5001**
Programmable Distortion Analyzer ..... **$4,395**
**Includes:** Instruction Manual (070-4598-01); Instrument Interface Guide (070-4788-00); Reference Guide (070-4597-00).
**Opt. 02 –** CCIR/DIN (includes Intermodulation Distortion) ... **+$495**

**AA 501A**
Distortion Analyzer ..... **$3,460**
**Includes:** Instruction Manual (070-2958-00).
**Opt. 01 –** Intermodulation Distortion. ..... **+$825**
**Opt. 02 –** CCIR/DIN (includes Intermodulation Distortion) ..... **+$1,265**

**WARRANTY-PLUS SERVICE PLANS OPTIONS**
**Opt. M7 –** Calibration Service
AA5001 ..... **+$170**
AA501A ..... **+$45**
**Opt. M9 –** Repair Protection
AA5001 ..... **+$245**
AA501A ..... **+$35**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The AA 5001 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# Amplifier
## Signal Conditioner - Modular



*Extend the capabilities of any oscilloscope.*

**AM 502**

- Differential Gain
- 2% Gain Accuracy
- 100 dB CMRR to 50 kHz
- Selectable Upper and Lower –3 dB Points
- Adjustable DC Offset
- DC to 1 MHz Maximum Bandwidth




### AM 502 Differential Amplifier/Comparator

The versatile AM 502 lets you control gain, DC offset, and low and high frequency response for maximum rejection of unwanted signals. The AM 502 is particularly suited to sensor signal amplification or applications where one side of the measured voltage is not ground. For example, the AM 502 can amplify small voltage drops across resistors to monitor current flow to the bandwidth of the amplifier. Adjustable DC offset before attenuation/amplification allows high amplification even when low-level signals have a DC component. Adjustable filtering (with differential amplification) permits the AM 502 to emulate different loop filters on the differential phase comparator outputs in a phase locked loop design.

**TRUE VS. PSEUDO DIFFERENTIAL**

The AM 502 is ideal for driving oscilloscopes, chart recorders, or other instruments that do not have differential inputs. One commonly used oscilloscope technique for differential measurements is the Add/Invert function (CH 1 – CH 2). In addition to tying up both main inputs, this technique has limited dynamic range since sensitivity decreases with increasing common mode voltage. True differential amplifiers such as the AM 502 isolate small differential voltages riding on common mode voltages which are orders of magnitude larger.

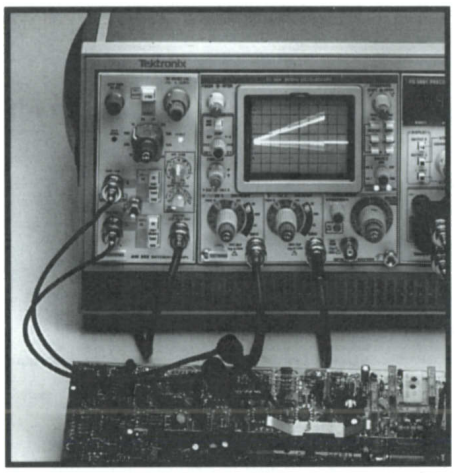
Common mode voltages may also have a large AC component at the line or switching frequency. Differential amplifiers have matched "+" and "–" input pairs which are critical for AC common mode rejection. The AM 502 has a common mode rejection ratio of at least 100 dB up to 50 kHz. High CMRR translates to greater confidence that a measured differential voltage is not corrupted by a fluctuating common mode voltage. Traditional 1X P6101B or 10X P6062B Probes may be used to provide access to the DUT (Device Under Test). Or a matched differential probe pair such as the P6135A is available as the signal path from the desired test points.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Amplifier
## Signal Conditioner - Modular







*AM 502 provides differential comparator capability to scopes with single-ended inputs.*

**TRUE DIFFERENTIAL VS. DIGITAL PROCESSING**
The AM 502 enhances the capabilities of both analog and digital storage oscilloscopes. Digital post-processing capabilities such as waveform subtraction can simulate differential measurements between two simultaneously sampled signals. However, the dynamic range of digital waveform subtraction is typically limited by sampled data resolution (such as 8-Bit a/d converter results) rather than the precision of the subtraction algorithm. The AM 502 as a front-end to a digital oscilloscope insures that the digital conversion capability is applied to measuring the desired difference voltage rather than as a guard to a/d converter overflow for large common mode signals.

**DC OFFSET VS. OSCILLOSCOPE POSITIONING**
Alternatively, a scope's vertical position control can visually "offset" a waveform by bringing an off-screen signal into viewing range. While this apparently performs the DC offset function, its dynamic range is limited. The vertical positioning capability of most oscilloscopes is typically less than ±20 vertical divisions. The AM 502's true DC offset effectively provides thousands of vertical divisions of offset.

### Characteristics (AM 502)

**Gain –** 100 to 100,000, 1 to 1000 in ÷100 Mode; 1-2-5 sequence; accurate within 2%. Continuously variable gain between steps in uncalibrated mode.

**HF – 3 dB Point –** Selectable in 9 steps (1-3 sequence) from 100 Hz to 1 MHz, Upper –3 dB point reduces to 500 kHz at 50K gain; 250 kHz at 100K gain.

**LF – 3 dB Point –** Selectable in 6 steps (1-10 sequence) from 0.1 Hz to 10 kHz; AC coupling limits –3 dB point to 2 Hz or less.

**Variable DC Offset –** At least ±1 V. Equivalent to ±100 V in ÷100 Mode.

**Common-Mode Rejection Ratio –** At least 100 dB, DC to 50 kHz. ÷100 Mode: At least 50 dB, DC to 50 kHz.

**Maximum Input Bias Current –** ±100 pA each input for T ≤30°C.

**Maximum Voltage Drift –** 100 µV/°C referred to input.

**Maximum Noise –** ≤25 µV (tangentially measured) referred to input.

**Common Mode Voltage Range –** ±5 V, ÷ 100 Mode: ±50 V.

**Maximum Safe Input Voltage –** DC coupled: 15 V (DC + peak AC). ÷ 100 Mode DC coupled: 350 V (DC + peak AC). AC coupled: 350 V (DC +peak AC) with coupling capacitor precharged.

**Input R and C –** 1 MΩ paralleled by ≈ 47 pF. Input impedance can be increased to a FET input via a simple internal jumper change.

**Maximum Output –** ±5 V, ±20 mA, output resistance is 5 Ω or less.

**Minimum Load Impedance –** 250 Ω.

**Over-Range –** Front-panel lamp indicates most over-range conditions.

## ORDERING INFORMATION

**AM 502**
Differential Amplifier ..... **$1,945**
**Includes:** Instruction manual (070-1582-01).

**RECOMMENDED ACCESSORIES**
See page 424 for complete selection information.

**PROBES**
**Differential Probe Pair –** Order P6135A ..... **$750**
**Passive Probe –** 1X, 15 MHz. Order P6101B ..... **$65**
**Passive Probe –** 1X/10X. Order P6062B ..... **$260**

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M7 –** Calibration Service. AM502 ..... **+$155**
**Opt. M9 –** Repair Protection. AM502 ..... **+$155**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# TVC 501 / AM 503S / A6302 / A6303 Signal Conditioners
## Modular

*The TVC 501 provides real-time scope display of time-interval variations vs. time.*

*The AM503S displays AC/DC current signals on any oscilloscope.*

**TVC 501**
- Real-Time Scope Display of Time-Interval Variations vs. Time
- Time Delay, Pulse Width, and Period Measurements
- >2 Million Uninterrupted Event-by-Event Measurements/Second

**AM 503S**
- Displays AC/DC Current Signals on an Oscilloscope
- DC to 50 MHz Bandwidth

**A6302**
- 20 A Continuous Current
- 50 A Peak Pulse Measurements
- DC to 50 MHz Bandwidth

**A6303**
- 100 A Continuous Current
- 500 A Peak Pulse Measurements
- DC to 15 MHz Bandwidth

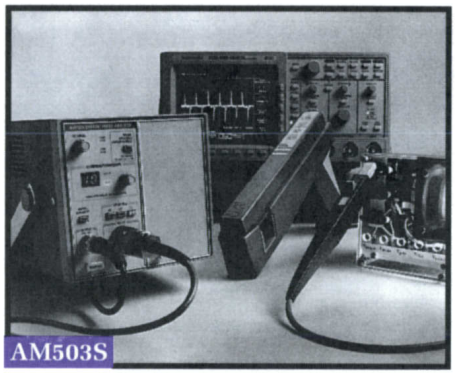

TVC 501

### TVC 501 Time-Interval to Voltage Converter

The TVC 501 adds three measurement functions to a scope's voltage vs. time capability: time-delay vs. time, pulse-width vs. time, and period vs. time. The TVC continuously measures the timing parameter and instantaneously generates a voltage proportional to the measurement. Conversions are performed pulse-to-pulse without averaging. The TVC 501 provides seven vertical scales from 1 µsec to 1 sec per division. Up to 30,000 divisions of offset permits small timing variations to be viewed on events with large average values.

The continuous TVC output becomes another trace on a scope that can be correlated, measured, and analyzed with waveforms on other channels. Since the TVC generates voltages proportional to time-intervals, a scope can be set to trigger on timing violations such as a time-delay that exceeds a threshold or an incorrectly narrow pulse or glitch.

See page 488 for detailed information.


AM503S

### AM 503S Current Probe System

The AM 503S Current Probe System allows the display of current on any oscilloscope having 10 mV/div sensitivity, 50 Ω or 1 MΩ input, and (for performance to full bandwidth) at least 200 MHz bandwidth. The amplifier attenuator has 12 calibrated steps in a 1-2-5 sequence. An LED display indicates current/division. See page 476 for detailed information.

The AM 503S Current Probe System has a wide variety of applications from SCR and power-supply measurements to medical applications. The clip-on probes use inductive coupling to minimize interference with the circuit under test.

## ORDERING INFORMATION

**TVC 501** – Time-Voltage Converter. ..... TD **$2,495**
See page 488 for further information.

**AM 503S** – Current Probe System ..... TD **$2,745**
**Includes:** AM 503A, A6302 (calibrated to AM 503), Tool Box, TM 502A. See page 475 for further information.

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M7** – Calibration Service (AM 503S) ..... **+$120**
**Opt. M9** – Repair Protection (AM 503S) ..... **+$405**

**A6302** – 2 m 20A Current Probe ..... TD **$795**
**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).

**A6303** – 2 m 100A ..... TD **$1,435**
**Includes:** Carrying Case (016-0622-02).

Information for the use of the A6303 Current Probe is included in the AM 503S Operator's Manual (070-8170-00). Service information is in the AM 503S Service Manual (070-8174-00). Must be used with an AM 503A or AM 5030.

**AUXILIARY PRODUCTS**
See page 385 for Auxiliary Instruments.

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571). AM503S also available through TekDirect. Call 1-800-426-2200.

# Mainframes
## Modular

### Mainframes and Accessories

**TM 500 POWER MODULE MAINFRAMES**

The TM 500 power modules (mainframes) are the heart of the modular instrument architecture. Designed for maximizing benchtop, portable, and rackmount testing, these mainframes along with your choice of many plug-ins from Tektronix, can be used to configure hundreds of multi-function or application specific packages.

**PLUG-IN COMPATIBILITY**

The TM 500 plug-in instruments operate in any of the TM 500 Series mainframes that accept instruments in combinations of up to six single-wide plug-ins.

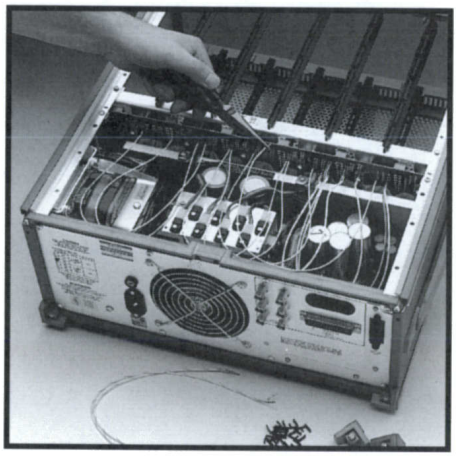
TM 5000 Power Module Mainframes provide additional flexibility and expansion into future ATE applications. These GPIB programmable mainframes will accept either TM 500 or TM 5000 plug-in instruments. The TM 5006A provides additional flexibility for Rack and Stack Systems with the Option 10 Slide Rack configuration.

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# TM 5000 SERIES TM 500 SERIES Mainframes

## Modular



### TM 5000 POWER MODULE MAINFRAMES

The TM 5000 mainframes extend the convenience of the TM 500 concept into the programmable instrument IEEE Standard 488 arena. The TM 5003 accepts up to three instruments at one time; the TM 5006A accepts up to six instruments at one time. These two TM 5000 mainframes were designed for use with the Tektronix TM 5000 line of programmable, IEEE-488 compatible test and measurement instruments, and all of the TM 500 manual plug-in instruments. Manual and programmable instruments can be mounted together in adjacent slots.

Any of the mainframes may be operated with less than a full complement of plug-in instruments installed; you don't have to have all of the compartments occupied in order to operate a TM 500 or TM 5000 system. Use only as much of the system as you need; add to it as your needs change. A blank front panel-like cover (016-0195-03) or tool box (016-0362-02) is available to cover/fill empty slots.

### BENCHTOP

The five benchtop mainframes are the TM 502A, TM 503B, TM 506A, TM 5003 and TM 5006A. The TM 502A and TM 5003 are the most compact of the multiple instrument units. The TM 506A, and TM 5006A each include a high-power compartment at the right-hand side to supply higher current levels to instruments that provide higher performance or higher output levels, such as the PS 503A, and PS 5010 Power Supplies. The TM 506A, TM 5003, and TM 5006A incorporate a quiet fan for optimum cooling. All operate from 110 or 220 VAC.

### RACKMOUNT

The TM 506A Option 10, and the TM 5006A Option 10 rackmount mainframes each features slide assemblies and handles, plus a higher-power fan to accommodate the higher ambient temperatures often found in enclosed racks and consoles.

### REAR INTERFACE CAPABILITY

Most TM 500 plug-in modules contain a duplication of the front-panel input and output connections in the back. These interface lines are built into the rear-edge circuit card connector of each plug-in. Some plug-in modules also have additional signal or control lines that are present only at the back of the instrument. In either case, different modules may be interconnected by the user to reduce front-panel clutter or to perform functions not otherwise available. Any module can be internally connected through the mainframe and also can be externally interfaced out the rear panel.

Option 02 provides square-pin connectors at the rear interface between the mainframe and the plug-in instruments, plus a multi-pin connector and one or more BNC connectors mounted on the rear panel of the mainframe. To allow as much flexibility as possible, these connectors are not pre-wired. A wire kit consisting of specially prepared jumper wires and coax cables and pins is provided with the option. Then, interfacing between instruments within a mainframe and with external devices is simply a matter of connecting the appropriate terminals together.

### ECONOMY

Relatively fixed packaging costs for frames, covers, primary power circuits, unregulated secondary power circuits and other items are a significant portion of the cost of a typical instrument. Since these fixed costs associated with packaging are shared by many functional instruments in the TM 5000/TM 500 lines, the cost-per-function may be lower than comparable, one- or two-function monolitic instruments.

Reduced cabling costs made possible by the rear-interface capability, the requirement for fewer GPIB cables for an equal number of instruments in the TM 5000 line; and the reduced space requirements for a measurement system all contribute to a saluable economy for test and measurement.

# Mainframes
## Modular



### TM 5006A

The TM 5006A mainframe can accept and provide power for up to six single-width TM 500 and/or TM 5000 plug-ins. The right hand compartment is a high-power compartment. The mainframe features a switching DC power supply. All DC voltages are electronically regulated. Forced-air cooling is standard.

Available options: Option 02 Rear Interface, Option 10 Rackmount, Option 12 Combination of Options 02 and 10 and Option 15 which improves EMI compatibility.

Cabinet-to-rackmount conversion kit, equipped with slide out assemble, required to convert a TM 5006A to rackmount capability. Order 040-0982-00.

Rackmount-to-cabinet conversion kit, equipped to convert a TM 5006A with rackmount configuration to cabinet style. Order 040-0983-00.

### TM 5003

The TM 5003 can accept and provide power for up to three single-wide TM 500 and/or TM 5000 plug-ins. It features a switching DC power supply. All DC voltages are electronically regulated. Forced-air cooling is standard.

Available options: Option 02 Rear Interface.

### Characteristics

**POWER REQUIREMENTS**

**Line Voltage Ranges** – 100, 110, 120, 200, 220, and 240 VAC (not to exceed 250 VAC on 240 VAC range); selectable via internal jumper or rear panel.

**Line Frequency Range** – 48 Hz to 66 Hz.

**Power Consumption** – TM 5006A: ~ 650 VA. TM 5003: ~ 300 VA.
(Actual power consumption depends on plug-in selection and operating modes.)

**ENVIRONMENTAL**

**Temperature Range** – Operating; 0°C to +50°C. Nonoperating: –55°C to +75°C.

**PHYSICAL CHARACTERISTICS**

| | TM 5006A | | TM 5003 | |
|---|---|---|---|---|
| **Dimensions** | **mm** | **in.** | **mm** | **in.** |
| Width | 445 | 17.5 | 230 | 9 |
| Height | 194 | 7.6 | 194 | 7.6 |
| Depth | 488 | 19.2 | 488 | 19.2 |
| **Weight ≈** | **kg** | **lb.** | **kg** | **lb.** |
| Net | 14.5 | 32 | 8.6 | 19 |
| Shipping | 20.9 | 46 | 12 | 26.5 |

**TM 5006A**

- Six Compartment Mainframe
- High Power Compartment
- Switching DC Power Supply
- Forced Air Cooling
- Rear Panel Interface Connections with Opt. 02
- Rackmounting Capability with Opt. 10
- UL Listed 1244, Certified CSA 22.2-M89

**TM 5003**

- Three Compartment Mainframe
- Switching DC Power Supply
- Forced-Air Cooling
- Interface Connections on Rear Panel Via Opt. 02
- UL Listed 1244, Certified CSA 22.2-M89

*Programmable modular mainframes are ideal for benchtop or system ATE. Fast, flexible configurations with a minimum of cable connections.*

## ORDERING INFORMATION

**TM 5006A**
Power Module Mainframe ..... TD $1,435
**Includes:** Instruction Manual (070-7614-00).
**Opt. 02** – Rear Interface ..... +$195
**Opt. 10** – Rackmount. Includes high-power fan ..... +$110
**Opt. 12** – Combination Opt. 02 and Opt. 10 ..... +$295
**Opt. 15** – Electro Magnetic Compatibility ..... +$495

**TM 5003**
Power Module Mainframe ..... TD $1,195
**Includes:** Instruction Manual (070-2955-00).
**Opt. 02** – Rear Interface ..... +$195

**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1** – Universal Euro 220 V, 50 Hz ..... NC
**Opt. A2** – United Kingdom 240 V, 50 Hz ..... NC
**Opt. A3** – Australian 240 V, 50 Hz ..... NC
**Opt. A4** – North American 240 V, 60 Hz ..... NC
**Opt. A5** – Switzerland 220 V, 50 Hz ..... NC
See General Customer Information Section for additional description.

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M7** – Calibration Service. TM5003 ..... +$55
**Opt. M9** – Repair Protection. TM5003 ..... +$80

TD Product available within 24 hours through TekDirect Call 1-800-426-2200.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 TM 5006A and TM 5003 comply with IEEE Standard 488.1-1987.

# TM 506A
# TM 503B
# TM 502A

# Mainframes
## Modular

*Compact modular benchtop solutions for reconfigurable test requirements.*

**TM 506A**
- Six Compartments
- High Power Compartment
- Forced Air Cooling
- Interface Connection on Rear Panel Via Opt. 02

**TM 503B**
- Three Compartments
- Portable
- Convection Cooled
- Interface Connections on Rear Panel Via Opt. 02
- UL Listed 1244, Certified CSA 22.2 No. 231-M89

**TM 502A**
- Two Compartment
- Convection Cooled

### TM 500 Power Module Mainframes

TM 500 plug-ins can operate in several different mainframes, including benchtop, portable, and rackmount configurations in the TM 500 and TM 5000 Series mainframes. This allows hundreds of different instrumentation packages to be configured for specific tasks.

**BENCHTOP**

Three benchtop mainframes are available: the TM 502A, TM 503B, and TM 506A. The TM 506A includes a high-power compartment at the right side to supply higher current levels. The TM 506A incorporates a quiet fan for maximum cooling. All benchtop models have feet, tilt-bails, and handles, and operate from 110 to 220 VAC.

**RACKMOUNT**

TM 506A has a slide assembly and handles, plus a higher-power fan to accommodate higher ambient temperatures.

### TM 506A

The TM 506A mainframe accepts up to six different TM 500 plug-ins, providing a complete test station with one power cord. The right hand compartment is a high-power compartment. Forced air cooling is standard. Like most TM 500 mainframes, the TM 506A is available with the Option 02 which allows rear interfacing of different modules, reducing front panel clutter.

### TM 503B

The TM 503B accepts up to three, single width TM 500 plug-ins. This light weight, portable, benchtop mainframe includes a tilt bail handle and rear panel power entry, switch, and line selector assembly.

### TM 502A

The New TM 502A accepts up to two single width TM 500 plug-ins. This lightweight, portable, benchtop mainframe includes a tilt bail handle and rear panel power entry, switch, and line selector assembly. An optional Toolbox plug-in (Opt. 13) is available.

### Characteristics

**Line Voltage Ranges –** 100, 110, 120, 200, 220, and 240 VAC (not to exceed 250 VAC on 240 VAC range); selectable via internal jumper or rear panel.

**Line Frequency Range –** TM 506A: 48 Hz to 66 Hz. TM 503B, TM 502A: 48 Hz to 400 Hz.

**Power Consumption –** TM 506A: ~300 VA. TM 503B ~250 VA. TM 502A: ~120 VA Actual power consumption depends on plug-in selection and operating modes.

**ENVIRONMENTAL**

**Temperature Range –** Operating; 0°C to +50°C. Nonoperating: –55°C to +75°C.

## ORDERING INFORMATION

**TM 506A**

Power Module Mainframe ..... **$950**
**Includes:** Instruction Manual (070-6929-00).

**Opt. 02 –** Rear Interface ..... **+$195**

**Opt. 10 –** Rackmount. Includes high-power fan. ..... **+$110**

**Opt. 12 –** Combination Opt. 02 and Opt. 10. ..... **+$305**

**CONVERSION KITS**

**Cabinet-to-Rackmount Conversion Kit –** Equipped with slide-out assembly to convert TM 506A to rackmount capability. Order 040-0982-00 ..... *1

**Rackmount-to-Cabinet –** Equipped to convert TM 506A with rackmount configuration to cabinet style. Order 040-0983-00 ..... **$135**

**TM 503B**

Power Module Mainframe ..... **$495**
**Includes:** Instruction Manual (070-7808-00).

**Opt. 02 –** Rear Interface ..... **+$75**

**TM 502A**

Power Module Mainframe ..... **$395**
**Includes:** Instruction manual (070-6502-00)

**Opt. 13 –** Includes Plug-in Toolbox ..... **+$80**

**INTERNATIONAL POWER PLUG OPTIONS**

Opt. A1 - Opt. A5 Available ..... **NC**
See General Customer Information Section for additional description.

**WARRANTY-PLUS SERVICE OPTIONS**

**Opt. M7 –** Calibration Service
TM 506A ..... **+$35**
TM 502A ..... **+$35**

**Opt. M9 –** Repair Protection
TM 506A ..... **+$100**
TM 502A ..... **+$80**

**AUXILIARY PRODUCTS**

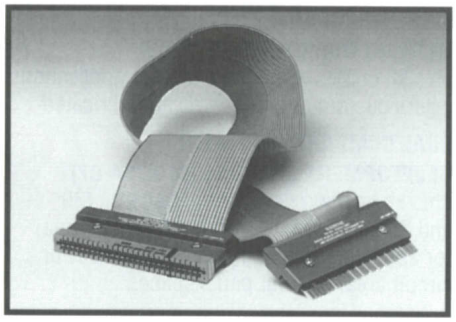
See next page for Auxiliary Instruments.

*[1] Contact your local Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Accessories
## Modular

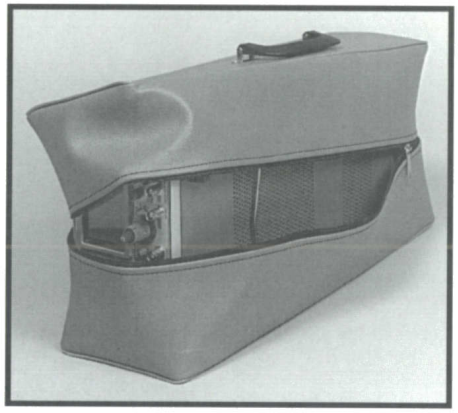




*Standard Extension Cable*

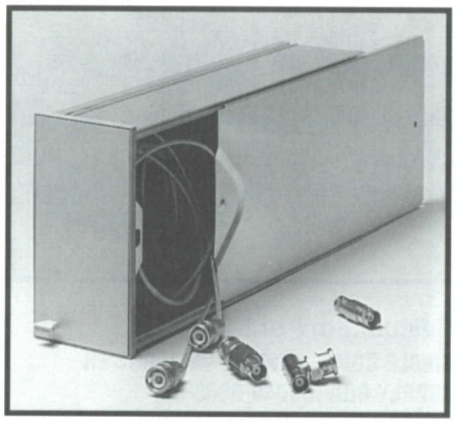
### Extension Cable

Designed to couple a TM 500 or TM 5000 Plug-in with the mainframe rear interface or GPIB board connections outside the mainframe for calibration and/or Customer Plug-in design.



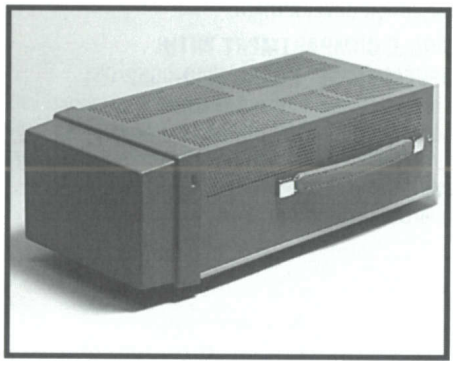
### Rain Covers

These soft, weather-proof vinyl-coated Rain Covers come in sizes for TM 503B, TM 504, and the PFG 5105, AFG 5102, and other TM 5000 monolithic packages.



### Plug-in Toolbox

The plug-in toolbox provides space within your TM mainframe for storing 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 in.).



### Protective Front Cover

A snap-on front cover, molded of high-impact plastic, is available for the TM 503B.

*Continued on next page.*

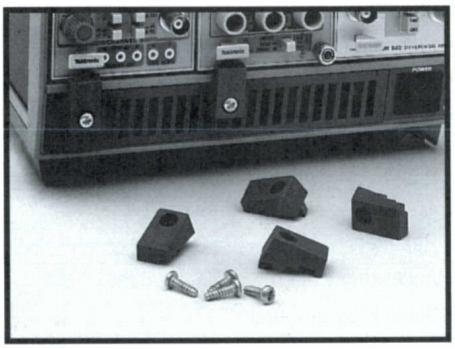
**ACCESSORIES**

- Extension Cable
- Rain Covers
- Tool Box
- Protective Front Cover
- Mainframe Plug-in Retainers
- Accessory Pouch
- Blank Plug-in Panel
- Rear Interface Data Book

*Auxiliary instruments, accessories, and flexible plug-in extender cables.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Accessories
## Modular

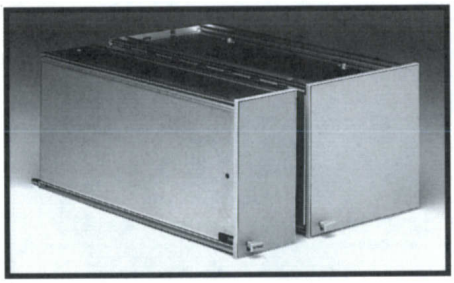


### Mainframe Plug-in Retainers

A mainframe Retainer Bar Kit is available for RTM 506 to secure plug-ins, order part number 020-0549-00. Initial installation requires replacement of an existing bottom member of the mainframe with a new part supplied in the kit. Thus providing a mechanism for securing the plug-ins. TM 506A, TM 503B, TM 502A, TM 5003, and TM 5006A use Retainer Clips.

### Blank Plug-in Panel

When operating TM 500/TM 5000 instruments with less than the full complement of plug-ins, the blank plug-in panel can be used to cover unused compartments.



### Custom Plug-in Kits

**SINGLE COMPARTMENT WITH POWER SUPPLY BOARD (040-0803-02)**
The kit includes parts and a pre-etched circuit board layout for (1) a ground-referenced positive and negative supply, capable of 7 to 20 V at up to 400 mA, and (2) a ground-reference supply, nominally 5 V, not adjustable, with up to 1 amp current capability. The circuit board includes the edge-connector interface and has about 30 square inches of 0.1 in. grid perforated board with plated holes for circuit development.

**SINGLE COMPARTMENT WITH DEVELOPMENT BOARD (040-0652-05)**
This kit comes without the power supply components or the pre-etched power supply circuit. The board includes the edge-connector interface and has about 35 square inches of board development area.

**SINGLE COMPARTMENT WITHOUT BOARD (040-0821-03)**
This kit comes without a board for applications where custom circuit boards are fabricated.

**DUAL COMPARTMENT WITH DEVELOPMENT BOARDS (040-0754-07)**
This kit has two development boards (30 and 35 square inches of development area) for applications requiring additional power, circuit area, or front panel space.

### Rear Interface Data Book

The Rear Interface Data Book provides diagrams and related interface information for most of the TM 5000/TM 500 plug-ins.

## ORDERING INFORMATION

**CABLES**
**Extension Cable** – For TM 500/TM 5000 Mainframes.
Standard Cable. Order 067-0645-02 ..... **$470**
**GPIB Extender Cable** – Order 067-0996-00 ..... **$235**
**GPIB Interconnecting Cables** –
(0.5) Order 012-1015-00 ..... **$85**
(2m) Order 012-0630-01 ..... **$120**
(2m) Double Shielded. Order 012-0630-03 ..... **$125**

**RACKMOUNT KITS**
**TM 506A/TM 5006A** – Order 040-0982-00 ..... *1

**COVERS**
**Front Panel Cover** – Snap-on.
(TM 503B) Order 200-3554-00 ..... **$29**
(TM 504) Order 200-1727-00 ..... **$20**
(TM 506) Order 200-1728-00 ..... **$24**
(TM 5003) Order 200-3252-00 ..... **$11.25**
**Rain Covers** – For TM 503B, PFG 5105, AFG 5102, TM 5000. Order 016-0621-00 ..... **$45**

**ADDITIONAL ACCESSORIES**
**Rear Interface Kits** –
1-3 wide Mainframes. Order 020-1611-01 ..... *1
4-6 wide Mainframes. Order 020-1746-00 ..... *1
**Retainer Clips** –
TM 506A, TM 5003, TM 5006A. Order 354-1085-00 ..... *1
TM 502A, TM 503B. Order 407-3658-00 ..... **$1.45**
**Accessory Pouch** – Order 016-0351-00 ..... **$37**
**Blank Plug-in Panel** – Order 016-0195-05. ..... **$47**
**Plug-in Toolbox** – Order 016-0362-02. ..... **$95**
**Rear Interface Data Book** – Order 070-2088-04. ..... **$33**
**Travel/Carrying Case** – TM 503B/TM 5003.
Order 016-0565-01 ..... **$920**
**Single Compartment with Power supply board** –
Order 040-0803-03 ..... **$160**
**Single Compartment with Uncommitted Board** –
Order 040-0652-06 ..... **$135**
**Single Compartment without Board** –
Order 040-0821-04 ..... **$70**
**Double Compartment with Two Boards** –
Order 040-0754-07 ..... **$260**
**Rear-Interface Data Book** – Order 070-2088-04 ..... **$33**
**Flexible Extender Cable** – Order 067-0645-02 ..... **$470**

*1 *Contact your local Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Oscilloscope Calibration
## Modular

### Support of Scopes

At Tektronix, we've been building the world's best-engineered and most reliable oscilloscopes for over four decades. Our successes have demanded hard work and uncompromising design, plus an insistence on customer satisfaction.

Inherent in the quality of Tektronix oscilloscopes has been the unequaled support of our products through accurate and precise manual and programmable calibration systems, service manuals, training programs and standard Tektronix Service offerings.

This is the same calibration equipment we use in our own labs to ensure our scopes are in top condition – and to ascertain whether performance meets or exceeds all specifications. Tektronix automated scope cal systems are specified by the U.S. Military to upgrade their existing calibration equipment as part of their long-term modernization program – a distinction not easily come by.

That's strong support for your own scope cal purchase decision. But there's even more.

Tektronix is a safe buy, certainly, but is also a wise investment. Simply because within our range of scope cal solutions, you are certain to find the level of performance, accuracy and support you need to keep pace with growing requirements. Plus, there is the built-in modularity to allow easy, cost-effective expansion.

#### A CHOICE OF SOLUTIONS

Our industry-leading TM 500 manual instrumentation provides a wide range of standard amplitude square waves, plus the fastest rise times, the lowest aberrations, the fastest time marks, and the widest leveled sinewave frequency range of any equipment in its class.

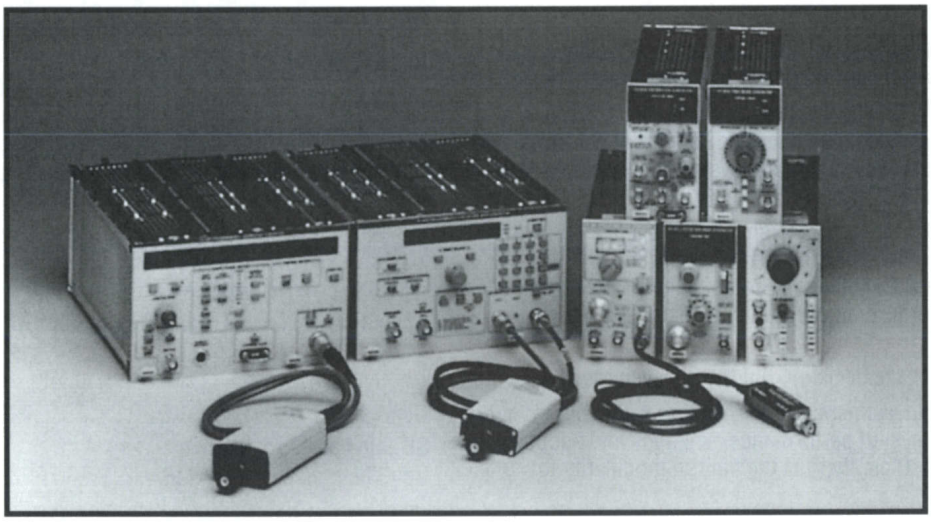
The TM 500 set of manual calibration instruments can be configured into a portable test set for in-field oscilloscope service and calibration.

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# Oscilloscope Calibration
## Modular - Manual



### CALIBRATION INSTRUMENT SELECTION GUIDE

| Instrument | Primary Functions | Secondary Functions | Module Width |
|---|---|---|---|
| CG 5011 | Amplitude Calibration<br>Time Base Calibration | Testing risetime and transient response, attenuator compensation, oscilloscope non-linearity | 3 Wide |
| SG 5030 | Bandwidth Calibration | Broadband sinewave generation | 3 Wide |
| PG 506A | Amplitude Calibration | Testing risetime and transient response, attenuator compensation | 1 Wide |
| TG 501A | Time Base Calibration | Testing oscilloscope nonlinearity | 1 Wide |
| SG 502 | LF Response & Triggering | Low distortion leveled signal source | 1 Wide |
| SG 503 | Bandwidth Calibration | General leveled RF signal source | 1 Wide |
| SG 504 | Bandwidth Calibration | General leveled RF signal source with frequency modulation capability | 1 Wide |

### MANUAL SOLUTIONS

The TG 501A Time Mark Generator provides time marks from 5 s to 1 ns, plus a variable timing output which allows you to read the scope's percentage timing error directly on a digital display.

The PG 506A Calibration Generator provides clean, fast-rise square waves and calibrated-amplitude square waves for checking oscilloscope transient response and for setting the vertical-amplifier gain of the oscilloscope respectively. The PG 506A has a variable mode of operation which allows you to read the oscilloscope's calibration error directly in percent from its digital display.

The SG 503 and SG 504 generators provide leveled sine waves for bandwidth checks and triggering performance checks. The range of the SG 503 is 250 kHz to 250 MHz, while the range for the SG 504 is from 245 to 1050 MHz.

The SG 502 Oscillator is perfect for calibration applications where verification of low-frequency rolloff in AC modes and performance measurement of low-frequency-reject triggering modes is required.

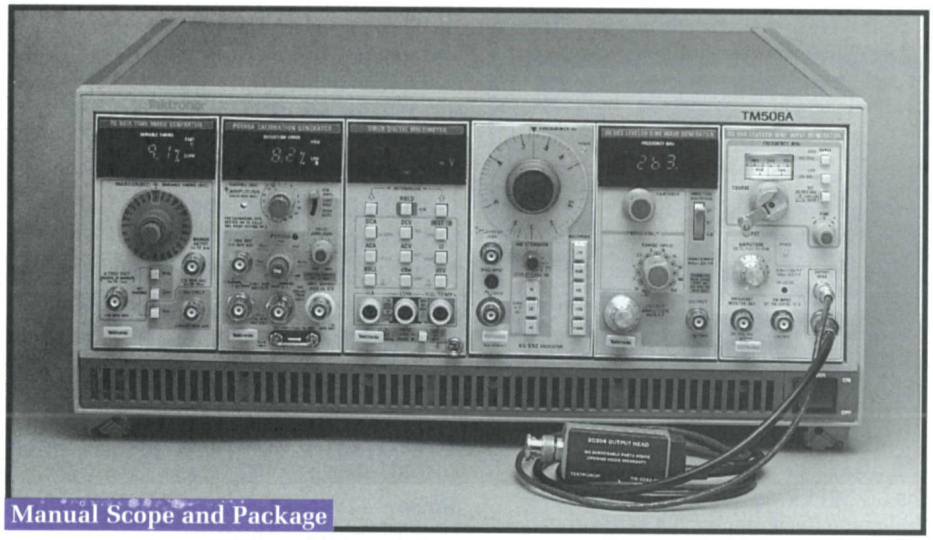
### PROGRAMMABLE SOLUTIONS

If you manage a cal lab, chances are you're already using Tektronix oscilloscope calibration equipment. In which case our CG 5011 Programmable Calibration Generator and SG 5030 Programmable Leveled Sinewave Generator can help automate test procedures, making them faster and easier for any technician on your staff to perform. Each instrument offers easy test setup over the GPIB, and automated testing has the benefit of virtually eliminating the risk of operator error.

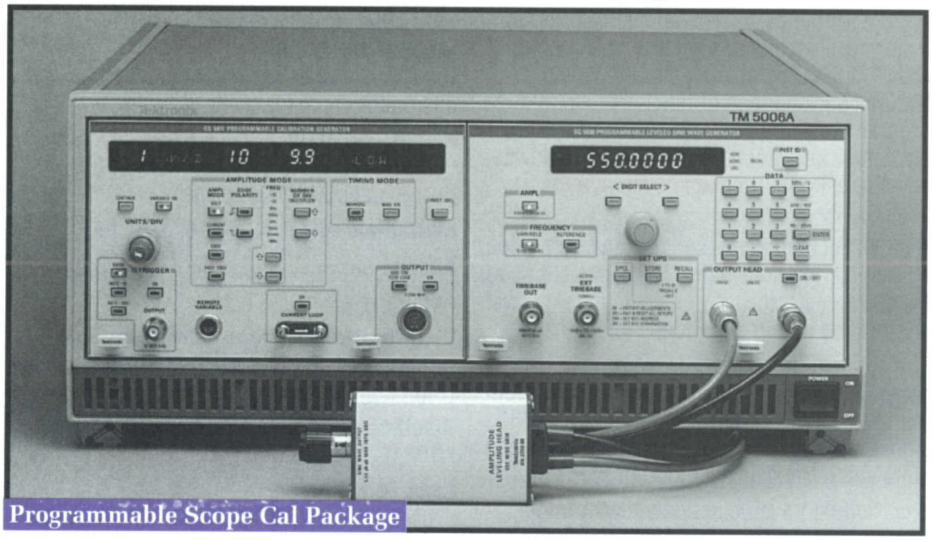
The CG 5011 is designed to cover both analog and digital requirements up to 2 GHz and is ideally suited for environments where multiple scopes are maintained. It is complemented by the SG 5030 Programmable Leveled Sinewave Generator for oscilloscope bandwidth calibration. The SG 5030's leveled output is variable from 0.1 Hz to 550 MHz. Accurately calibrated output voltages are obtained through the use of a remote levelling head which plugs directly into the instrument under test.

# Oscilloscope Calibration
## Modular - GPIB






Manual Scope and Package




Programmable Scope Cal Package

### Manual Scope Cal Package

Configured for manual calibration and verification of scopes with sweep speeds to 1 ns/div and bandwidths to 1 GHz. Includes a TG 501A Time Mark Generator, PG 506A Calibration Generator, SG 503 and SG 504 Leveled Sinewave Generators, DM 511 Digital Multimeter and SG 502 Oscillator.

- Calibrate oscilloscope time bases with sweep speeds from 5 sec/div to 1 ns/div with the TG 501A.
- Test amplifier transient response to <1 ns with fast rise/fall output using the PG 506A.
- Test amplifier bandwidths from 250 kHz to 1.05 GHz with the SG 503 and SG 504.
- Calibrate trigger circuits with the SG 502 and SG 503.
- Read timing and amplitude deflection errors directly in percent from the PG 506A, TG 501A and SG 503 digital displays.
- Measure oscilloscope power supplies with the DM 511.

### Programmable Scope Cal Package

Configured for automated calibration and verification of scopes with sweep speeds to 500 ps/div and bandwidths to 500 MHz. Includes a CG 5011 Programmable Calibration Generator and SG 5030 Programmable Leveled Sinewave Generator.

- The CG 5011 is the preferred choice for calibrating oscilloscopes up to 2 GHz.
- Calibrate oscilloscope time bases with sweep speeds from 5 sec/div to .5 ns/div.
- Test amplifier response with the pulse-head fast rise/fall output of 150 ps.
- Calibrate scope vertical, X-axis and Z-axis amplifier gain using the standard amplitude output.
- Read timing and amplitude deflection errors directly in percent from the digital display.
- Test amplifier bandwidths to 550 MHz using the SG 5030.
- Calibrate trigger circuits down to 0.1 Hz.
- Additional recommended plug-ins include the DM 5110 Digital Multimeter, FG 5010 Function Generator and DC 5010 Universal Counter/Timer.

# CG 5011
# PG 506A
# TG 501A

# Calibration Generators
## Modular

*Solutions for all your oscilloscope calibration needs.*

**CG 5011**
- Vertical Gain
- Horizontal Timing and Gain
- Vertical Bandwidth/Pulse Response Characteristics
- Probe Accuracy and Compensation
- Current-Probe Accuracy
- Calibrator-Output Accuracy
- Next-Cal-Date Tracking

**PG 506A**
- Three Square-Wave Output Modes
- 10 Hz to 1 MHz
- Direct Readout of Oscilloscope Deflection Error

**TG 501A**
- Marker Outputs, 1 ns to 5 s
- Direct Readout of Oscilloscope Timing Error
- External Trigger Output

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The CG 5011 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.



CG 5011

### CG 5011

The CG 5011 Programmable Oscilloscope Calibration Generator can be used either manually or as a part of a computerized system for the calibration and verification of major oscilloscope parameters. It is a three-wide TM 5000 compatible plug-in which features a wide range of functions, all programmable by controller via the GPIB or from the front panel. A "Learn" mode allows any manually set function or range to be acquired by a controller.

A CG 5011 computer-based test and calibration system can provide step by step instructions to the operator significantly reducing the skill level and/or time required for scope maintenance.

The optional Comparator Head is used to calibrate built-in oscilloscope calibrators. Both the oscilloscope calibrator and the CG 5011 signals are applied to the Comparator Head and simultaneously displayed on the scope's CRT.

The Remote Variable option allows remote operation of the Units/Div, Variable/Fixed button, the Continue push-button, and the VAR.

The CG 5011 is designed to greatly reduce your maintenance costs. Built in self test routines and hardware check the operation of all major circuits each time power is turned on. The Cal-Due-Date is displayed on the front panel.

A calibration certificate to MIL-STD-45662A with data is provided with the CG 5011.

### Characteristics

**VOLTAGE (AMPLITUDE MODE)**
Used to calibrate vertical display accuracy.

**Range –** 40 µV to 200 V, 1 MΩ load; 40 µV to 5 V, 50 Ω load (1-2-5 steps with multiplier).

**Multipliers –** 1, 2, 3, 4, 5, 6, 8, or 10.

**Polarity –** Positive from ground.

**Aberrations –** Less than ±15% of amplitude (±10 mV).

**Accuracy –** ±(0.25% + 1 µV).

**Frequency –** 40 µV to 80 mV: 10 Hz to 10 kHz. 100 mV to 10 V: +DC or –DC, 10 Hz to 100 kHz. 12 V to 200 V: +DC or –DC, 10 Hz to 10 kHz.

**Variable Range –** ±9.9.%

**CURRENT (AMPLITUDE MODE)**
Used to calibrate current probes.

**Range –** 1 mA to 100 mA (1-2-5 sequence).

**Multipliers –** 1, 2, 3, 4, 5, 6, 8, or 10.

**Aberrations –** Less 5% of period and less than ±15% of amplitude (±100 µA).

**Accuracy –** ±(0.25% + 2 µA.).

**Frequency –** DC or 10 Hz to 1 MHz (decade steps).

**Droop –** ≤1% p-p.

**Variable Range –** ±9.9%.

**LOW EDGE AND HIGH EDGE (AMPLITUDE MODE)**
Used to test oscilloscope input amplifier and attenuator compensation.

**Range –** 20 mV to 1 V p-p 50 Ω, Low Edge 1.2 V to 100 V p-p 1 MΩ load, High Edge (1-2-5 steps with multipliers).

**Multipliers –** 1, 2, 3, 4, 5, 6, 8, or 10.

**Aberrations –** ±2% of square wave amplitude.

**Accuracy –** ±3%.

**Polarity –** Positive or negative transitions to ground (Low Edge). Positive transitions only (High Edge).

**Risetime/Falltime –** ≤1.3 ns (Low Edge). ≤100 ns (High Edge).

**Long Term Flatness –** ±0.5% after first 10 ns (Low Edge). ±0.5% after first 500 ns (High Edge).

**Frequency –** 10 Hz to 1 MHz in decade steps. (Low Edge). 10 Hz to 100 kHz in decade steps. (High Edge).

**Variable Amplitude Range –** ≥ ±9.9% from nominal.

**MARKERS (TIMING MODE)**
Used to calibrate oscilloscope time bases.

**Range –** 0.5 ns to 5 s (1-2-5 steps).

**X10 Magnifier –** Increases marker rate by a factor of ten (0.1 µs to 5 s range only).

**Accuracy –** ±0.0003% (+15°C to + 50°C).

**Amplitude –** 1 V minimum 5 s to 2 ns, 350 mV minimum: 1 ns, 100 mV minimum: 0.5 ns. into 50 Ω.

**Variable Range –** ±9.9.%

# Calibration Generators
## Modular

**CG 5011**
**PG 506A**
**TG 501A**



**TRIGGER OUTPUT**
The oscilloscope under test is normally triggered externally from this source.

**Output Amplitude –** 1 V minimum into 50 Ω.

**Trigger Rate (Marker Mode) –** Normal: Slaved to marker rate from 100 ns to 5 s; remains at 100 ns for faster markers. Divided by 10: Reduces normal trigger rate by a factor of ten. Divided by 100: Reduces normal trigger rate by a factor of one hundred.

**All Other Modes –** Normal: Slaved to output frequency. Divided by 10: One-tenth output frequency. Divided by 100: One-hundredth output frequency.

**REFERENCE FREQUENCY**
**Output Frequency –** 1 MHz with internal time base accuracy.

**Output Amplitude –** TTL compatible.

**Input Frequency –** 1, 2, 3, 4 or 5 MHz.

**Input Amplitude –** 1 V to 10 V RMS.

**Required Accuracy –** ±0.001%.

**Input Resistance –** 10 kΩ (Nominal).

**FAST EDGE (AMPLITUDE MODE)**
The Pulse Head is used to generate fast rise, low-distortion pulses for testing higher bandwidth vertical amplifiers.

**Polarity –** Positive or negative transitions from ground.

**Risetime –** ≤150 ps.

**Aberrations –** ±3% of pulse amplitude; not to exceed 4% p-p for adjacent peaks.

**Frequency –** 100 Hz to 100 kHz (decade steps).

**Amplitude –** 1.1 V peak ±5% into 50 Ω.

**Variable Range –** ±10.% general.

**ENVIRONMENTAL**
**Operating –** 0°C to +50°C.

**Nonoperating –** 20°C to +65°C.

**Power Consumption –** 65 VA.

**Safety –** UL Listed 1244.

## PG 506A

The PG 506A Calibration Generator provides three modes of square wave output, selectable DC outputs, and a variable-amplitude output with front panel digital indication of oscilloscope deflection error. Simultaneous, plus and minus low-level, fast-rise (1.0 ns) square waves or high-amplitude (60 V), extremely clean square waves are available at frequencies from 10 Hz through 1 MHz for checking oscilloscope transient response. A 5 mA calibration current loop is useful for current probe calibration. A 1 kHz square wave can be generated in the amplitude-calibration mode. Its amplitude can be varied around the calibrated level until the square wave aligns with the oscilloscope graticule divisions. Scope deflection error can then be read directly off the PG 506A digital display in percentage high or low, permitting rapid verification of oscilloscope performance.

### Characteristics

**AMPLITUDE-CALIBRATOR MODE**
**Period –** Fixed at ≈1 ms or DC.

**Amplitude –** From 200 µV p-p to 100 V p-p in 1-2-5 sequence, accurate within 0.25% into 1 MΩ. 100 µV p-p to 5 V p-p into 50 Ω.

**Error Readout –** Range: ±7.5%. Resolution: 0.1%.

**PULSE MODES**
**Period –** 1 µs to 10 ms (within 5%) in decade steps with the variable control in Cal position. Variable extends period to at least 100 ms.

**Symmetry –** ≈50% duty cycle.

**HIGH AMPLITUDE OUTPUT**
**Rise Time –** Unterminated: 100 ns or less. Terminated into 50 Ω: 10 ns or less.

**Amplitude Range –** Unterminated: 6 V or less to at least 60 V. Terminated into 50 Ω: 0.5 V or less to at least 5 V.

**Leading-Edge Aberrations –** Within 2% or 50 mV p-p, whichever is greater, when terminated into 50 Ω.

## TG 501A

The TG 501A Time Mark Generator provides marker outputs from one nano-second to five seconds. A unique feature of the TG 501A is a variable timing output with a front panel two-digit LED display. The display indicates percentage of timing error between the normal time interval and a variable interval that lines up the marker pulse with graticule or division marks on the display. This feature not only provides direct readout in terms of percent error, but also helps eliminate errors associated with visually estimating error from a display.

### Characteristics

**Markers –** 1 ns through 5 s in a 1-2-5 sequence.

**Marker Amplitude –** ≥1 V peak into 50 Ω on 5 s through 10 ns markers. ≥750 m V p-p into 50 Ω on 5 ns and 2 ns markers. ≥200 mV p-p into 50 Ω on 1 ns markers.

**Trigger Output Signal –** Slaved to marker output from 5 s through 100 ns. Remains at 100 ns for all faster markers.

**Internal Time Base –** Crystal Frequency 5 MHz; Stability (0 to 50°C within 5 parts in $10^7$ after 1/2 hour; Long-Term Drift 1 part or less in $10^7$ per month; Setability adjustable to within 5 parts in $10^8$.

**External Reference Input –** Available with internal changes. Acceptable frequencies, 1 MHz, 5 MHz, or 10 MHz. Input amplitude must be TTL-compatible.

**Timing Error Readout Range –** To 7.5%.

**Timing-Error Measurement Accuracy –** Device under test error is indicated to within one least significant digit (to within one displayed count).

## ORDERING INFORMATION

**CG 5011** Programmable Calibration Generator ..... **$17,500**
**Includes:** Output Cable Assembly (012-0884-00); Pulse Head (015-0611-00); Instrument Interface Guide (070-7747-00); Instruction Manual (070-7745-00); Programmer's Reference Manual (070-7748-00); Service Manual (070-7746-00).

**ADDITIONAL ACCESSORIES**
**Comparator Head –** Order 015-0310-01 ..... **$975**
**Remote Variable –** Order 015-0309-01 ..... **$735**
**Pulse Head –** (When purchased separately) Order 015-0611-00 ..... **$2,215**
**Rigid Circuit Board Extender –** Order 067-0975-00 ..... **$170**
**Trouble Shooting Aid –** Order 067-0974-00 ..... **$585**
**PG 506A** Calibration Generator ..... **$3,995**
**Includes:** Instruction Manual (070-6687-00).

**ADDITIONAL ACCESSORIES**
**Precision Voltage Divider –** Order 015-0265-00. ..... **$325**
**Tunnel-Diode Pulser –** Order 067-0681-01. ..... **$395**
**TG 501A** Time Mark Generator ..... **$3,595**
**Includes:** Instruction Manual (070-1576-02)

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M7 –** Calibration Service
PG506A ..... **+$90**
TG501A ..... **+$105**
**Opt. M9 –** Repair Protection
CG5011 ..... **+$585**
PG506A ..... **+$200**
TG501A ..... **+$215**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The CG 5011 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

SG 5030
SG 502

SG 503
SG 504

# Leveled Sinewave Generators, Oscillator

## Modular

*Only Leveled Sinewave Generators provide the accuracy for oscilloscope bandwidth testing.*

**SG 5030**

- Oscilloscope Bandwidth Calibration
- 0.1 Hz to 550 MHz
- 4.5 mV to 5.5 V Amplitude Range
- Amplitude Flatness From ±1.5% to ±4% of 50 kHz Reference Frequency
- 20 Stored Front Panel Settings

**SG 502**

- 5 Hz to 500 kHz Sine Waves and Square Waves
- Low-Distortion Sine Wave
- 5 V RMS Open Circuit – 600 Ω Source
- 0 to 40 dB Output Variable Plus 0 to 70 dB in 10 dB Steps

**SG 503**

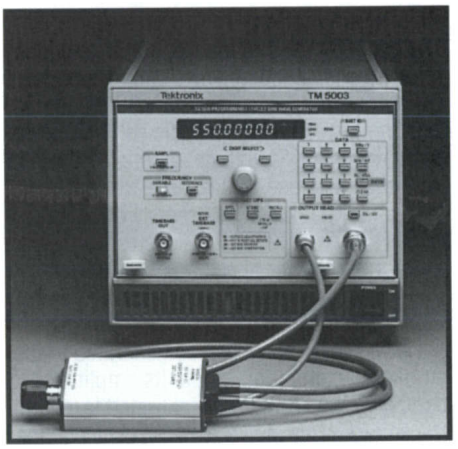
- 250 kHz to 250 MHz
- Leveled, Variable Output
- Digital Readout of Frequency

**SG 504**

- 245 MHz to 1050 MHz
- Leveled, Variable Output
- Frequency-Modulation Capability
- Internal Peak Detection

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488 The SG 5030 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.




### SG 5030 Leveled SineWave Generator

The SG 5030 is the only choice for anyone who needs leveled output amplitude to calibrate analog or digital scopes with bandwidth to 550 MHz – under either local or programmable control. That's because no other programmable leveled sine wave generator is built specifically to fill scope calibration requirements. The SG 5030's leveled output is variable from 0.1 Hz to 550 MHz with a reference frequency of 50 kHz. Crystal-controlled frequency accuracy eliminates drift so there's no second-guessing results.

Accurately calibrated output voltage is provided from 4.5 mV to 5.5 V peak-to-peak into 50 Ω. Absolute amplitude accuracy is ±1.5% from 0.1 Hz to 50 kHz, with flatness from ±1.5 to ±4% over the remainder of the frequency range to 550 MHz.

A remote leveling head is standard and plugs directly into the oscilloscope to ensure that the output signal is level at all times. All other signal generators are specified at the front-panel BNC connector, not at the end of the cable going to the instrument under test.

Frequency and amplitude along with 20 front-panel store/recall settings are all fully programmable. Automating test procedures makes scope calibration some four times faster than manual test methods allow – and virtually eliminates the risk of operator error.

Configure the SG 5030 with a CG 5011 Programmable Calibration Generator. As three-wide TM 5000 Series modules, they conveniently fill a six-slot TM 5006A mainframe to form a complete, cost-effective benchtop or rackmount calibration system.

### Characteristics

**FREQUENCY**

**Range/Resolution –**
0.1 Hz – 4.9999 kHz: 0.1 Hz steps;
5 kHz – 49.999 kHz: 1 Hz steps;
50 kHz – 550 MHz: 10 Hz steps.

**Accuracy With Internal Timebase (within 1 year of adjustment) –**

| Range | ppm of Setting + Hz |
|---|---|
| 0.1 Hz – 4.9999 kHz: | ± (3 + 0.06) |
| 5 kHz – 49.999 kHz: | ± (3 + 0.3) |
| 50 kHz – 550 MHz: | ± (3 + 3) |

**Accuracy With External Timebase (10 MHz) –**
0.1 Hz – 4.9999 kHz: ± (ext. t.b. error + 0.06 Hz);
5 kHz – 49.999 kHz: ± (ext. t.b. error + 0.3 Hz);
50 kHz – 550 MHz: ± (ext. t.b. error + 3 Hz).

**AMPLITUDE**

**Range/Resolution –**
4.5 mV – 55 mV: 0.02 mV/step;
55.2 mV – 550 mV: 0.2 mV/step;
552 mV – 5.5 V: 2 mV/step;
–42.95 dBm – +18.75 dBm: 0.05 dBm/step.

**Accuracy (within 1 year of adjustment) –**
0.1 Hz – 50 kHz: ±1.5% of setting.

**Flatness (within 1 year of adjustment) –**
50 kHz – 100 MHz: ±1.5% of 50 kHz Ref. Frequency;
100 MHz – 250 MHz: ±3% of 50 kHz Ref. Frequency;
250 MHz – 550 MHz: ±4% of 50 kHz Ref. Frequency.

**OUTPUT**

**Leveling Settling Time –** Less than 20 ms.

**Source Resistance –** 50 Ω, ±1%.

**DC Offset –** ±20 mV.

**VSWR –** Less than 1.2:1 up to 550 MHz.

**HARMONIC DISTORTION**

**0.1 Hz – 49.999 kHz –** All Harmonics and Spurs <–50 dBc.

**50 kHz – 550 MHz –** 2nd Harmonic <–30 dBc. All others <–35 dBc. Nonharmonics <–40 dBc. Phase Noise <–85 dBc/Hz at 10 kHz offset.

**INTERNAL TIMEBASE OUTPUT**

**Frequency –** 10 MHz.

**Accuracy –** ±3 ppm.

**Amplitude –** 400 mV p-p into 50 Ω.

**Impedance –** 50 Ω.

**EXTERNAL TIMEBASE INPUT**

**Frequency –**10 MHz, ±1.5 ppm.

**Amplitude –** –10 dBm to +10 dBm, (70 to 700 mV RMS).

**Impedance –** 50 Ω AC, 500 Ω DC.

**GENERAL**

**Environmental –** Operating 0°C to 40°C. Nonoperating: 40°C to +71°C.

**Power Consumption –** 65 VA.

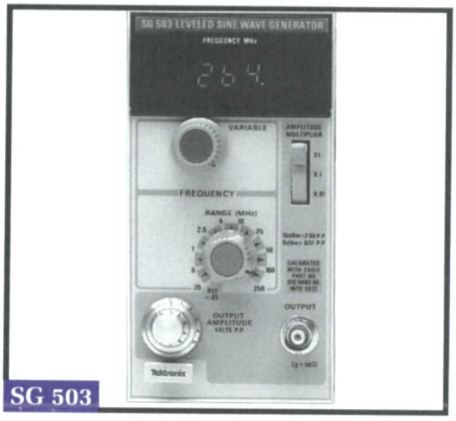
# Leveled Sinewave Generators, Oscillator

## Modular

SG 5030 SG 503
SG 502 SG 504




SG 502


SG 503


SG 504

### SG 502 Oscillator

The SG 502 features a wide frequency range of 5 Hz to 500 kHz with low distortion (0.035% between 20 Hz and 50 kHz) and is desirable for general test purposes. Other features include 70 dB amplitude control plus a simultaneous fixed-amplitude square wave.

### Characteristics

**Frequency Range –** 5 Hz to 500 kHz in 5-decade steps. Frequency accuracy within 5% of dial setting from 5 Hz to 50 kHz; within 10% of dial setting from 50 to 500 kHz.

**Amplitude Response (1 kHz Reference) –** Flatness: 0.3 dB over entire range.

**Attenuation –** Selectable from 0 to 70 dB in 10-dB steps with pushbuttons. Accurate within 0.2 dB for each step selected, additive. An uncalibrated control provides continuous variation from 0 to 40 dB.

**Harmonic Distortion –** <0.035% (70 dB) from 20 Hz to 50 kHz. <0.15% from 50 to 500 kHz RL ≥600 Ω.

**Maximum Output Voltage –** 5 V RMS open circuit; 2.5 V RMS into 600 Ω.

**Output Impedance –** 600 Ω, grounded.

**SQUARE WAVE**

**Freq. Range/Accuracy –** Same as sine wave.

**Rise Time and Fall Time –** 50 ns or less.

**Amplitude –** +5 V, fixed, open circuit.

**Output Impedance –** 600 Ω, grounded.

### SG 503 Leveled Sinewave Generator

The SG 503 provides a leveled output that is variable in frequency from 250 kHz to 250 MHz. The selected frequency is indicated by a built-in autoranging frequency counter with a three-digit LED readout on the front panel. Accurately calibrated output voltage is variable from 5 mV to 5.5 V peak-to-peak into 50 Ω.

### Characteristics

**Frequency Range –** 250 kHz to 250 MHz, plus 50 kHz reference frequency.

**Frequency Accuracy –** Within ±0.7 of one count of the least significant digit of indicated frequency.

**Amplitude Range –** 5 mV to 5.5 V p-p into 50 Ω termination in three decade ranges.

**Amplitude Accuracy (50 kHz Reference) –** Within 3% of indicated amplitude on (X1) range, 4% on (X.1) range, and 5% on (X.01) range.

**Flatness (P-P) –** From 250 kHz to 100 MHz, output amplitude will not vary more than 1% of the value at 50 kHz except that up to +1.5%, –1% variation may occur between 50 and 100 MHz on amplitude multiplier X.1 and X.01 ranges only. From 100 to 250 MHz, amplitude variation is within 3% of the value at 50 kHz.

**Harmonic Content –** Second Harmonic: At least 35 dB down. Third Harmonic and All Higher Harmonics: At least 40 dB down.

**Rear Interface –** Addresses the leveling circuit.

### SG 504 Leveled Sinewave Generator

The SG 504 provides leveled output amplitude and is variable from 245 to 1050 MHz in two bands via its compact output leveling head. Frequency is indicated by a high-resolution tape dial that expands each band over 28 inches. The accurately calibrated output voltage is variable from 0.5 V to at least 4.0 V p-p into 50 Ω.

### Characteristics

**Frequency Range –** Low Band: 245 to 550 MHz. High Band: 495 to 1050 MHz, plus 50 kHz or 6 MHz reference frequency (internally selected).

**Frequency Accuracy –** ±2% of dial indication.

**Amplitude Range –** 0.5 V to at least 4.0 V p-p.

**Amplitude Accuracy (At Reference) –** Within 3% of indicated amplitude.

**Flatness –** ±4% of amplitude at reference frequency.

**Harmonic Content –** Second Harmonic: At least 25 dB down. Third Harmonic and All Higher Harmonics: At least 40 dB down.

**FM Input –** Frequency Range: DC to 100 kHz. Deviation Sensitivity: ±9 V produces from 0.05% to 0.5% deviation of carrier, depending on output frequency.

**Frequency Monitor Output –** ≥0.3 V p-p into a 50 Ω load from 245 to 1050 MHz.

**Rear Interface –** Address FM input, frequency-monitor output, and amplitude control.

## ORDERING INFORMATION

**SG 5030** Programmable Leveled Sine Wave Generator ..... **$9,650**
**Includes:** Operators Manual (070-7705-00), Instrument Interfacing Guide (070-7704-00), Reference Guide (070-7706-00), Leveling Head (015-2350-00).

**SG 502** Oscillator ..... **$1,800**
**Includes:** Instruction manual (070-1430-01).

**SG 503** Leveled Sinewave Generator ..... **$3,895**
**Includes:** Three-foot precision 50 Ω cable (012-0482-00) Instruction Manual (070-6770-00).

**SG 504** Leveled Sinewave Generator ..... **$5,395**
**Includes:** Instruction Manual (070-1632-01); Leveling head (012-0282-01).

**WARRANTY-PLUS SERVICE OPTIONS**

**Opt. M7** – Calibration Service
SG5030 ..... +$105
SG502 ..... +$70
SG503 ..... +$100
SG504 ..... +$170

**Opt. M9** – Repair Protection
SG5030 ..... +$145
SG502 ..... +$160
SG503 ..... +$235
SG504 ..... +$270

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

GPIB IEEE-488

The SG 5030 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# 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, 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.

## Digital Multimeters

Tektronix digital multimeters measure AC and DC voltage and current, plus resistance and decibels.

The New 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, and 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.

## TM250 Basic Bench Set

Whether you are setting up a lab, a production line, or replacing a mismatched collection of old instruments, you will find this set a cost effective way to get the measurement power you need to do the job right. The TM250 Basic Bench Set is unbeatable in a classroom when used with the excellent instructional materials available from Tektronix.

The set includes the CFG250, CDM250, and CPS250. You will want to add your choice of optional counters or a basic oscilloscope for more complete test and measurement capability.

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# CDM250 DM2510 DM2510G TM250 Digital Multimeters

*Digital Multimeters for testing electronic products, power supplies, audio visual equipment, automotive electronics, and control systems.*

**CDM250**

Digital Multimeter

- 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

**TM250**

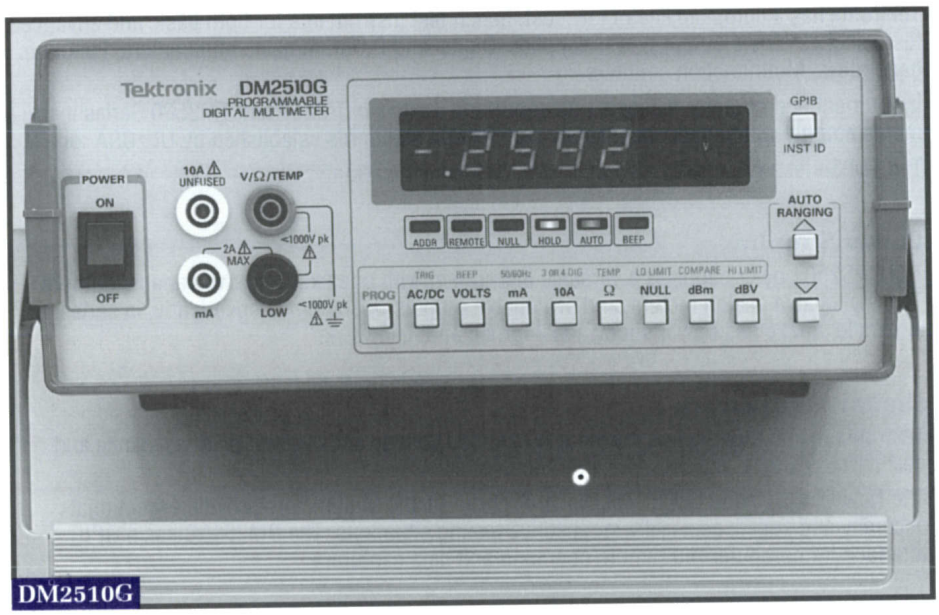
- Digital Multimeter
- 2 MHz Functional Generator
- Triple Output Power Supply

**TM250 APPLICATIONS**

- Electronic Service
- Education
- Training
- Manufacturing Test

TD

Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.



DM2510G

## CDM250

The CDM250 Digital Multimeter displays measurements of 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-selectable 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, a programmable six-function autoranging digital multimeter, has a GPIB interface for computerized programming or remote operation and data capture. This instrument is for use with a GPIB controller, such as the Tektronix RIC386 or a computer with a GPIB card on board.

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. Applications include education, design, service, and manufacturing.

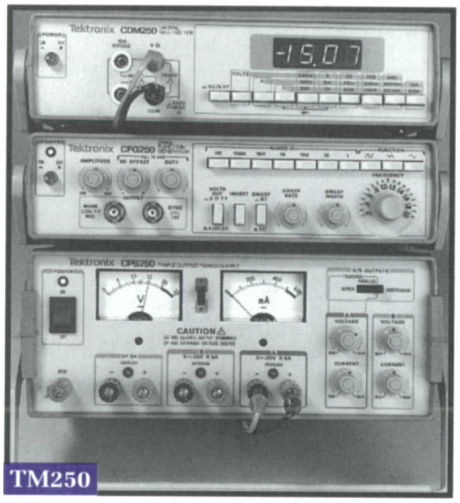
# Digital Multimeters

CDM250 DM2510 | DM2510G TM250



## 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 rdg+0.015% of full scale) |
| Max. Input Voltage | 500 VDC (DC + peak AC) | 1000 VDC |
| **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 rdg+0.05% of full scale) |
| Max. Input Voltage | 350 VAC RMS<br>500 V (DC + peak AC) | Front panel, V/Ω/Temp to LOW:<br>500 V RMS or 600 VDC<br>Front panel, V/Ω/Temp to GND and<br>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,<br>200 mA, 2 A, 10 A | 200 µA, 2 mA, 20 mA,<br>200 mA, 2 A, 10 A |
| Basic Accuracy | ±(1.0% of rdg+1 count) | ±(0.06% of rdg+0.01% of full scale) |
| Max. Input Current | 2 A fused, 10 A unfused | 2 A any range, mA to LOW<br>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,<br>200 mA, 2 A, 10 A | 200 µA, 2 mA, 20 mA,<br>200 mA, 2 A, 10 A |
| Basic Accuracy | ±(1.5% of reading +4 counts) | ±(0.8% of rdg+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,<br>200 kΩ, 2 MΩ, 20 MΩ | 200 Ω , 2 kΩ, 20 kΩ,<br>200 kΩ, 2 MΩ, 20 MΩ |
| Basic Accuracy | ±(0.75% of rdg+1 count) | ±(0.05% of rdg+0.02% of full scale) |
| Max. Input Voltage | 500 V (DC + peak AC) | 300 V peak (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 Listed, CSA Certified |




### TM250 Basic Bench Set

Whether you are setting up a lab, a production line, or replacing a mismatched collection of old instruments, you will find this set a cost effective way to get the measurement power you need to do the job right. The TM250 Basic Bench Set is unbeatable in a classroom when used with the excellent instructional materials available from Tektronix. The set includes the CFG250, CDM250, and CPS250. With the addition of the 2205 20 MHz Oscilloscope or one of our new TAS scopes, and your choice of optional counters, a set can be configured to meet your test or training needs.

## ORDERING INFORMATION

**CDM250**
Digital Multimeter ..... TD **$365**
**Includes:** Test Leads, Operator's Manual, US power cord, one year warranty.

**DM2510**
Programmable Digital Multimeter ..... TD **$595**
**Includes:** Test Leads, Instruction Manual, US power cord, one year warranty.

**DM2510G**
Programmable Digital Multimeter with GPIB Interface .... TD **$725**
**Includes:** Test Leads, Instruction Manual, US power cord, one year warranty.

**WARRANTY-PLUS SERVICE OPTIONS**
**Opt. M7** – Calibration Service
CDM250 ..... **+$43**
DM2510 ..... **+$125**
DM2510G ..... **+$140**

**Opt. M9** – Repair Protection
CDM250 ..... **+$63**
DM2510 ..... **+$75**
DM2510G ..... **+$90**

**AVAILABLE ACCESSORIES**
**Temperature Probe** – Order P6602 ..... **$335**
**GPIB Interface Cable** – Order 012-0991-01 ..... **$195**
**GPIB Reference Manual** – Order 070-8630-00 ..... **$25**

**TM250**
Basic Bench Set ..... TD **$1,095**
**Includes:** CFG250 2 MHz Function Generator, CPS250 Triple Output Power Supply, CDM250 Digital Multimeter

**Opt. 01** – CFC250 100 MHz Frequency Counter ..... **+$365**
**Opt. 02** – CMC250 1.3 GHz Multifunction Counter ..... **+$525**
**Opt. 03** – CDC250 175 MHz Universal Counter with High Stability Time Base ..... **+$525**
**Opt. 04** – CMC251 1.3 GHz Multifunction Counter with High Stability Time Base ..... **+$595**

**RECOMMENDED TEST LEADS**
**ALM01** – Shrouded banana plugs and hook tips, UL aprvd. ..... **$25**

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.

# CMC251 CDC250 CMC250 CFC250 Counters

*Multifunction Counter for use in high frequency systems. Universal Counter with temperature compensated time base to ensure performance in changing ambient temperature.*

**CMC251**
- 1 Hz to 100 MHz (CH 1)
  80 MHz to 1.3 GHz (CH 2)
- ±1 ppm Time Base
- Display Hold
- Remote Start-stop

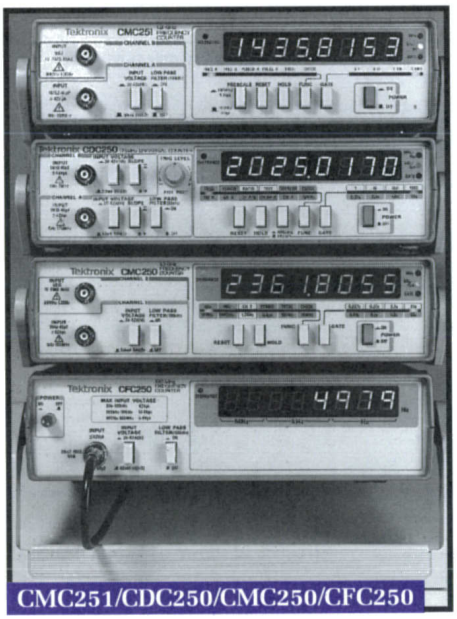
**CDC250**
- 5 Hz to 175 MHz
- Frequency Ratio
- Time Interval
- ±1 ppm Time Base

**CMC250**
- 5 Hz to 100 MHz (CH 1)
- 80 MHz to 1.3 GHz (CH 2)
- ±10 ppm Time Base
- Display Hold
- Remote Start-stop

**CMC251/CDC250/ CMC250**

Common Features
- Period Average, Period, Frequency, Totalize, Self Test
- Overrange Indicator

**CFC250**
- 5 Hz to 100 MHz
- Switchable Input Sensitivity
- 1 Hz Resolution
- Overrange Indicator



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 will be 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 counts frequency of sine, square and triangle waves from 5 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 measurement functions. Like the Tektronix CMC251, 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. Unlike the CMC251, the CMC250's time base stability is ± 10 ppm/yr.

## 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 use of the CFG250. Applications include adjustment, testing, and repair of electronic items such as audio equipment, radios, televisions, computer clocks, and musical instruments.

*Specifications on next page.*

## ORDERING INFORMATION

**CMC251**
1.3 GHz Frequency Counter with High Stability Time Base... TD **$595**
**Includes:** Operator's Manual, US power cord, one year warranty.

**CDC250**
175 MHz Universal Counter... TD **$525**
**Includes:** Operator's Manual, US power cord, one year warranty.

**CMC250**
1.3 GHz Frequency Counter... TD **$525**
**Includes:** Operator's Manual, US power cord, one year warranty.

**CFC250**
100 MHz Frequency Counter... TD **$365**
**Includes:** Operator's Manual, US power cord, one year warranty.

**AVAILABLE ACCESSORIES**

**10X Probe, 250 MHz.** – Order P6106A... **$200**

See page 424 for additional Accessory information and needs.

**WARRANTY-PLUS SERVICE OPTIONS**

**Opt. M7** – Calibration Service
CFC250... **+$43**
CDC250... **+$30**
CMC250... **+$30**
CMC251... **+$60**

**Opt. M9** – Repair Protection
CFC250... **+$59**
CDC250... **+$60**
CMC250... **+$40**
CMC251... **+$75**

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.

# Counters

## CMC251 CDC250 CMC250 CFC250



### KEY SPECIFICATIONS

| | CMC251 | CDC250 | CMC250 | CFC250 |
|---|---|---|---|---|
| **Channel A** | | | | |
| Frequency Range | 1 Hz to 100 MHz | 5 Hz to 175 MHz | 5 Hz to 100 MHz | 5 Hz to 100 MHz |
| Sensitivity | 20 mV RMS, 1 Hz–30 MHz; 50 mV RMS, 30–100 MHz | kHz/ms mode: 20 mV RMS, 5 Hz–10 MHz; MHz/µs mode: 50 mV RMS, 5 MHz–125 MHz; 100 mV RMS, 125 MHz–150 MHz; 150 mV RMS, 150 MHz–175 MHz | 20 mV RMS, 5 Hz–30 MHz; 50 mV RMS, 30 MHz–100 MHz | 30 mV RMS, 5 Hz–30 MHz; 50 mV RMS, 30 MHz–70 MHz 80 mV RMS, 70 MHz–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 | 5 Hz to 5 MHz: 42 V pk; 5 MHz to 100 MHz: 4.9 V pk | 5 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–10 MHz: 13.8 V pk; 10 MHz–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 | 5 Hz to 2 MHz | 80 MHz to 1.3 GHz | — |
| Sensitivity | 5 mV RMS, 80 MHz–600 MHz; 15 mV RMS, 600 MHz–900 MHz; 35 mV RMS, 900 MHz–1.3 GHz | 30 mV RMS, 5 Hz to 2 MHz | 10 mV RMS, 80 MHz–600 MHz; 25 mV RMS, 600 MHz–900 MHz; 50 mV RMS, 900 MHz–1.3 GHz | — |
| Impedance | 50 Ω | 1.0 MΩ, paralleled by 40 pF | 50 Ω | — |
| Max Input Voltage | 1 V RMS | 42 V peak | 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–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 | 5 Hz to 2 MHz | 5 Hz to 2.5 MHz | — |
| Events Averaged (N) | 1, 10, 100, 1000, 10000 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°C 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 CHA: CHB | No | Yes | No | No |
| Display Hold | Yes | Yes | Yes | No |
| Remote Start/Stop | No | Yes | Yes | No |
| Time Interval CHA: CHB | No | Yes | No | No |
| Safety Certification | ETL Listed, CSA Certified | UL Listed, CSA Certified | UL Listed, CSA Certified, VDE | UL Listed, CSA Certified, VDE |

# CFG250
# CFG253
# CFG280

# Function Generators

*Function generators for testing and calibration of audio, ultrasonic, and servo systems.*

**CFG250**

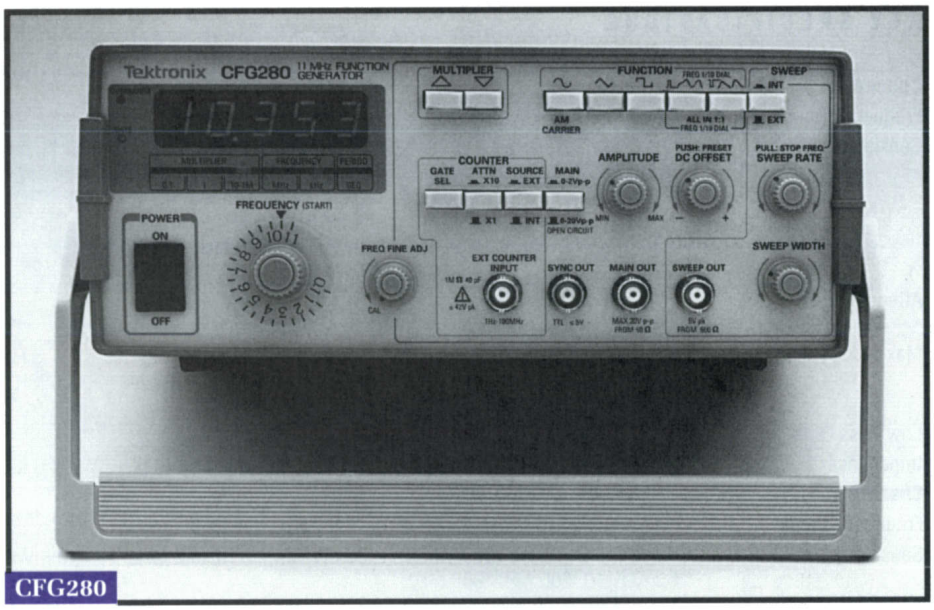
- 0.2 Hz to 2 MHz

**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 (20-80%)
- UL Listed, CSA Certified

**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 0-100% Input for External Sine Wave
- Internal or External Frequency Sweep




CFG280

## CFG250 & 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. Applications for the CFG253 include testing and calibration of audio, ultrasonic, and servo systems.

## 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.

TD

Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.

# Function Generators

**CFG250**
**CFG253**
**CFG280**



## 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 |
| Range | 0.03 Hz to 3.0 MHz | 0.2 Hz to 2.0 MHz | 0.1 Hz to 11 MHz<br>0.01 Hz to 11 MHz (uncalibrated) |
| 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)<br>–30 dB at all other frequencies |
| Triangle Wave Linearity | 20 Hz to 200 kHz: ≥99%;<br>200 kHz to 3 MHz: ≥97% | 20 Hz to 200 kHz: ≥99%;<br>200 kHz to 2 MHz: ≥97% | 0.1 Hz to 110 kHz: ≥99%;<br>110 kHz to 1 MHz: ≥97%,<br>1MHz 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 | 0-20 V p-p | 0-20 V p-p | 0-20 V p-p |
| Attenuator | 20 dB | 20 dB | 20 dB |
| SYNC/TTL Output | TTL output level, rise <25 ns (20 TTL load) ≥3 V peak | TTL output level, rise <25 ns (20 TTL load) ≥3 V peak | <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 VDC input with frequency control set at maximum | 100:1 minimum for 0 to +10 VDC input with frequency control set at maximum | 100:1 minimum for 0 to ±10 VDC 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 – 100%, DBSC, external sine wave only |
| Warranty | One year | One year | One year |
| Safety | UL Listed, CSA Certified | UL Listed, CSA Certified, VDE | ETL Listed |
| **Counter Specifications** | | | |
| Frequency Range (AC coupled) | — | — | 1 Hz to 100 MHz |
| Sensitivity | — | — | 30 mV RMS from 1 Hz to 50 MHz;<br>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

**CFG250**
2 MHz Function Generator ..... TD **$395**
**Includes:** Operator's Manual, US power cord, one year warranty.

**CFG253**
3 MHz Function Generator ..... TD **$445**
**Includes:** Operator's Manual, US power cord, one year warranty.

**CFG280**
11 MHz Function Generator w/ 100 MHz Counter ..... TD **$995**
**Includes:** Instruction Manual, US power cord, one year warranty.

**WARRANTY-PLUS SERVICE OPTIONS**

**Opt. M7 –** Calibration Service
CFG250 ..... **+$58**
CFG253 ..... **+$60**
CFG280 ..... **+$120**

**Opt. M9 –** Repair Protection
CFG250 ..... **+$66**
CFG253 ..... **+$65**
CFG280 ..... **+$80**

**ACCESSORIES**
See page 424 for additional Accessory information and needs.

TD
Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.

# CPS250 PS281 PS280 PS282 PS283 Power Supplies

*Versatile bench or portable power supplies for most basic test and lab bench requirements.*

**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

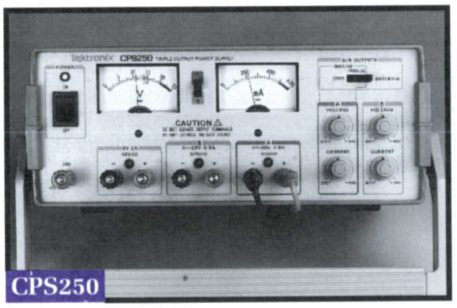
**PS 280/283**

- One Fixed 5 V, 3 A Supply
- Two variable Outputs, 0 to 30 V, 2A (PS250), 1A (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**

- 90W, Single Output, 3-1/2 digit display.
- 0 to 30 V, 0 to 3A (PS281).
- 0 to 18 V, 0 to 5A (PS282).
- Variable Current Limiting.
- Overload and Over Voltage Protection.

TD
Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.


CPS250




## 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.

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, and the controls of the right (master) power supply adjust the voltage or current of both power supplies.

## 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** | 0–30 volts DC | 0–18 volts DC |
| **Output Current** | 0–3.0 amps | 0–5.0 amps |
| **Line Regulation** | ≤ 0.01% + 3 mV | ≤ 0.01% + 3 mV |
| **Load Regulation** | ≤ 0.01% + 3 mV | ≤ 0.01% + 3 mV (≤ 3 amps)<br>≤ 0.01% + 5 mV (> 3 amps) |
| **Ripple / Noise** | ≤ 0.5 mV RMS, 5 Hz to 1 MHz | ≤ 0.5 mV RMS, 5 Hz–1 MHz (≤ 3 A)<br>≤ 1.0 mV RMS, 5 Hz–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 volts DC | ≥ 20 MΩ at 500 volts DC |
| Chassis to Power Cord | ≥ 30 MΩ at 500 volts DC | ≥ 30 MΩ at 500 volts DC |
| **Safety Certification** | ETL Listed | ETL Listed |

# Power Supplies

**CPS250 PS280 PS283**

**PS281 PS282**



## KEY SPECIFICATIONS

| | CPS250 | PS280 | PS283 |
|---|---|---|---|
| **Output Voltage** | | | |
| Two Variable | 0–20 V DC | 0–30 V DC | 0–30 V DC |
| One Fixed | 5.0 V | 5.0 V | 5.0 V |
| **Output Current** | | | |
| Two Variable | 0–0.5 A (CC)*1 | 0–2.0 A (CC)*1 | 0–1.0 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, 0–60 V single series tracking supply (CV); 0.2% + 3 mA (CC) | ≤ 0.01% + 3 mV (CV) ≤ 300 mV, 0–60 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 Three Modes** | | | |
| **Independent Mode** | Two variable 0–20 V (CV); 0.5 A (CC) | Two variable 0–30 V (CV); 2.0 A (CC) | Two variable 0–30 V (CV); 1.0 A (CC) |
| Parallel Mode | One 0–20 V, 1.0 A max | One 0–30 V, 4.0 A max | One 0–30 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 | 0–25 V DC ± 2.5% of full scale | 0–30 V DC ± (0.5% of rdg + 2 digits) | 0–30 V DC ± (0.5% of rdg + 2 digits) |
| Current Indicator | 0–800 mA ± 2.5% of full scale | 0–2 A DC ± (0.5% of rdg + 2 digits) | 0–2 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 Listed, CSA Certified | ETL Listed | ETL Listed |

*1 *(CC): When operated in Constant Current mode.*
*(CV): When operated in Constant Voltage mode.*

## ORDERING INFORMATION

**PS280**
Triple Output 0-30V/2A Power Supply ..... TD **$695**

**PS283**
Triple Output 0-30V/1A Power Supply ..... TD **$650**
**Both PS280/PS283 Include:** Operator's Manual, 3 pairs of test leads, US power cord, one year warranty.

**PS281**
Single Output 30V/3A Power Supply ..... TD **$375**

**PS282**
Single Output 18V/5A Power Supply ..... TD **$375**
**Both PS281/PS282 Include:** Instruction Manual, 1 pair of test leads, US power cord, one year warranty.

**CPS250**
Triple Output Power Supply ..... TD **$465**
**Includes:** Operator's Manual, 3 pairs of test leads, US power cord, one year warranty.

**WARRANTY-PLUS SERVICE OPTIONS**

**Opt. M7 –** Calibration Service
PS280 ..... **+$45**
PS283 ..... **+$45**
PS281 ..... **+$60**
PS282 ..... **+$60**
CPS250 ..... **+$43**

**Opt. M9 –** Repair Protection
PS280 ..... **+$80**
PS283 ..... **+$80**
PS281 ..... **+$50**
PS282 ..... **+$50**
CPS250 ..... **+$81**

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.

# Handheld Digital Multimeters

**DM250**
**DM251**
**DM252**
**DM253**
**DM254**
**DM255**
**DM256**
**DM257**

*Rugged handheld multimeters for field/plant maintenance, trouble shooting, classroom labs.*



The Handheld Digital Multimeters from Tektronix are compact, battery-powered test instruments. In this group are seven DMMs and a component checker, the DM253. Varying by model, these instruments measure resistance, AC and DC current, AC and DC voltage, capacitance, and frequency, as well as testing SCRs, transistors, batteries, diodes, and LEDs. Whether you are a hobbyist, a laboratory technician, or an industrial maintenance engineer, one of these eight meters is sure to fit both your measurement needs and your budget.

Tektronix Handheld Digital Multimeters are designed and manufactured to comply with safety standards established by UL and IEC.

**DM250**
- 3-1/2 Digit Display
- 0.5% Basic Accuracy
- Autoranging
- Diode Test
- Continuity Check

**DM251**
- 4000 Count Autoranging
- 0.3% Basic Accuracy
- Analog Bar Graph
- Frequency Measurement
- Capacitance Test

**DM252**
- 4000 Count Autoranging
- 0.1% Basic Accuracy
- Analog Bar Graph
- Frequency Measurement
- Capacitance Test

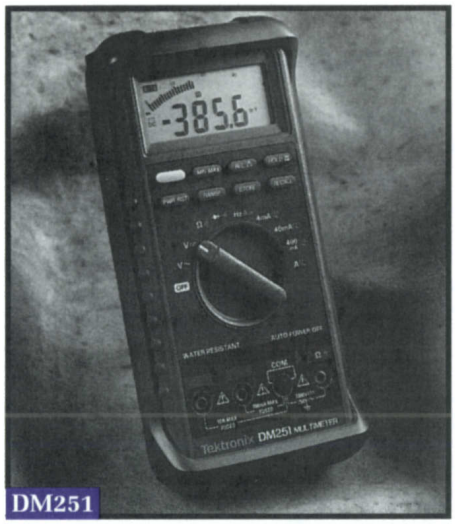
**DM253**
- 0.5% Basic Accuracy
- Capacitance Measurement
- Resistance Measurement
- SCR Go/No-go Test

**DM254**
- True RMS Measurement
- 0.1% Basic Accuracy
- Frequency Measurement
- Capacitance Test
- 4000 Count Autoranging

TD
Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.

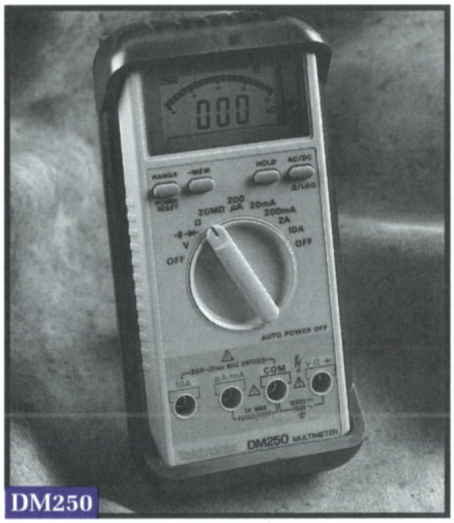
# Handheld Digital Multimeters






DM251

*The DM251 is an extended function DMM for users with moderate accuracy requirements. Safety features give a high level of operator protection.*




DM250

*The DM250 is designed for field service, laboratory work, and for the electronics hobbyist.*

| Key Specifications | DM250 | DM251 |
|---|---|---|
| Basic DC Volts Accuracy | 0.5% | 0.3% |
| AC Voltage Ranges | 2 V to 750 V | 400 mV to 750 V |
| DC Voltage Ranges | 200 mV to 1000 V | 400 mV to 1000 V |
| True RMS AC | — | — |
| AC Current Ranges | 200 µA to 10 A | 4 mA to 10 A |
| DC Current Ranges | 200 µA to 10 A | 4 mA to 10 A |
| Resistance Ranges | 200 Ω to 20 MΩ | 400 Ω to 40 MΩ |
| Capacitance Ranges | — | 4 nF to 40 µF |
| Frequency Ranges | — | 100 Hz to 1 MHz |
| **Customer Requested Features** | | |
| Analog Display | Yes | Yes |
| Auto Power Off | Yes | Yes |
| Autoranging | Yes | Yes |
| Compare Mode | Yes | Yes |
| Continuity Check/Beeper | Yes | Yes |
| Data Hold | Yes | Yes |
| Digital Display | 3-1/2 digit LCD | 3-3/4 digit LCD |
| Diode Test | Yes | Yes |
| LED Test | — | — |
| Low Battery Indicator | — | — |
| Memory Offset | Yes | Yes |
| Overrange Indication | Yes | Yes |
| Safety Certification | UL Listed | UL Listed |
| SCR Test | — | — |
| Transistor Leakage ICEO Test | — | — |
| Transistor hFE Test (PNP or NPN) | — | — |
| Water-Resistant Case | Yes | Yes |

## DM250
## DM251
## DM252
## DM253
## DM254
## DM255
## DM256
## DM257

**DM255**

- 3-1/2 Digit Display
- 0.7% Basic Accuracy
- Autoranging or Manual Selection
- Data Hold
- Current Measurement

**DM256**

- 3-1/2 Digit Display
- 0.5% Basic Accuracy
- Fast Continuity Beeper
- Memory Offset
- Capacitance Measurement

**DM257**

- 3-1/2 Digit Display
- 0.5% Basic Accuracy
- Autoranging or Manual Selection
- Low Battery Indicator
- Current and Capacitance Measurement

*Rugged handheld multimeters for field/plant maintenance, electronic troubleshooting, and classroom labs.*

TD

Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.

DM250
DM251
DM252
DM253
DM254
DM255
DM256
DM257

# Handheld Digital Multimeters



DM252

*The DM252 has the same safety features and measurement functions as the DM251 but is a more accurate instrument.*



DM253

*The DM253 Component Checker is an indispensable tool for the electronic service technician. With several ranges for versatility, it will test transistors, diodes, LEDs, capacitors, and batteries.*



DM254

*The DM254 is for the professional who needs full function capabilities with exceptional accuracy. It provides precise true RMS measurement of all AC signals.*

**Key Specifications**

| DM252 | DM253 | DM254 | |
|---|---|---|---|
| Basic DC Volts Accuracy | 0.1% (except 400 mV range) | (0.5% R & C) | 0.1% (except 400 mV range) |
| AC Voltage Ranges | 400 mV to 750 V | — | 400 mV to 750 V |
| DC Voltage Ranges | 400 mV to 1000 V | — | 400 mV to 1000 V |
| True RMS AC | — | — | Yes |
| AC Current Ranges | 4 mA to 10 A | — | 4 mA to 10 A |
| DC Current Ranges | 4 mA to 10 A | — | 4 mA to 10 A |
| Resistance Ranges | 400 Ω to 40 MΩ | 200 Ω to 20 MΩ | 400 Ω to 40 MΩ |
| Capacitance Ranges | 4 nF to 40 µF | 200 pF to 20 mF | 4 nF to 40 µF |
| Frequency Ranges | 100 Hz to 1 MHz | — | 100 Hz to 1 MHz |
| **Customer Requested Features** | | | |
| Analog Display | Yes | — | Yes |
| Auto Power Off | Yes | Yes | Yes |
| Autoranging | Yes | Yes | Yes |
| Compare Mode | Yes | — | Yes |
| Continuity Check/Beeper | Yes | Yes | Yes |
| Data Hold | Yes | Yes | Yes |
| Digital Display | 3-3/4 digit LCD | 3-1/2 digit LCD | 3-3/4 digit LCD |
| Diode Test | Yes | Yes | Yes |
| LED Test | — | Yes | — |
| Low Battery Indicator | — | — | — |
| Memory Offset | Yes | — | Yes |
| Overrange Indication | Yes | Yes | Yes |
| Safety Certification | TUV Listed | N/A | UL Listed |
| SCR Test | — | Yes | — |
| Transistor Leakage ICEO Test | — | Yes | — |
| Transistor hFE Test (PNP or NPN) | — | Yes | — |
| Water-Resistant Case | Yes | Yes | Yes |

# Handheld Digital Multimeters

**DM250** **DM254**
**DM251** **DM255**
**DM252** **DM256**
**DM253** **DM257**





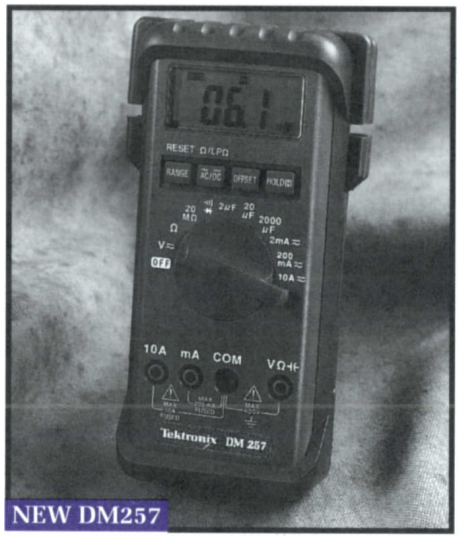

**NEW DM255**

*The DM255 is designed for indoor/outdoor service of electrical equipment. It has functions to satisfy the needs of most hobbyists.*




**NEW DM256**

*The DM256 is the multimeter for hobbyists and technicians testing voltage, capacitance, resistance, and diodes, but who don't need current measurement capability.*




**NEW DM257**

*The DM257 is ideal for the service technician or student needing a rugged, multifunction product with good accuracy for a reasonable price.*

| Key Specifications | DM255 | DM256 | DM257 |
|---|---|---|---|
| Basic DC Volts Accuracy | 0.7% | 0.5% | 0.5% |
| AC Voltage Ranges | 2 V to 600 V | 2 V to 600 V | 2 V to 600 V |
| DC Voltage Ranges | 200 mV to 600 V | 200 mV to 600 V | 200 mV to 600 V |
| True RMS AC | — | — | — |
| AC Current Ranges | 2 mA to 10 A | — | 2 mA to 10 A |
| DC Current Ranges | 2 mA to 10 A | — | 2 mA to 10 A |
| Resistance Ranges | 200 Ω to 20 MΩ | 200 Ω to 20 MΩ | 200 Ω to 20 MΩ |
| Capacitance Ranges | — | 2 µF to 200 µF | 2 µF to 200 µF |
| Frequency Ranges | — | — | — |
| **Customer Requested Features** | | | |
| Analog Display | — | — | — |
| Auto Power Off | Yes | Yes | Yes |
| Autoranging | Yes | Yes | Yes |
| Compare Mode | — | — | — |
| Continuity Check/Beeper | Yes | Yes | Yes |
| Data Hold | Yes | Yes | Yes |
| Digital Display | 3-1/2 digit LCD | 3-1/2 digit LCD | 3-1/2 digit LCD |
| Diode Test | Yes | Yes | Yes |
| LED Test | — | — | — |
| Low Battery Indicator | Yes | Yes | Yes |
| Memory Offset | Yes | Yes | Yes |
| Overrange Indication | Yes | Yes | Yes |
| Safety Certification | ETL Listed | ETL Listed | ETL Listed |
| SCR Test | — | — | — |
| Transistor Leakage ICEO Test | — | — | — |
| Transistor hFE Test (PNP or NPN) | — | — | — |
| Water-Resistant Case | Yes | Yes | Yes |

DM250
DM251
DM252
DM253
DM254
DM255
DM256
DM257

# Handheld Digital Multimeters

## ORDERING INFORMATION

**DM250**
Handheld Digital Multimeter ..... TD **$140**
**Includes:** Right-angle Test Leads, Spare Fuse, 9 Volt Battery, Operator's Manual.

**DM251**
Handheld Digital Multimeter ..... TD **$189**
**Includes:** Test Leads, Two AAA batteries, User Manual, Holster.

**DM252**
Handheld Digital Multimeter ..... TD **$209**
**Includes:** Test Leads, Two AAA batteries, User Manual, Holster.

**DM253**
Handheld Digital Multimeter ..... TD **$95**
**Includes:** Right-angle Test Leads, Spare Fuse, 9 Volt Battery, Operator's Manual.

**DM254**
Handheld Digital Multimeter ..... TD **$229**
**Includes:** Test Leads, 9 V Battery, User Manual, Holster.

**DM255**
Handheld Digital Multimeter ..... TD **$65**
**Includes:** Test Leads, 9 V Battery, User Manual, Holster.

**DM256**
Handheld Digital Multimeter ..... TD **$75**
**Includes:** Test Leads, 9 V Battery, User Manual, Holster.

**DM257**
Handheld Digital Multimeter ..... TD **$85**
**Includes:** Test Leads, 9 V Battery, User Manual, Holster.

**ACCESSORIES**
**Fuse –** For DM250. Order 159-5001-00 ..... **$3.60**
**Fuse –** For DM253. Order 159-0183-00 ..... **$0.85**
**Fuse –** For DM251, DM252, and DM254. 600 V - 1 Amp. Order 159-0337-00 ..... **$4.75**
**Fuse –** For DM251, DM252, and DM254. 600 V - 15 Amp. Order 159-0287-00 ..... **$9.50**
**Fuse –** For DM255 and DM257 (DM256 uses no fuse). 250 V - 1 Amp. Order 159-0355-00 ..... **$2.50**
**Fuse –** For DM255 and DM257. 250 V - 13 Amp. Order 159-0357-00 ..... **$2.50**
**Holster –** For DM250 and DM253. Order 118-8733-00 ..... **$18**
**Soft Carrying Case –** For DM251, DM252, DM253, and DM254 (fits with holster removed). Order 118-8338-00 ..... **$18**

TD
Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.

# Test and Measurement
## Education



### 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

**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 test and 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
- Physics
- Mechanical Engineering
- Semi and fully automated test

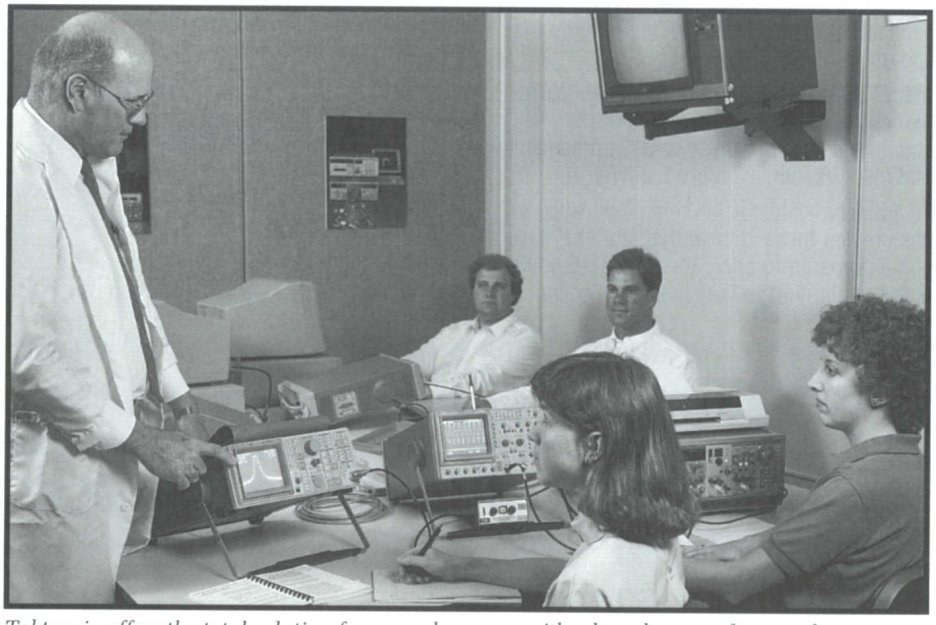
And in every Tektronix product you'll find the familiar, easy operation that's become a de facto standard the world over. Which is perhaps the main reason why people in so many different environments prefer Tektronix equipment.

Because whether your students are preparing to seek their fortune, or applying what they've learned to make it, there's no substitute for the confidence that comes from using the best: Tektronix.

**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



*Tektronix offers the total solution for your classroom with a broad range of test and measurement instrumentation. From spectrum analyzers and oscilloscopes to modular instruments and printers.*

**'A diverse environment demands an extensive selection'**

*Tektronix has a long history of commitment to partnership with education. To further assist you in reaching your educational goals, Tektronix now offers qualifying institutions the finest test and measurement equipment at substantial discounts.*

*We are giving eligible non-profit organizations discounts on all of Tektronix test and measurement equipment and software.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Test and Measurement
## Education




*Tektronix' extensive selection of learning materials can save you countless hours in the preparation and presentation process so that you can concentrate on what you do best – educating our next generation of engineers and technicians.*

### 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. The engineer as well as the student 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**

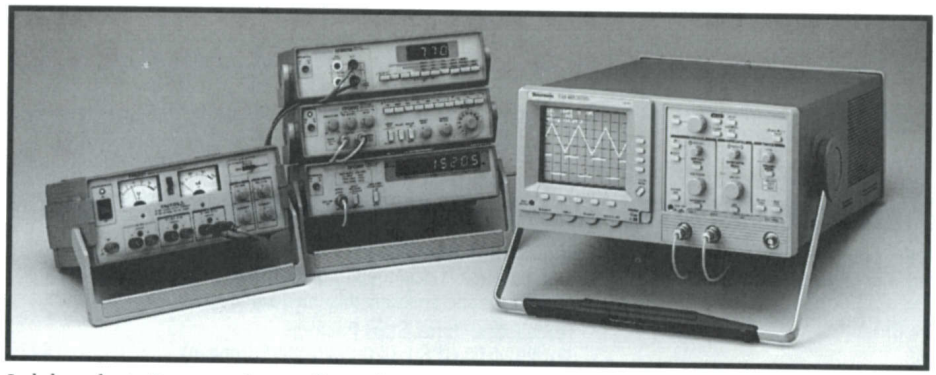
These especially designed packages provide detailed hands-on instruction and application examples. Each package provides step-by-step workbooks and especially designed signal generation boards to help the user get up and running in no time at all. These packages are designed for self-paced use or integrated into the classroom curriculum.

**VIDEO TAPE AND LITERATURE**

Tektronix offers educators one of the most extensive libraries of video taped 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.

# Test and Measurement
## Education





*Lab bench stations can be configured to your needs. Our stackable triple-output power supply, digital multimeter, 100 MHz frequency counter and 2 MHz function generator (see pages 395-408) join a 100 MHz dual-trace TAS 465 Oscilloscope (pages 120-123) as a popular setup for basic lab stations.*



*Tektronix cameras and printers make lab documentation easy. Tektronix SCOPE-MOBILE® carts free up valuable bench space and make sharing of equipment between students convenient.*

**RUGGED AND SAFE**
In both design and test, we ensure our products meet stringent standards for EMI, humidity, temperature, electrostatic shock, and vibration. Tektronix products are also third-party certified by UL, CSA. Not only do these certifications protect you and your students, they help you comply with many state and local regulations.

**SERVICE AND SUPPORT ALSO KEY**
Tektronix' highly trained sales engineers, applications engineers, and education representatives 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 warranty plus service packages 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.

**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 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.



*"We are pleased to say that in our Industrial Electronics training program we are still successfully using Tektronix test equipment that was purchased sixteen 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*

# Test and Measurement
## Education

## ORDERING INFORMATION

**VIDEO TAPE 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 at four/$100.

**Fundamentals of Analog Scopes** 068-0270-XX.....**$115**
**Fundamentals of Probes** 068-0269-XX.....**$115**
**Fundamentals of Digital Scopes** 068-0268-XX.....**$115**
**Fundamentals of GPIB** 068-0260-XX.....**$115**
**Fundamentals of RS232** 068-0259-XX.....**$115**
**Using the PC as a Controller** 068-0301-XX.....**$145**
**Fundamentals of Logic** Analyzers068-0291-XX.....**$115**
**Operating the 2201** 068-0290-XX.....**$60**
**Operating the 2205** 068-0289-XX.....**$60**
**Operating the 2210** 068-0274-XX.....**$125**
**Operating the 2211** 068-0311-XX.....**$125**
**Operating the 2213A/2215A** 068-0278-XX.....**$115**
**Operating the 2220** 068-0273-XX.....**$125**
**Operating the 2221** 068-0272-XX.....**$115**
**Operating the 2224** 068-0310-XX.....**$125**
**Operating the 2225** 068-0279-XX.....**$115**
**Operating the 2230** 068-0271-XX.....**$125**
**Operating the 2232** 068-0312-XX.....**$125**
**Operating the 2235** 068-0277-XX.....**$115**
**Operating the 2236** 068-0276-XX.....**$115**
**Operating the 2245A** 068-0325-XX.....**$125**
**Operating the 2246A** 068-0326-XX.....**$125**
**Operating the 2247A** 068-0327-XX.....**$125**
**Operating the 2430A** 068-0267-XX.....**$145**
**Operating the 2432** 068-0266-XX.....**$145**
**Operating the 2432A** 068-0305-XX.....**$145**
**Operating the 2440** 068-0265-XX.....**$145**
**Operating the 2445A/2465A** 068-0262-XX.....**$145**
**Operating the 2445B/2465B/2467B** 068-0261-XX.....**$145**
**Operating the 11301A/11302A** 068-0264-XX.....**$145**
**11301/11302 Waveform Measurement** 068-0304-XX.....**$145**
**11401/11402 Waveform Measurement** 068-0302-XX.....**$145**
**11401/11402 Adv. Waveform Measurement** 068-0303-XX.....**$145**
**Operating the 1230** 068-0288-XX.....**$115**

**QUICKSTART PACKAGES**
Each package is designed to give step-by-step instruction using workbooks and specially designed signal generation boards.

**TDS500/600 Quick Start Package**
020-2024-00 (U.S.), 020-2025-00 (European).....**$225**

**2400 Series Digital Oscilloscopes QuickStart Package*1**
020-1679-00 U.S. power (VHS/NTSC), 020-1681-00 European power (VHS/PAL).....**$315**

**2402 TekMate QuickStart Pkg**
020-1747-00 (U.S.), 020-1748-00 (European).....**$325**

**11403 QuickStart Package**
020-1767-01 (U.S.), 020-1768-01 (European).....**$270**

**DSA 600 QuickStart Package**
020-1769-00 (U.S.), 020-1770-00 (European).....**$270**

**2252/2247A/2245A QuickStart Package*1**
020-1864-04 (VHS/NTSC), 020-1864-06 (VHS/PAL).....**$240**

**2232/2224/2221A QuickStart Package*1**
020-1812-04 (VHS/NTSC), 020-1812-06 (VHS/PAL).....**$280**

**VIDEO TAPES**

**Oscillo-what? What is an Oscilloscope?** Discusses the display, vertical, horizontal and trigger sections and introduces digitizing oscilloscopes. 068-0218-XX.....**$60**

**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.....**$60**

**Advanced 2200 Series Operation** 068-0151-XX.....**$60**

**CDM250 Video Tape** Digital multimeter training 068-0254-XX.....**$60**

**CFC250 Video Tape** Frequency counter training 068-0253-XX.....**$60**

**CFG250 Video Tape** Function generator training 068-0252-XX.....**$60**

**CPS250 Video Tape** Power supply training 068-0251-XX.....**$60**

**The Vital Link – Probe and Signal Concepts** 068-0229-XX.....**$75**

**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.....**$60**

**Fundamentals of Oscilloscopes: Digital Storage Concepts** Describes and illustrates functional concepts of typical digital storage oscilloscope. 068-0240-XX.....**$60**

**22PS PowerScout Operation** Overview of oscilloscope operation and a detailed front panel tour of the 222PS PowerScout. 068-0344-XX.....**$60**

**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.....**$60**

**LITERATURE**

**Lab Bench Equipment Orientation** Instructor guide and workbooks for CFC250, CFG250, CDM250 and CPS250. (50 workbooks, 1 guide) 062-9511-01.....**$50**

**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.....**$120**

**ABCs of Probes** 062-9471-00 (50 primers).....**$120**

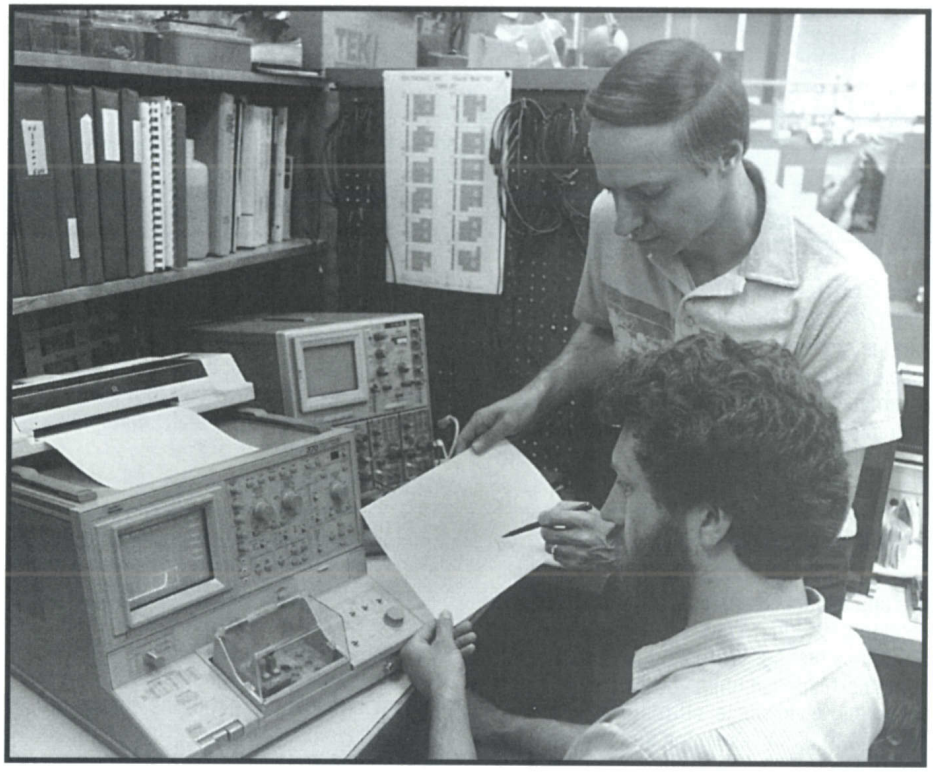
**1 Video-tape included where noted.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Semiconductor DC Characterization

### Characterization and Test Solutions for Semiconductor Design, Manufacture and Quality Assurance

- The 372 Semiconductor Workbench features 25 fA, 25 uV resolution for precise low current measurements.
- 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.
- The low cost 571 is versatile and ideally suited for educational use.



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# Semiconductor Workbench™



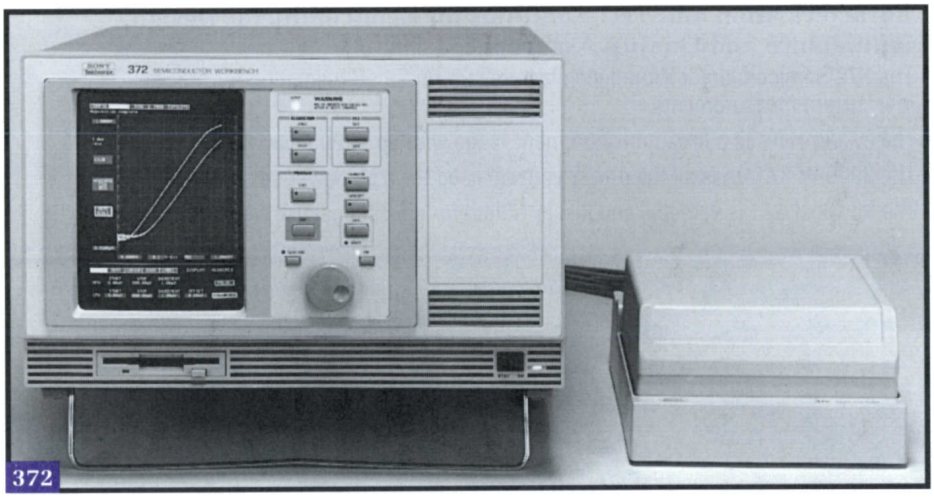
*Advanced features provide fast access to even the most complex measurements.*

**372 BENEFITS/FEATURES**

- Range: up to 200 V, 400 mA
- Resolution: to 25 fA, 25 µV
- Kelvin sense
- Flexible waveform math
- Automatic pass/fail testing
- Intuitive User Interface
- MS-DOS compatible disk
- Stand-alone programming
- Hardcopy output

**APPLICATIONS**

- IC Testing
  - Research
  - Design
  - Manufacturing
  - Quality Assurance




## 372 Semiconductor Workbench™

The 372 offers a different approach to semiconductor characterization, combining the resolution and advanced features found in parameter analyzers with a curve tracer's interactive user interface and sourcing capability. Plus, it provides features, such as automatic pass/fail testing and built-in setups, that greatly reduce the cost and time needed for DC characterization.

The 372 provides the measurement capabilities and advanced analysis required for IC research, design, manufacturing and quality assurance testing. With two high-precision stimulus-response units you can make highly accurate, Kelvin sense, current measurements with 25 fA resolution and source up to 400 mA or 200 V with a maximum output of 10 watts. Powerful analysis features such as waveform math and flexible display parameters allow you to see your results in the form you want. These capabilities make the 372 useful for a wide range of device technologies including CMOS, bipolar, GaAs and BiCMOS.

### HIGH PRECISION STIMULUS/RESPONSE

The keys to the 372's performance are its high precision stimulus-response units – a high power unit capable of sourcing 400 mA and 200 V and a low power unit capable of sourcing a maximum 100 mA and 100 V . Both units have Kelvin sense capability. These two units and an active ground unit capable of sinking up to 700 mA at 0 V ±1 mV can be flexibly interchanged among device terminals via an internal switching matrix.

### POWERFUL ANALYSIS

In addition to a high precision stimulus-response system, the 372 has powerful tools for device analysis. The 372's waveform math function lets you display a mathematical function of the data on the y-axis. So whether you want to display log $I_C$ and log $I_B$ versus $V_{BE}$ or the square root of $I_D$ versus $V_{GS}$, the 372 lets you see what you want to see. The 372 also lets you plot current or voltage versus time for tracking down critical device drift problems. And, the 372 has 4 different cursor types which allow you to measure I, V points, slopes, gain, or make automatic pass/fail decisions.

### INTERACTIVE CONTROL

The 372's interactive interface allows you to configure a test and view the data on the same menu screen, giving you instant feedback. In many cases you can change set up parameters by simply touching the parameter on screen and turning the general purpose knob – no paging through menus. This level of interaction lets you get to the bottom of tough problems quickly.

### APPLICATIONS

**QA/Incoming Inspection:** Whether you need a fully automated solution, a manual solution, or something in between, the 372 is ideal for QA and incoming inspection applications. The 372's program mode will let you fully automate many test sequences, eliminating the need for an external controller. Pass/no-pass cursors make pass/fail decisions on your acquired data, saving time and eliminating the need for external data analysis. The 372 is also programmable over GPIB and for those who want to step through each test manually, setups may be recalled from MS-DOS formatted diskettes to speed the configuration process.

**Process Monitoring:** With its highly accurate stimulus/response units and its automation features, the 372 is an excellent tool for process monitoring. Whether your technology is bipolar or MOS the 372 has the ranges and resolutions necessary for typical wafer level measurements. For stand-alone monitoring applications measurements may be automated under the 372's program mode, or by recalling setups from disk.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The 372 complies with IEEE Standard 488.2 and Tektronix Standard Codes and Formats.

# Semiconductor Workbench™



**Device Research/Troubleshooting:** An interactive user interface for zeroing in quickly on device characteristics, highly accurate measurements of up to 4000 points, and a flexible display to see the data in a useful form are all powerful tools for device research and troubleshooting applications.

## Source Characteristics

The 372's two stimulus/response units, the high power unit (HPU) and the low power unit (LPU), both have the same resolution and accuracy. The HPU simply extends the maximum ranges of the LPU from 100 mA and 100 V to 400 mA and 200 V. Range resolution and accuracy for the HPU is specified as follows:

### HPU VOLTAGE RANGE, RESOLUTION AND ACCURACY

| V Range | Resolution | Stimulus Accuracy | Response Accuracy | Max Current |
|---|---|---|---|---|
| 0.1 V | 25 µV | ±(0.1% + 500 µV) | ±(0.1% + 500 µV) | 400 mA |
| 1 V | 250 µV | ±(0.1% + 500 µV) | ±(0.1% + 500 µV) | 400 mA |
| 10 V | 2.5 mV | ±(0.1% + 5 mV) | ±(0.1% + 5 mV) | 400 mA |
| 100 V | 25 mV | ±(0.1% + 50 mV) | ±(0.1% + 50 mV) | 100 mA (V > 10 V)<br>400 mA (V ≤ 10 V) |
| 200 V | 50 mV | ±(0.1% + 100 mV) | ±(0.1% + 100 mV) | 40 mA (V > 100 V)<br>100 mA (10 V ≤ V < 100 V)<br>400 mA (V ≤ 10 V) |

### HPU CURRENT RANGE, RESOLUTION, AND ACCURACY

| Range | Resolution | Stimulus Accuracy | Response Accuracy | Max V |
|---|---|---|---|---|
| 100 pA | 25 fA | ±0.6% ± 6 pA + 100 fAx$V_0$* | ±0.6% ± 5 pA + 100 fAxV | 200 V |
| 1 nA | 250 fA | ±0.6% ± 7 pA + 100 fAx$V_0$ | ±0.6% ± 6 pA + 100 fAxV | 200 V |
| 10 nA | 2.5 pA | ±0.5% ± 23 pA + 100 fAx$V_0$ | ±0.5% ± 20 pA + 100 fAxV | 200 V |
| 100 nA | 25 pA | ±0.5% ± 180 pA + 100 fAx$V_0$ | ±0.5% ± 150 pA + 100 fAxV | 200 V |
| 1 µA | 250 pA | ±0.1% ± 1.8 nA + 100 fAx$V_0$ | ±0.1% ± 1.5 nA + 100 fAxV | 200 V |
| 10 µA | 2.5 nA | ±0.1% ± 18 nA | ±0.1% ± 15 nA | 200 V |
| 100 µA | 25 nA | ±0.1% ± 180 nA | ±0.1% ± 150 nA | 200 V |
| 1 mA | 250 nA | ±0.1% ± 1.8 µA | ±0.1% ± 1.5 µA | 200 V |
| 10 mA | 2.5 µA | ±0.1% ± 18 µA | ±0.1% ± 15 µA | 200 V |
| 100 mA | 25 µA | ±0.1% ± 180 µA | ±0.1% ± 150 µA | 100 V (I > 40 mA)<br>200 V (I ≤ 40 mA) |
| 400 mA | 100 µA | ±0.1% ± 720 µA | ±0.1% ± 600 µA | 10 V (I > 100 mA)<br>100 V (100 mA ≥ I > 40 mA)<br>200 V (I ≤ 40 mA) |

*$V_0$ = (HPU voltage ÷ 1 V)*

*Source and measurement accuracies are specified at 23°C ±5°C after instrument has been allowed to warm up for at least 40 minutes with AUTOCAL set to ON.*

## ORDERING INFORMATION

**372**
Semiconductor Workbench™ ..... **$30,900**
**Includes:** Operator's Manual; 3.5 in., 2HD Floppy Disk; Power Cord; Fast Blow 250 V, 1 A Fuse; Test Fixture and Cable; six 1.5 meter Triaxial Cables; Set of Miniature Banana Connection Leads; Carrying Case; A1101, A1102, A1103 and A1104 Adapters.

**Opt. 1R** – Rackmount ..... **+$525**
**Opt. 20** – 3 meter cable set ..... **+$2,200**
**CART** – Order K475 ..... **$895**
**CAMERA** – Order C-9 Opt. 11 ..... **$660**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The 372 complies with IEEE Standard 488.2 and Tektronix Standard Codes and Formats.

# 370A Curve Tracer

*Wide measurement range and productivity enhancement features allow the 370A to address a broad range of semiconductor devices.*

## 370A FEATURES

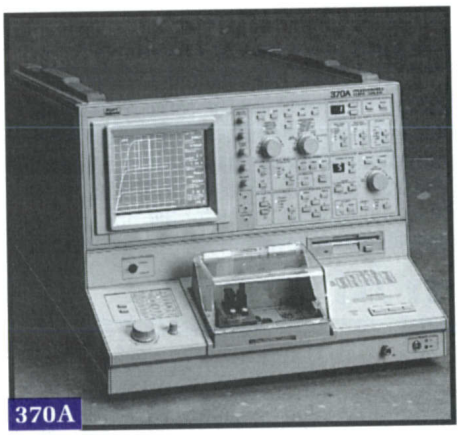
- 3.5 inch MS-DOS Compatible Disk Storage
- Non-Volatile Storage via GPIB Interface
- Waveform Comparison
- Dot Cursor
- Envelope Display
- Digital Storage Display and Non-Storage Mode
- Waveform Averaging

## BENEFITS

- Versatile Power Range
- Programmable
- Save/Recall Setups from Disk
- Kelvin Sense Measurements

## APPLICATIONS

- Semiconductor Device Testing
  - R&D
  - Manufacturing
  - Incoming Inspection
  - Quality Control
  - Engineering
  - Component Matching
  - Failure Analysis



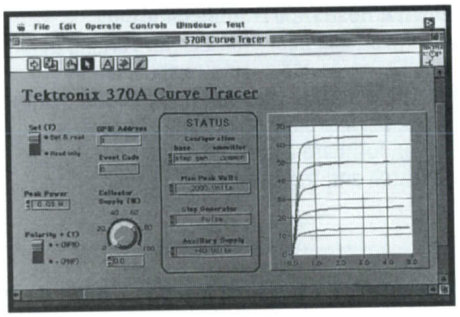

### 370A Programmable Curve Tracer

The 370A Programmable Curve Tracer provides DC parameter characterization of transistors, thyristors, diodes, SCRs, MOSFETs, optoelectronic components, solar cells, solid state displays and other semiconductor devices. With the 370A you can perform automated device characterizations for: Manufacturing processes, incoming inspection, semiconductor R & D, quality control, component engineering, component matching and failure analysis.

**INTERACTIVE, PROGRAMMABLE CONTROL**

Interactive control of all measurements allows you to refine characterizations for unique devices during research or design. After completing the characterization definition, interactive settings can be stored in the curve tracer's memory, disk or an external controller.

The 370A's non-volatile memory provides automatic test sequencing. Or, you may perform external controller test sequencing from an IBM compatible PC via the GPIB interface. With either method, the 370A front panel settings can be recalled and measurements made, storing the results for later review or comparison.




**TEST FIXTURING**

The test fixture is a standard accessory that provides safe device enclosure to assure 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.

**HARDCOPY**

Plotter output data is sent directly from the 370A without the need for an external controller. Plotting can continue while the 370A performs the next tasks.

**ACQUISITION**

In storage mode, information is displayed in one of three ways: normal, envelope or average.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

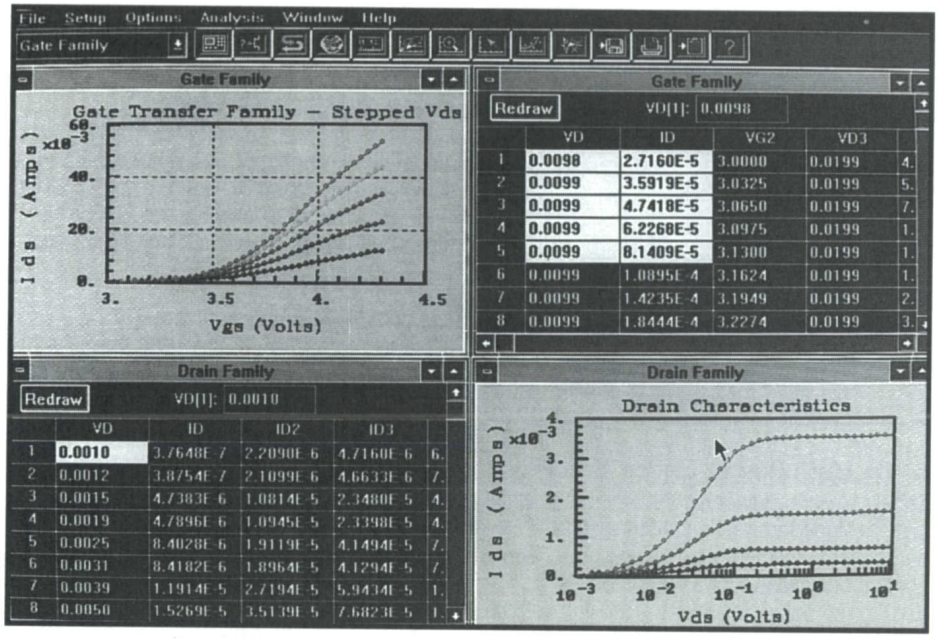
GPIB IEEE-488

The 370A complies with IEEE Standard 488.1 and Tektronix Standard Codes and Formats.

# Curve Tracer








## Source Characteristics

### COLLECTOR SUPPLY

**Modes –** AC, ±DC, ±Leakage, ±Rectified Sine.

| Range | Max Peak Current (±) | Peak Current Pulsed (±)* |
|---|---|---|
| 16 V | 10 A | 20 A |
| 80 V | 2 A | 4 A |
| 400 V | .4 A | .8 A |
| 2000 V | .05 A | .1 A |

**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.

## Software

### METRICS™ BY ALLIANCE TECHNOLOGIES

METRICS™ Software gives you the ability to control the 370A as well as to collect, analyze, and display the data using a PC. METRICS™ features are easy to use and require no programming. You graphically construct test setups through intuitive mouse-driven editing. Using Dynamic Data Exchange, the data can be easily transferred in real-time to other Windows™ based applications.

### LabVIEW™ BY NATIONAL INSTRUMENTS

LabVIEW™ is a graphical programming system for data acquisition and control, data analysis, and data presentation. LabVIEW™ offers an innovative programming methodology in which you graphically assemble software modules called virtual instruments (VIs). LabVIEW™ gives you an alternative to cumbersome text-based programming.

## ORDERING INFORMATION

**370A**
Curve Tracer ..... **$23,900**
**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 125V/4A (159-0259-00); Slow Blow 250V/2A Fuse (159-0160-00); Power Cord (161-0066- 00); Operator's Manual (070-7779-00).

**Opt. 1P –** HC100 Plotter with Opt. 01 ..... **+$1,260**

**Opt. 1R –** Rack Mounting ..... **+$525**

**ADDITIONAL ACCESSORIES**

**Service Manual –** Order 070-7780-00 ..... **$135**

**Calibration Fixture –** Order 067-0187-00 ..... **$645**

**Rackmount Kit –** Order 016-0930-00 ..... **$1,045**

**Socket Adapters –** See adapters on page 420.

**SOFTWARE**

**METRICS™ Software –** Core Program. Order 063-1649-00 ..... **$1,595**

**METRICS™ Software –** Tektronix Drivers. Order 063-1650-00 ..... **$595**

**LabVIEW™ –** National Instruments LabVIEW™ for Windows*[1]

**CART –** Order K475 ..... **$895**

**CAMERA –** Order C-9 Opt. 1A and Opt. 07 ..... **$875**

**[1] Contact your local Tektronix representative for price information.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The 370A complies with IEEE Standard 488.1 and Tektronix Standard Codes and Formats.

# Curve Tracer



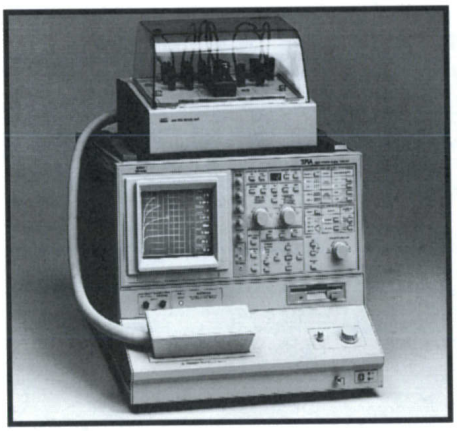
*For characterization and test of power semiconductors.*

**371A BENEFITS/FEATURES**

- Test High Power Devices:
  - Up to 3,000 Volts
  - Up to 400 Amps
  - Up to 3,000 Watts
- 3.5 inch MS-DOS Compatible Disk Storage
- Waveform Comparison
- Cursor Measurements
- Readout of Control Settings and Cursor Values
- Programmable
- Save/Recall Setups from Disk
- Kelvin Sense Measurements

**APPLICATIONS**

- Automated DC Parameter Characterization of High Power Semiconductors



## 371A High Power Curve Tracer

The 371A High Power Curve Tracer is specifically designed to provide automated DC parameter characterization of high power semiconductor devices such as thyristors, STRs, IGBTs, and power MOSFETs. The high voltage collector mode permits testing the Off-Characteristics of a device up to 3000 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.

**COMPLETE PROGRAMMABILITY**

The 371A provides remote setup, computerized control and software analysis with external programming over the IEEE-488 GPIB.

**COMPREHENSIVE STORAGE CAPABILITIES**

For enhanced productivity the 371A can save up to 64 setups and 64 displays on a 3.5 in. floppy and 16 of each in internal memory. With stored setups you can easily cycle through a series of tests, either manually or automatically through GPIB program control. To help identify data, up to 24 characters of text may be used to label or annotate a curve.

**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.

**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.

## 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

**371A**

High Power Curve Tracer ..... **$27,500**

**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).

**Opt. 1P** – HC100 Plotter ..... **+$1,145**

**ADDITIONAL ACCESSORIES**

**Field Wiring Cable** – Order 198-5628-00 ..... **$365**

**Service Manual** – Order 070-6840-00 ..... **$105**

**Calibration Fixture** – Order 067-1345-00 ..... **$3,995**

**Rackmount Kit** – Order 016-0930-00 ..... **$1,200**

**Socket Adapters** – See Adapters Section on page 420.

**SOFTWARE**

**METRICS™ Software** – Core Program. Order 063-1649-00 ..... **$1,595**

**METRICS™ Software** – Tektronix Drivers. Order 063-1650-00 ..... **$595**

**LabVIEW™** – National Instruments LabVIEW™ for Windows*1

**CART** – Order K475 ..... **$895**

**1 Contact your local Tektronix representative for price information.*

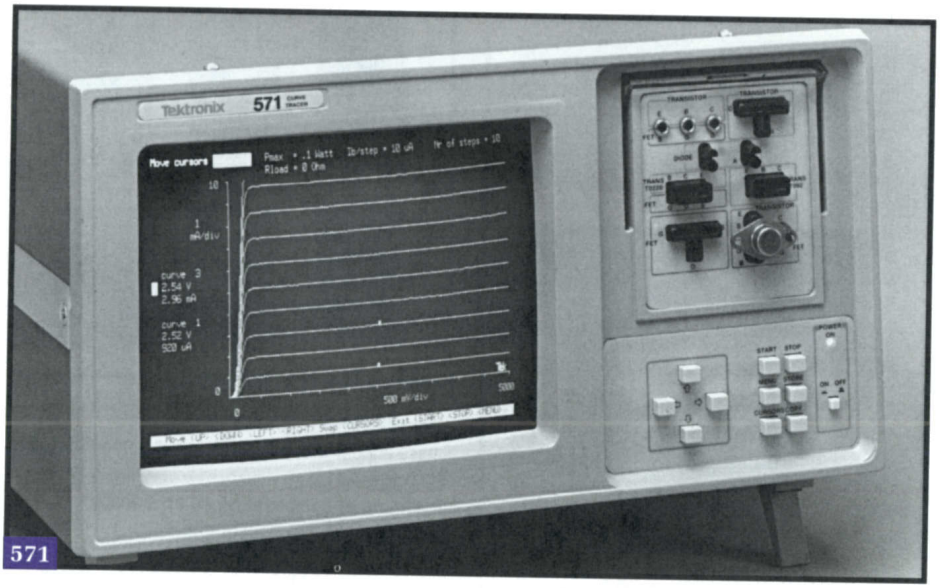
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

GPIB IEEE-488 The 371A complies with IEEE Standard 488.1 and Tektronix Standard Codes and Formats.

# Curve Tracer








## 571 FEATURES

- Easy to Operate
- Menu Driven
- Non-Volatile EEROM Store 12 Test Setups
- Accurate Cursor Measurements
- Hard Copy Output to Printer
- Built-in Safety Features
- Built-in Test Sockets

## BENEFITS

- Moderate Power
- Versatile Built-In Adapter Sockets

## APPLICATIONS

- Diode Testing
- Transistor Test
- Thyristors Test

*Ideal for Educational Laboratories!*

## 571 Curve Tracer

The 571 Curve Tracer is designed to accurately display the characteristics of two and three terminal semiconductor devices at a very affordable price. This easy-to-operate curve tracer is ideally suited for testing diodes, transistors, and thyristors.

Characteristic curves are digitized and displayed on a large video display CRT.

The 571 Curve Tracer is extremely versatile, yet remarkably easy to operate. Two main display screens are provided. The first screen is a menu page for selecting the device type and all relevant parameters. Parameters are selected and modified by a simple front-panel keypad entry.

The second screen displays the measured data – a family (set) of curves. The collector voltage and current parameters can be easily changed without switching back to the menu screen. An operator prompt line is provided at the bottom of each screen to indicate which push-buttons are active.

Up to 12 parameter setups (12 completed tests) can be stored in non-volatile EEROM memory to speed up testing of frequently used devices. One set of characteristic curves can be stored in RAM memory for comparison of one device to another (reference device).

A complete set of device adapter sockets are an integral part of the front-panel, preventing possible misplacement.

## Characteristics

**Collector Supply** – 0.5 to 100 volts in 8 ranges, max 2 A @ 50 V, 1 A @ 100 V.

**Selectable Load Resistor** – 0.3, 10, 100 Ω and 1, 10 kΩ.

**Base Drive** – Max 10 steps, 0.5 µA/step to 20 mA/step both source and sink in 15 ranges.

**Gate Drive** – 0.1 V/step to 1 V/step positive and negative in 4 ranges.

**$I_C$ Measurement** – 5 µA to 200 mA/div. in 15 ranges.

**Cursors** – Two cursors can be moved along the displayed curves. The X and Y position of the cursor will be displayed on the screen. Basic accuracy is 2% of full scale, all mentioned ranges are in 1-2-5 sequence.

**Printer Out** – Centronics® parallel interface. Output format for Epson® or IBM® compatible.

## ORDERING INFORMATION

**571**
Curve Tracer ..... **$3,500**
**Includes:** Operator's Manual, Power Cord

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

See General Customer Information Section for additional description.

**ADDITIONAL ACCESSORIES**
**Printer Cable** – 9 ft. Male to Male Centronics. Order 012-1284-00 ..... **$35**
**Printer Cable** – Shielded. Order 012-1233-00 ..... **$180**
**CART** – Order K475 ..... **$745**
**CAMERA** – Order C-9 Opt. 1A and Opt. 07 ..... **$875**

TD
Product available through an Authorized Tektronix Distributor (listed on pages 570-571).

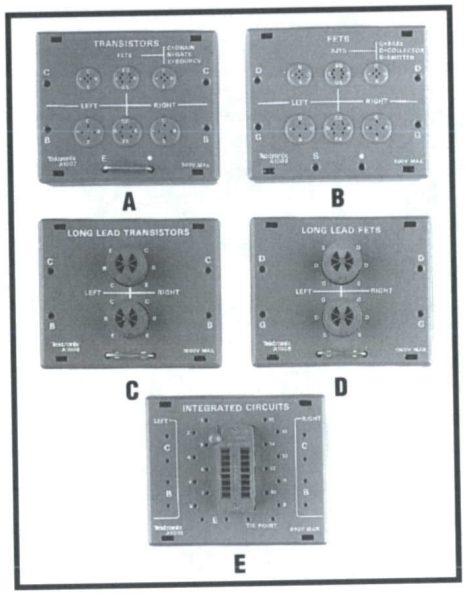
# Semiconductor Testers

## Device Adapters

*Adapters for 370A and 371A Curve Tracers and SMT Devices.*

**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 ..... **$315**

**B. FET Adapter for most FETs –** Order A1009 ..... **$310**

**C. Long Lead Transistor Adapter for Transistors with Untrimmed Leads –** Order A1006 ..... **$290**

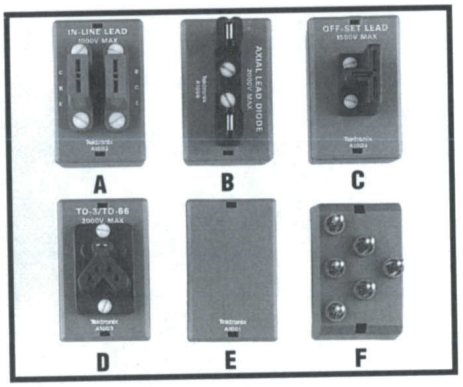
**D. Long Lead FET Adapter for FETs with Untrimmed Leads –** Order A1008 ..... **$315**

**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 ..... **$445**

**SMT DEVICE ADAPTERS**

**SOT-23 Adapter for Surface Mount Devices –** Order A1023 ..... **$265**

**TO 252/SMT DPack Adapter for Surface Mount Devices –** Order A1024 ..... **$265**




**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 ..... **$180**

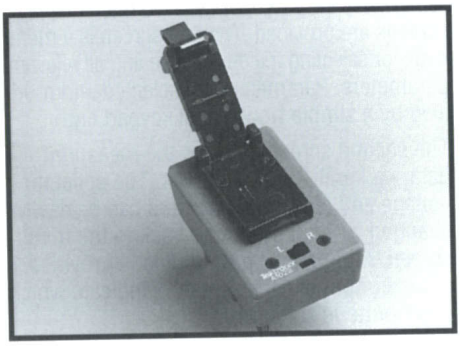
**B. Axial Lead Diode Adapter –** Order A1005 ..... **$180**

**C. Offset Lead Adapter for Power Transistor –** Order A1004 ..... **$180**

**D. TO-3/TO-66 Adapter for Power Transistors –** Order A1003 ..... **$180**

**E. Blank Adapter for Mounting Custom Sockets –** Order A1001 ..... **$95**

**F. Example Showing Adapter Bottom 6th Pin for Base/Gate Kelvin Sensing**



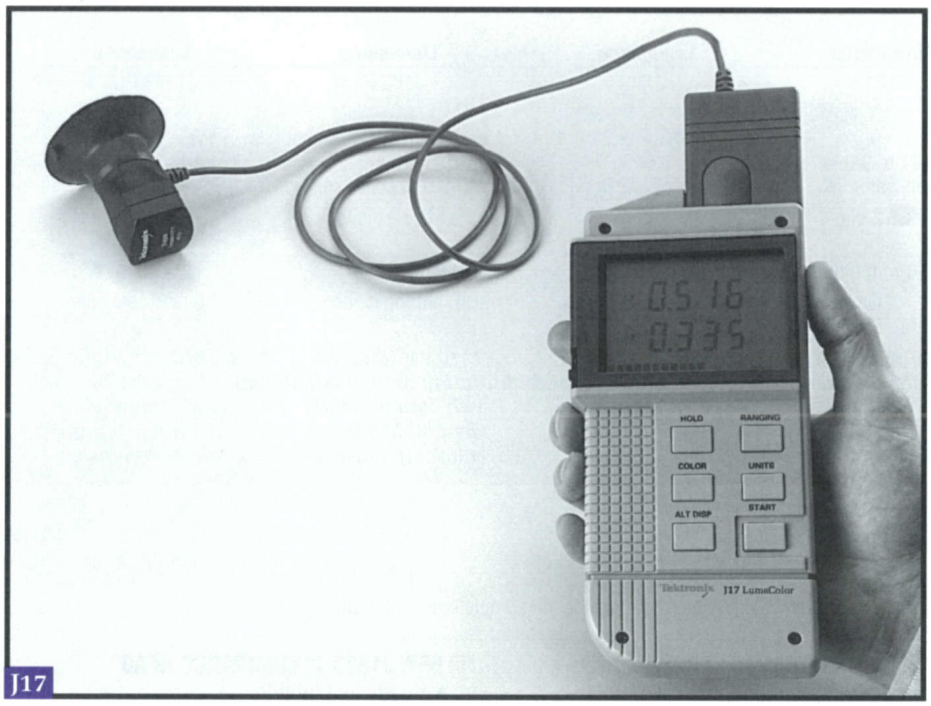
*A1023 SOT-23 Adapter.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# Photometer








J17

## J17 Photometer

The Tektronix J17 is a portable handheld digital Photometer/Radiometer/Colorimeter for the laboratory, field, or production area. A J17 System consists of a J17 handheld and one of eight interchangeable heads. At the heart of the J17 is a microprocessor capable of performing several functions and calculations: Metric-to-English conversion, auto-range, auto-zero, hold, and conversion between color coordinate systems. Via RS-232, the J17 can be utilized with a PC for automated testing and data recording. The internal 9 volt battery will operate the J17 for thirty hours of normal use.

Pre-calibrated plug-in heads measure illuminance, radiance, light emitting diode output, and color using CIE coordinates (u' v' or xy). All heads use silicon photodiodes with spectrally corrected, laminated, multi-element glass filters for long term stability and accuracy. Connection of a head to the J17 automatically selects the correct measurement units. The backlighted liquid crystal display can be read easily in the dark.

**J17**

- Improved Spectral Response
- Interchangeable Pre-calibrated Heads
- Accurate Spectral and Cosine Corrections
- CIE Color Measurement Head
- Metric/US Conversions
- Auto-Range, Auto Zero
- Large LCD with Backlight
- RS-232 Output
- Rugged
- Handheld
- Easy to Read in Dark Areas
- Adaptable to Many Light Measurement Needs

*The J17 builds on over 20 years of Tektronix experience in light measurement.*

*The J17 is smaller and has built-in features typical of products costing much more.*

TD

Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.

# Photometer



## CHARACTERISTICS

| Application | Illuminance | Irradiance | Luminance | Luminance | Luminance |
|---|---|---|---|---|---|
| **Probe** | J1811 | J1812 | J1803 | J1823 | J1823 Opt. 1 |
| **Range** | 0.001 to 50,000 footcandles 0.01 to 50,000 lumens/$m^2$ (lux) | 0.01 to 9,999 milliwatts/$m^2$ | 0.1 to 999,990 footlamberts 1 to 9,999,000 candelas/$m^2$ (nits) | 0.1 to 9999 fL 1 to 99,990 cd/$m^2$ (nits) | 1 to 99,990 fL 10 to 999,900 cd/$m^2$ (nits) |
| **Accuracy (NIST standard)** | ±5% ±2 digits | ±5% ±2 digits | ±5% ±2 digits | ±5% ±2 digits | ±5% ±2 digits |
| **Calibrated with:** | Illuminant "A" | 760 mm filter | Illuminant "A" | Illuminant "A" | Illuminant "A" |
| **Spectral Response** | CIE photopic curve | ±8% of flat from 450 to 950 nm | CIE photopic curve | CIE photopic curve | CIE photopic curve |
| **Acceptance Angle** | *Cosine corrected (180°)* | *50% sensitivity at 48° off axis* | *8° (1.7 in. diam/ft; minimum area:0.5 in.)* | *1° (0.21" diam/ft; minimum area of 0.040" with commercially available 55mm close up lenses)* | *1/3° (0.07" diam/ft; minimum area of 0.015" with commercially available 55mm close up lenses)* |
| **Integral Optical Sight** | – | – | – | *Yes* | *Yes* |
| **Cable Length** | 6 ft. | 6 ft. | 3.5 ft. | 6 ft. | 6 ft. |
| **Linearity (all heads)** | Within 2% over entire range enabling single point calibration | | | | |

### J1811 ILLUMINANCE HEAD

- Highway Illumination
- Luminaires and Lamps
- Workstation Illumination

The J1811 is an illuminance head with read-out 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 (color corrected) for accurate measurement of spectrally differing light sources including trichromatic fluorescent, sodium, metal halide, etc. Broad sensitivity allows measurement from moonlight to daylight.

The angular response is accurately cosine corrected, simulating an ideal 180° field-of-view detector. The low-profile sensor has a leveling indicator.

### J1806 8° RADIANCE/RADIANT INTENSITY HEAD

- Display Color Balance

The J1806 is useful for verifying or resetting color balance once initial color characterization has been done using the J1820.

### J1812 IRRADIANCE HEAD

- Laser Experiments
- Radiant Efficiency
- Infrared LED Testing

The J1812 measures irradiance in milliwatts/$m^2$ or output power in milliwatts. The spectral response is ±8% from 450 to 950 nanometers. The response is typically down 50% at 400 and 1030 nm.

### J1803 8° LUMINANCE HEAD

- Video and Projection Screens
- Surface Reflectance

The J1803 measures luminance in candelas/$m^2$ (nit) or foot-lamberts where light scattered or emitted by a surface must be measured. The head is pointed at the emitting surface. Spectral response is 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.

### NEW J1823 1° LUMINANCE HEAD

- Roadway Lighting
- Contrast Measurements
- Signs and Displays
- Glare Measurements

The J1823 heads can be used as telephotometers for measurements such as glare from roadways or reflectance from signs. By adding commercially available 55mm diameter photographic close-up lenses,areas down to 0.040 in. diameter can be measured, while the ⅓° version, J1823 Opt. 01, can measure areas as small as 0.015 in. The focusing range is from infinity to 18 in. closer with the close-up lenses. These heads are particularly useful for flat panel and CRT measurement.

# Photometer





## HEAD CHARACTERISTICS

| Application | LED | Radiance | Chromaticity/Luminance |
|---|---|---|---|
| **Probe** | J1805 | J1806 | J1820 |
| **Range** | 1° micro-candelas to 99.99 candelas | 1 mW/M²/sr to 999.9 W/M²/sr | 0 to 0.999 x, y, u', v'<br>Luminance same as J1803 |
| **Accuracy (NIST standard)** | ±5% ±2 digits | ±5% ±2 digits | 0.018 x, y, u', v' |
| **Calibrated with:** | Illuminant "A" | 610 nm filter | Illuminant "A" |
| **Spectral Response** | CIE photopic curve | ±8% of flat from 450 to 950 nm | CIE Tristimulus functions |
| **Acceptance Angle** | Intercepts 3° of LED beam | 8° (1.7 in. diam/ft; min. area:0.5 in.) | 16° (3.4 in. diam/ft; min. area:1 in.) |
| **Integral Optical Sight** | – | – | – |
| **Cable Length** | 3.5 ft. | 3.5 ft. | 3.5 ft. |
| **Linearity (all heads)** | Within 2% over entire range enabling single point calibration | | |

### 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.

### J1820 CHROMATICITY HEAD

- Color Monitor Chromaticity and White Balance
- Light Source Color Temperature

The J1820 is for measurement of color coordinates in the 1931 CIE and 1976 CIE-UCS chromaticity systems. Color coordinates are automatically computed and displayed in either x an y or u' and v' units. Luminance in cd/m² or foot-lamberts may also be measured.

## ORDERING INFORMATION

**J17**
LumaColor™ ..... TD **$950**
**Includes:** Battery, Operator's Manual

**J1803**
Luminance Head ..... TD **$550**
**Includes:** Suction Cup, Retainer/Filter Holder, Light Occluder, Operator's Manual, Spectral Curve, Lens Covers

**J1823**
1° Luminance Head ..... TD **$1,895**
**Includes:** Operator's Manual, Spectral Curve
**J1823, Option 1** – ⅓°Luminance Head ..... **NC**

**J1805**
LED Head ..... TD **$550**
**Includes:** Four adapters for the most common LED's, Rubber Retainer, Operator's Manual, Spectral Curve

**J1806**
Radiance/Radiant Intensity Head ..... TD **$550**
**Includes:** Rubber Retainer for Holding Customer Supplied 1 in. Diameter Filters, Suction Cup, Operator's Manual, Spectral Curve

**J1811**
Illuminance Head (cosine corrected) ..... TD **$685**
**Includes:** Cover, Operator's Manual, Spectral Curve

**J1812**
Irradiance Head ..... TD **$685**
**Includes:** Cover, Operator's Manual, Spectral Curve

**J1820**
Color Head ..... TD **$1,450**
**Includes:** Suction Cup, Operator's Manual, Spectral Curve

ACCESSORIES

**RS-232 Cable** – Order 012-1411-00 ..... **$55**
**120 V AC Supply** – Order 119-5032-00 ..... **$26**

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.

# Accessories

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## With Tektronix, the Difference is Measurable

Whether you're using a scope from our revolutionary TDS, TAS or 11000 Series, our portable 2400 or 2200 Series, or our new TLS Series, you've invested in the finest line of measurement instruments available. That's why it doesn't pay to compromise performance with accessories you can't be sure of.

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 complemented by an amazingly wide array of probe accessories for virtually every need.

### DOCUMENTATION

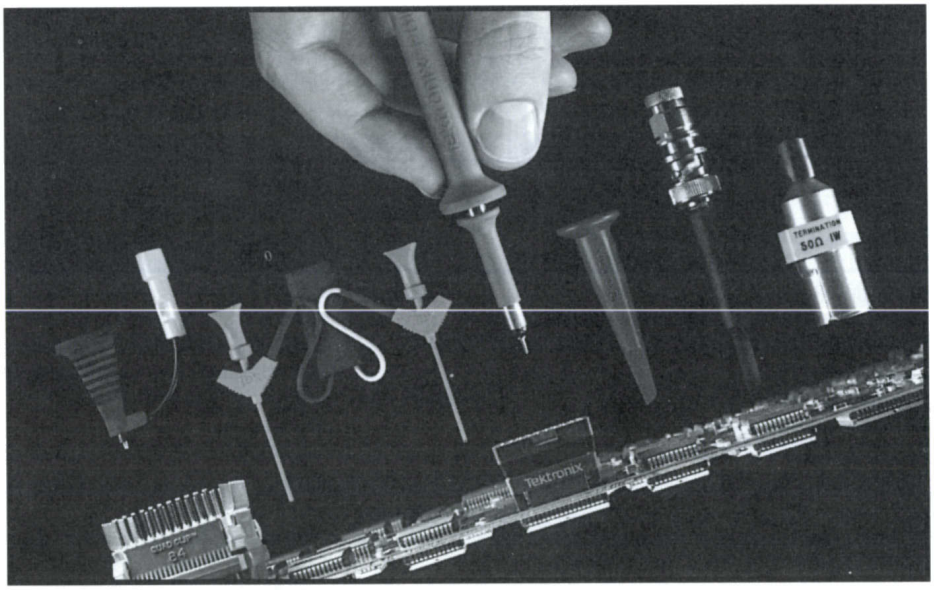
We also provide a complete family of products for documenting your measurement results, a step that's become almost as essential as testing itself. As with our probes, only Tektronix digitizing systems, film-based cameras, printers, and plotters are precision-matched to your instrument and applications. 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 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, anytime 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

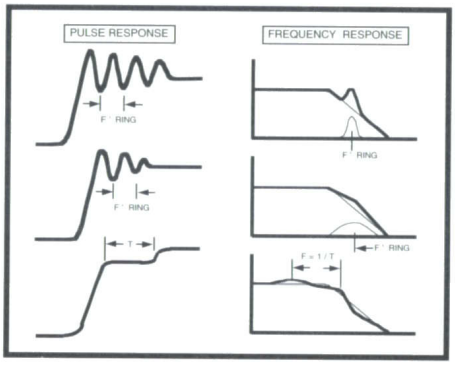


## Tektronix Instrument Probes

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.

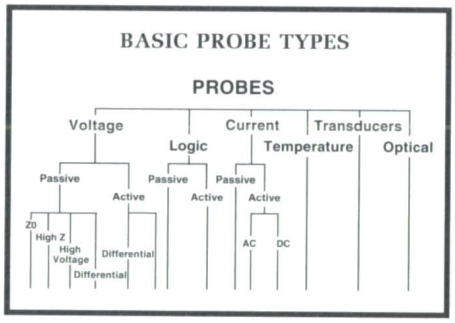
However, these "simple probes" do not fulfill the essential purpose of a probe; that is "to extract minimal energy from the circuit under test and transfer it to a measuring instrument with maximum fidelity." The bare wire can load the input amplifier with its high capacitance and inductance or even 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 cable's capacitance in today's high speed probing products.




## 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.




### GENERAL PURPOSE PASSIVE (PAGES 444 TO 449)

Attenuating Passive Voltage Probe's 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 436)

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 < 2 pF to < 0.4 pF) and high input resistance values (typically > 100 kΩ). Some FET probes include an offset control that allows a substantial increase in the active probes 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 480)

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, a reduction in the input capacitance of approximately 3 pF is achieved. This helps reduce the current shunting effects at higher frequencies.

### CURRENT PROBES (PAGE 473)

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" 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. Hall effect current probes use semiconductors to provide a frequency response from DC to 50 MHz. Because of it's "non-invasive" nature, a current probe imposes less loading than other probes (typically less than a few ohms in series, shunted by few nanohenrys, with the wire with a stray capacitance of less than 1 pF).

### 50 Ω DIVIDER PROBES (Z0) (PAGE 442)

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.

# Probe Tutorial

**DIFFERENTIAL PROBES (PAGE 470)**
Tektronix oscilloscope plug-ins are available with high common rejection ratio (10,000:1, 11A33). 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 the variety of Tektronix plug-ins. This attenuation adjustment includes probe compensation so the probes match at high frequency as well as low frequencies.

**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-6053-4 (Free)

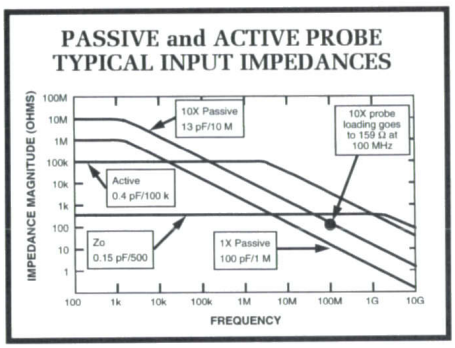
**"Probing High Frequency Digital Circuitry" –**
• Literature # 60W-8412-0 (Free)

**"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" –**
• Video Tape and Workbook.
Order 068-0299-XX specify tape format:
-00 3/4" U-MATIC
-01 Beta
-02 Beta II
-03 Beta III
-04 VHS NTSC
-06 VHS PAL
-07 VHS SECAM)

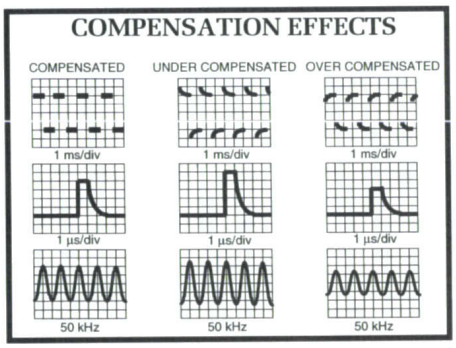
**CRITERIA**
**Bandwidth/Rise Time**
The bandwidth of a probe can be defined as the maximum -3 dB frequency a user can expect with a scope/probe system. In most probes, the bandwidth/rise time product is close to 0.35. In many cases the bandwidth is verified by pulse rise time to ensure minimum aberrations. To accurately define these parameters, 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.

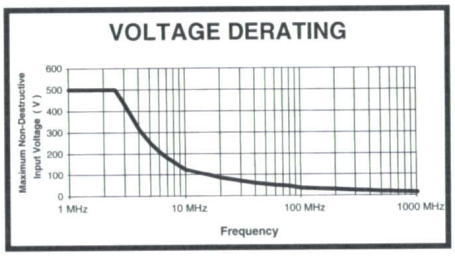



*Tip - Always remember to check/adjust the compensation of your probe when you move it between channels or to another scope.*

**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 are available to mechanically connect the probe to the circuit under test (See page 424 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.

# Probe Tutorial



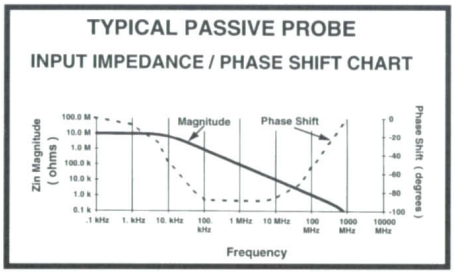
**Maximum Current (CW)**
The maximum sine wave current that can be measured with a specified current probe without distortion.

**Maximum Current (PULSE)**
The maximum pulse current that can be measured with a specified current probe without distortion limited by Amp-Second (A-S) product.

**Amp-Second Product**
The maximum integral of the Current Pulse Waveform that may be measured without distortion. (See page 487 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

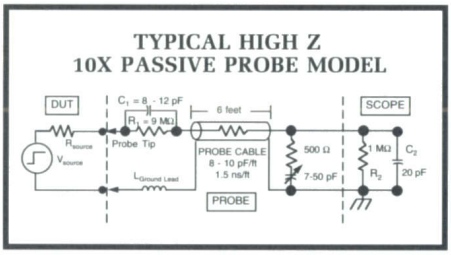
$$BW = 0.35 / t_{rise}$$

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 is represented by $R_2C_2$ and the probe resistance and capacitance is represented by $R_1$ $C_1$ (See the figure below).

**R2C2 = R1C1 = Optimum Signal Transfer**

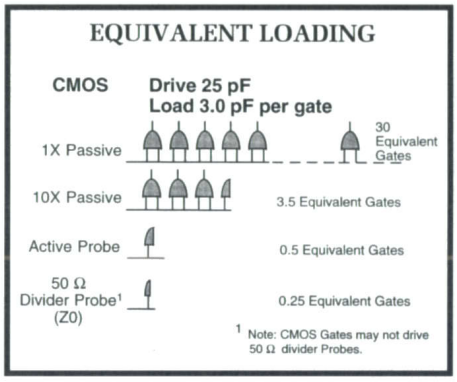



When the probe is first connected to the oscilloscope, compensate it by applying a low frequency square wave (1 to 10 kHz normally) to achieve the equalization of time constants. Improper compensation will result in either overshoot, roll-off or incorrect signal amplitudes (see Compensation Effects figure page 426).

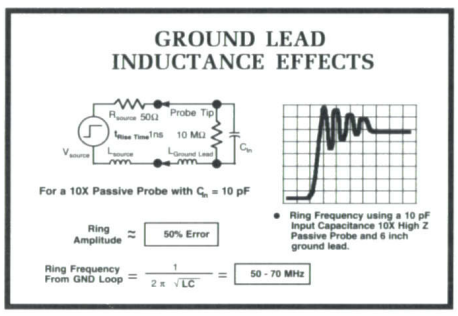
The charts on pages 428 to 433 give you information on specifications, oscilloscope compatibility and obsolete probe replacements to help you select the right probe for your application.

**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 (50Ω) scope inputs will require 50 Ω probes. One Megohm (1 MΩ) scope inputs will require 1 MΩ probes. Also check for connector interface compatibility or choose the appropriate adapter required.
- **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

*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.*

**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 300/400/500/600/800 Series** | | | | | | | | |
| TDS 320 | P6101B | **P6109B** | P6129B | P6561AS | | P6009 | P6015A | |
| TDS 350 | P6101B | **P6111B** | P6129B | P6561AS | | P6009 | P6105A | |
| TDS 420 | P6101B | **P6138** | P6129B | P6562AS | P6156*2 | P6009 | P6015A | P6205 |
| TDS 460 | P6101B | **P6138** | P6129B | P6562AS | P6156*2 | P6009 | P6015A | P6205 |
| TDS 520/A | P6101B | **P6139A** | | P6563AS | P6156*2 | P6009 | P6015A | P6205/P6204 |
| TDS 524/A | P6101B | **P6139A** | | P6563AS | P6156*2 | P6009 | P6015A | P6205/P6204 |
| TDS 540/A | P6101B | **P6139A** | | P6563AS | P6156*2 | P6009 | P6015A | P6205/P6204 |
| TDS 544/A | P6101B | **P6139A** | | P6563AS | P6156*2 | P6009 | P6015A | P6205/P6204 |
| TDS 620/A | P6101B | P6139A | | P6563AS | P6156*2 | P6009 | P6015A | **P6205**/P6204 |
| TDS 640/A | P6101B | P6139A | | P6563AS | P6156*2 | P6009 | P6015A | **P6205**/P6204 |
| TDS 644/A | P6101B | P6139A | | P6563AS | P6156*2 | P6009 | P6015A | **P6205**/P6204 |
| TDS 820 | | | | | P6150 | | | **P6207** |
| **TAS 400 Series** | | | | | | | | |
| TAS 465 | P6101B | **P6109B** | P6129B | P6561AS | | P6009 | P6015A | |
| TAS 475 | P6101B | **P6109B** | P6129B | P6561AS | | P6009 | P6015A | |
| TAS 485 | P6101B | **P6111B** | P6129B | P6561AS | | P6009 | P6015A | |
| TLS 216 | | | | | | | | |
| TLS 216 | | | | | | | | **P6240** |
| **11000 Series** | | | | | | | | |
| 11A32 | P6101B | P6134C | P6063B | P6562AS | | P6009 | P6015A | P6204/P6205 |
| 11A33 | P6101B | P6135A*4 | | P6562AS | | | | |
| 11A34/V | P6101B | P6134C | P6063B | P6562AS | | P6009 | | P6204*7/P6205*7 |
| 11A52 | | | | | P6156*2 | | | P6204/P6205 |
| 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 | P6009 | P6015A | P6202A*1 |
| 2431L | P6101B | **P6136 Opt. 25** | P6063B | P6562AS | P6156*2 | P6009 | P6015A | P6201*1 |
| 2432/A/M | P6101B | **P6137** | P6063B | P6562AS | P6156*2 | P6009 | P6015A | P6201*1 |
| 2439 | P6101B | **P6136 Opt. 25** | P6063B | P6562AS | P6156*2 | P6009 | P6015A | P6202A*1 |
| 2440/M | P6101B | **P6137** | P6063B | P6562AS | P6156*2 | P6009 | P6015A | P6201*1 |
| 2445 | P6101B | **P6131** | P6063B | P6562AS | P6156*2 | P6009 | P6015A | P6202A*1 |
| 2445A | P6101B | **P6133 Opt. 25** | P6063B | P6562AS | P6156*2 | P6009 | P6015A | P6202A*1 |
| 2445B | P6101B | **P6137** **P6133 Opt. 25*3** | P6063B | P6562AS | P6156*2 | P6009 | P6015A | P6202A*1 |
| 2455A/B | P6101B | **P6136 Opt. 25** | P6063B | P6562AS | P6156*2 | P6009 | P6015A | P6202A*1 |
| 2465 | P6101B | **P6131** | P6063B | P6562AS | P6156*2 | P6009 | P6015A | P6201*1 |
| 2465A | P6101B | **P6136 Opt. 25** | P6063B | P6562AS | P6156*2 | P6009 | P6015A | P6201*1 |
| 2465B | P6101B | **P6137** | P6063B | P6562AS | P6156*2 | P6009 | P6015A | P6201*1 |
| 2467 | P6101B | **P6136 Opt. 25** | P6063B | P6562AS | P6156*2 | P6009 | P6015A | P6201*1 |
| 2467B/HD | P6101B | **P6137** | P6063B | P6562AS | P6156*2 | P6009 | P6015A | P6201*1 |

**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 Opt. 25 for 10X plus 100X and see ordering information on page 442 for separate 1X and 20X attenuator tips.*

**3 2445B shipped with P6133 Opt. 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 Opt. 1E.*

**6 1 MΩ Input Required.*

**7 11A34 only.*

**8 P6205 plus 1103 power supply may also be used.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# Oscilloscopes to Probes

## Cross Reference



### RECOMMENDED PROBES

| | Passive 1X*6 | Passive 10X*6 | Passive 1X/10X*6 | Low-Z | High Volt. 100X*6 | High Volt. 1000X*6 | Active FET |
|---|---|---|---|---|---|---|---|
| **2200 Series** | | | | | | | |
| 2201/2205 | P6101B | **P6103B** | P6119B | | P6007 | P6015A | |
| 2210 | P6101B | **P6103B** | P6119B | | P6007 | P6015A | |
| 2211/2212 | P6101B | **P6109B** | P6129B | | P6009 | P6015A | |
| 2213/A | P6101B | **P6122** | P6119B | | P6007 | P6015A | |
| 2214 | P6101B | **P6103B** | P6119B | | P6007 | P6015A | |
| 2215/A | P6101B | **P6122** | P6119B | | P6007 | P6015A | |
| 2220 | P6101B | **P6109B** | P6129B | | P6007 | P6015A | |
| 2221/A/2224 | P6101B | **P6109B** | P6129B | | P6009 | P6015A | |
| 2225 | P6101B | **P6103B** | P6119B | | P6007 | P6015A | |
| 2230/2232 | P6101B | **P6109B** | P6129B | | P6009 | P6015A | |
| 2235/A | P6101B | **P6109B** | P6119B | | P6007 | P6015A | |
| 2235L | P6101B | **P6122** | P6119B | | P6009 | P6015A | |
| 2236/A | P6101B | **P6109B** | P6129B | | P6009 | P6015A | |
| 2245/A | P6101B | **P6109B** | P6129B | | P6009 | P6015A | P6205*5*8 |
| 2246/A | P6101B | **P6109B** | P6129B | | P6009 | P6015A | P6205*5*8 |
| 2247/A/2252 | P6101B | **P6109B** | P6129B | | P6009 | P6015A | P6205*5 |
| **200 Series** | | | | | | | |
| 222A | **P400** | P850 | | | | | |
| 222PS | **P400** | P850 | | | | | |
| 224 | **P400** | P850 | | | | | |
| **Digitizers** | | | | | | | |
| RTD710A/TD1301 | P6101B | P6109B | P6129B | | P6009 | P6015A | P6205*5 |
| RTD720A | | | | P6156*2 | | | P6204*5 |
| SCD1000 | | | | P6156*2 | | | P6217*5 |
| SCD5000 | | | | P6156*2 | | | P6217*5 |
| **TM 500/5000 Series** | | | | | | | |
| AM 502 | P6101B | P6135A*4 | | | | | |
| DC 503A | P6101B | P6106A | | | | | |
| DC 504A/5004 | P6101B | P6106A | | | | | |
| DC 509/5009 | P6101B | P6106A | | | | | |
| DC 510/5010 | P6101B | P6106A | | | | | |
| DC 505/A | P6101B | P6122 | | | | | |
| DC 508/A | P6101B | P6106A | | | | | |
| SC 501/2/3 | P6101B | | P6062B | | P6007 | P6015A | |
| SC 504 | P6101B | P6105A | P6129B | | P6009 | P6015A | |
| SI5010 | | | | P6156*2 | | | P6202A*1*8 |

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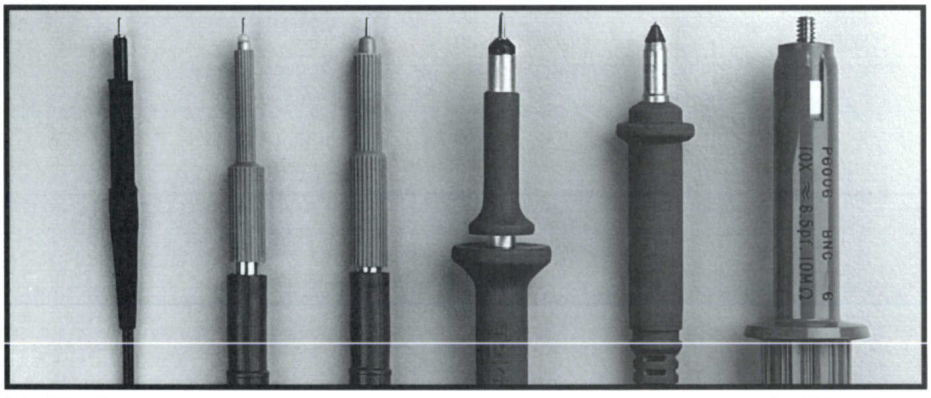
# Probes
## Specifications

### 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) | 444 |
| **10X Passive Probes** | | | | | | | | | | | |
| P6103B | 2 m | 10 | 60 MHz | 10 MΩ | 13 pF | 420 V | 15 to 35 pF | | | 5 mm (Min) | 444 |
| P6105A | 2 m | 10 | 100 MHz | 10 MΩ | 11 pF | 500 V | 15 to 35 pF | √ | √ | 5 mm (Min) | 446 |
| 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) | 446 |
| 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) | 444 |
| P6111B | 2 m | 10 | 200 MHz | 10 MΩ | 14 pF | 420 V | 15 to 35 pF | √ | | 5 mm (Min) | 444 |
| P6122 | 1.5 m | 10 | 100 MHz | 10 MΩ | 11 pF | 500 V | 15 to 35 pF | | | 5 mm (Min) | 446 |
| P6130 | 2 m | 10 | 250 MHz | 10 MΩ | 13.2 pF | 500 V | 15 to 35 pF | √ | | 2.5 mm (Sub) | 432 |
| Opt. 01 | 1.5 m | 10 | 250 MHz | 10 MΩ | 12.7 pF | 500 V | 15 to 35 pF | | | 2.5 mm (Sub) | |
| Opt. 03 | 3 m | 10 | 150 MHz | 10 MΩ | 14.5 pF | 500 V | 15 to 30 pF | | | 2.5 mm (Sub) | |
| P6131 | 1.3 m | 10 | 300 MHz | 10 MΩ | 10.8 pF | 500 V | 14 to 18 pF | √ | | 2.5 mm (Sub) | 448 |
| 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) | 448 |
| 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) | 448 |
| P6136 | 1.3 m | 10 | 350 MHz | 10 MΩ | 10.8 pF | 500 V | 12 to 18 pF | √ | | 2.5 mm (Sub) | 448 |
| 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) | 448 |
| P6138 | 1.3 m | 10 | 350 MHz | 10 MΩ | 10 pF | 500 V | 12 to 18 pF | √ | | 3.5 mm (Comp) | 448 |
| P6139A | 1.3 m | 10 | 500 MHz | 10 MΩ | 8 pF | 500 V | 8 to 12 pF | √ | | 3.5 mm (Comp) | 448 |
| P6561AS | 1.3 m | 10 | 200 MHz | 10 MΩ | <11 pF | 42 V | 15 to 35 pF | √ | | SMD | 450 |
| P6562AS | 1.3 m | 10 | 350 MHz | 10 MΩ | <11 pF | 42 V | 12 to 35 pF | √ | | SMD | 450 |
| P6563AS | 1.3 m | 20 | 500 MHz | 9.5 MΩ | <5 pF | 42 V | 7 to 30 pF | √ | | SMD | 450 |

m = meters V = volts MHz =- Megahertz MΩ = Mega Ohms pF = picofarads mm = millimeters

### TIP/HEAD STYLES




***Tip/Head Style:*** *SMD* *2.5 mm Subminiature* *3.5 mm Compact* *5 mm Miniature* *4 mm* *6/32 Thread Monolithic*

# Probes
## Specifications



### 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.) | 446 |
| 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 | | | 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.) | 446 |
| 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.) | 444 |
| P6129B | 2 m | 1/10 | 10/100 MHz | 1/10 MΩ | 100/18 pF | 420 V | 15 to 35 pF | √ | | 5 mm (min.) | 444 |
| **100X/1000X High Voltage** | | | | | | | | | | | |
| P6007 | 2.2 m | 100 | 20 MHz | 10 MΩ | 2.2 pF | 1,500 V | 8 to 55 pF | | | Mono. | 481 |
| Opt. 01 | 1.2 m | 100 | 25 MHz | 10 MΩ | 2.0 pF | 1,500 V | 8 to 55 pF | | | Mono. | |
| Opt. 03 | 3.4 m | 100 | 15 MHz | 10 MΩ | 2.4 pF | 1,500 V | 8 to 55 pF | | | Mono. | |
| Opt. 04 | 4.5 m | 100 | 13 MHz | 10 MΩ | 2.6 pF | 1,500 V | 8 to 55 pF | | | Mono. | |
| P6009 | 3.4 m | 100 | 120 MHz | 10 MΩ | 2.5 pF | 1,500 V | 8 to 55 pF | √ | | Mono | 480 |
| P6015A | 3.8 m | 1000 | 75 MHz | 100 MΩ | 3.0 pF | 40,000 V | 7 to 49 pF | | | HVP | 480 |
| Opt. 1R | 3.8 m | 1000 | 75 MHz | 100 MΩ | 3.0 pF | 40,000 V | 7 to 49 pF | √ | | HVP | |
| Opt. 25 | 9.4 m | 1000 | 25 MHz | 100 MΩ | 3.0 pF | 40,000 V | 7 to 49 pF | | | HVP | |
| Opt. 2R | 9.4 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 | ±5.6V | | Mono | 440 |
| | | 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 | 440 |
| | | 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.) | 436 |
| P6205 | 1.5 m | 10 | 750 MHz | 1 MΩ | 2.0 pF | ±40 V | ±10 V | N/A | | 5 mm (min.) | 436 |
| P6207 | 1.6 m | 10 | 4000 MHz | 100 kΩ | 0.4 pF | ±40 V | ±4.0 V | ±5 V | | 4 mm (min.) | 438 |
| P6217 | 1.5 m | 10 | 4000 MHz | 100 kΩ | 0.4 pF | ±40 V | ±4.0 V | ±5 V | | 4 mm (min.) | 436 |
| P6231 | 1.5 m | 10 | 1500 MHz | 450 Ω | 1.6 pF | ±30 V | ±5.0 V | ±5 V | √ | 2.5 mm (sub.) | 436 |

### 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 | 442 |
| | | 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 | √ | √ | Comp | 442 |
| 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 | | | | |

m = meters V = volts MHz =- Megahertz MΩ = Mega Ohms pF = picofarads mm = millimeters

*1 *Limited by scope input or 42 V RMS.*
*2 *Limited by scope input or 50 V RMS.*

# Obsolete Probes
## Replacement Guide

### PASSIVE PROBES

| Obsolete 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 | | **P6062B** | 1/10 | 7/100 | 15 to 47 | Y | | Body Size |
| 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 | | | | |
| 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 | 15-35 | 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 |

### ACTIVE PROBES

| Obsolete 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 | ±10V | ±10V | 40 | 2 | 10k | P6204 | 10 | 1000 | ±10V | ±10V | 40 | 1.9 | 10M |
| | | | | | | | | P6205 w/ 1103 | 10 | 750 | ±10V | N/A | 40 | 2 | 1M |
| P6206 | 10 | 1000 | ±10V | N/A | 40 | 2 | 1M | P6204 or | 10 | 1000 | ±10V | ±10V | 40 | 1.9 | 10M |
| | | | | | | | | P6205 w/ 1103 | 10 | 750 | ±10V | N/A | 40 | 2 | 1M |
| P6230 | 10 | 1500 | ±5V | ±5V | 30 | 1.3 | 450 | P6231 w/1103 | 10 | 1500 | ±5V | ±5V | 30 | 1.6 | 450 |

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| P6006 | 432 | P6057 | 432 | P6107A | 432 | P6129 | 432 | P6137 | 448 | P62096 | 432 |
| P6007 | 480 | P6062B | 446 | P6108A | 444 | P6129B | 444 | P6138 | 448 | P6207 | 438 |
| P6008 | 490 | P6063B | 446 | P6109 | 432 | P6130 | 432 | P6139A | 448 | P6217 | 436 |
| P6009 | 480 | P6101A | 432 | P6109B | 444 | P6131 | 448 | P6148A | 432 | P6230 | 432 |
| P6015 | 432 | P6101B | 444 | P6111B | 444 | P6133 | 448 | P6149A | 432 | P6231 | 436 |
| P6015A | 470 | P6102A | 432 | P6115 | 432 | P6134 | 432 | P6150 | 442 | P6561AS | 450 |
| P6046 | 432 | P6103 | 432 | P6119 | 432 | P6134C | 448 | P6156 | 442 | P6562 | 432 |
| P6053 | 432 | P6103B | 444 | P6119B | 444 | P6135 | 432 | P6201 | 440 | P6562AS | 450 |
| P6053B | 432 | P6105A | 446 | P6121 | 432 | P6135A | 471 | P6202A | 440 | P6563AS | 450 |
| P6053C | 432 | | | P6122 | 446 | | | P6203 | 432 | P850 | 480 |
| P6055 | 432 | | | P6125 | 432 | | | P6204 | 436 | | |

# Obsolete Scopes
## Probe Replacement Guide



**SUGGESTED REPLACEMENTS**

| Obsolete Scope | Passive 10X | Passive 1X/10X | SMD 10X | Low-Z | High Volt. 100X | High Volt. 1000X | Active |
|---|---|---|---|---|---|---|---|
| **11000 Series** | | | | | | | |
| 11201/A | P6134C | P6063B | P6562AS | | P6009 | P6015A | P6204/P6205 |
| 11A72 | | | | P6156 Opt. 25 | | | P6204/P6217 |
| **7000 Series** | | | | | | | |
| 7A13 | P6135A*3 | | | | P6009 | P6015A | |
| 7A15A/7A18/A | P6105A | P6129B | P6561AS | | P6009 | P6015A | P6202A*1/P6205*2 |
| 7A16A | P6106A | P6063B | P6561AS | | P6009 | P6015A | P6202A*1/P6205*2 |
| 7A19/7A24 | | | | P6156 Opt. 25 | | | P6201*1/P6217*2 |
| 7A22 | P6135A*3 | | | | | | |
| 7A26 | P6106A | P6063B | P6561AS | | P6009 | | P6202A*1/P6205*2 |
| 7A29/P | | | | P6156 Opt. 25 | | | P6201*1/P6217*2 |
| 7A42 | P6131 | P6063B | P6561AS | P6156 Opt. 25 | P6009 | | 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 | P6009 | P6015A | P6202A*1 |
| **2300 Series** | | | | | | | |
| 2335/2336 | P6109B | P6119B | | | P6007 | P6015A | |
| 2336YA | P6109B | P6119B | | | P6007 | P6015A | |
| 2337 | P6109B | P6119B | | | P6007 | P6015A | |
| **400 Series** | | | | | | | |
| 434 | P6105A | P6129B | P6561AS | | P6007 | P6015A | P6202A*1 |
| 455 | P6105A | P6129B | P6561AS | | P6009 | P6015A | P6202A*1 |
| 464 | P6105A | P6062B | P6561AS | | P6009 | P6015A | P6202A*1 |
| 464/M | P6105A | P6129B | P6561AS | | P6009 | P6015A | P6202A*1 |
| 465/B | P6105A | P6129B | P6561AS | | P6009 | P6015A | P6202A*1 |
| 465/M | P6105A | P6129B | P6561AS | | P6009 | P6015A | P6201*1 |
| 466 | P6105A | P6062B | P6561AS | | P6009 | P6015A | P6202A*1 |
| 468 | P6105A | P6129B | P6561AS | | P6009 | P6015A | P6202A*1 |
| 475/A | P6106A | P6063B | P6561AS | P6156 Opt. 25 | P6009 | P6015A | P6201*1 |
| 485 | P6106A | P6063B | P6561AS | P6156 Opt. 25 | P6009 | P6015A | P6201*1 |
| **300 Series** | | | | | | | |
| 305/314/335 | | P6062B | | | | | |
| 336/A | | P6062B | | | | | |
| 390AD | P6105A | P6129B | | | P6009 | P6015A | |
| **TAS 400 Series** | | | | | | | |
| TAS 455 | P6109B | P6129B | P6561AS | | P6009 | P6015A | |

**1 Requires Scope Power or 1101A Power Supply.*
**2 Requires Scope Power or 1103 Power Supply.*
**3 Differential Pair*

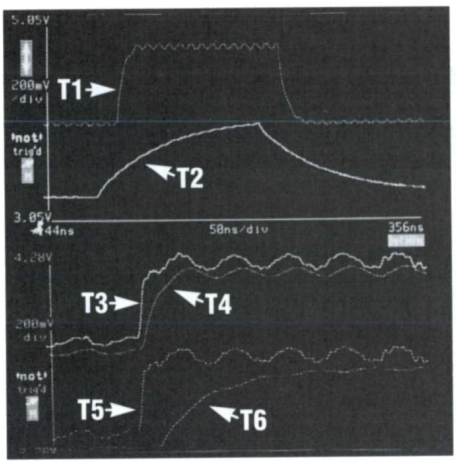
# Active Probes

## Choosing an Active Probe

*Active performance with passive simplicity.*

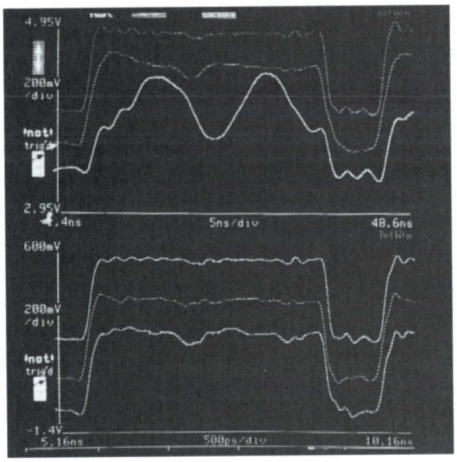
**DESIGNED FOR:**

- 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)] and*
- *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.*

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, externally by the probe itself or, for the P6205 model, there is no probe offset control to deal with.

### 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** (except P6207/P6217) improve electrical connections, reliability and lower maintenance costs.

*[1] 11000 Series Only*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Active Probes
## Choosing an Active Probe



### CHOOSING AN ACTIVE PROBE

| WHERE or WHEN YOU HAVE | WHAT YOU NEED | WHY |
|---|---|---|
| Source impedance test points; >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, allow the acquisition of the fastest rise times (input C influenced), accurate amplitude measurements and provide less signal drain than a conventional passive probe. |
| Small signal circuit analysis | P6201 with its 1X sensitivity or P6217, P6204 and P6205 with 11K 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, 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 over all circuit analysis capabilities (amplitudes, rise times, propagation delay, aberrations,etc.). |
| Tuned Circuits: Oscillators, tank circuits, etc. | P6217, P6207, 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 P6205 active probe provides 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 C's also provide a higher ring frequency than passive probes allowing the use of longer grounds. |

| Probe Type | Cable Length in meters | Attenuation | Bandwidth 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 | 900 | 3 | 100 k | ±0.6 | ±5.6 | ±100 | BNC/Y/N | 400/2400/ |
| | | 10X | 900 | 1.5 | 1 M | ±6.0 | ±56 | ±200 | BNC/Y/N | 7000 Series*3 |
| | | 100X | 900 | 1.5 | 1 M | ±60 | ±200 | ±200 | BNC/Y/N | |
| P6202A *1 | 2 | 10X | 500 | 2 | 10 M | ±6.0 | ±55 | ±200 | BNC/Y/N | 400/2400/ |
| | | 100X | 500 | 2 | 10 M | ±60 | ±200 | ±200 | BNC/N/N | 7000 Series *3 |
| P6204 | 1.5 | 10X | 1000 | 1.9 | 10 M | ±10 | ±15 | ±40 | TPB/Y/Y | 11000 *4 TDS 400/ 500/600*5 |
| P6205 | 1.5 | 10X | 750 | 2 | 1 M | ±10 | NA | ±40 | TPB/Y/N | 11000 *4 TDS 400/ 500/600*5 |
| P6217 | 1.5 | 10X | 4000 | 0.4 (typical) | 100 k | ±4.0 | ±5.0 | ±40 | TPB/Y/N | 11000 *4 TDS 400/ 500/600*5 |
| P6231 | 1.5 | 10X | 1500 | 1.6 | 450 | ±5.0 | ±5.0 | ±30 | TPB/Y/Y | 11000 *4 |
| P6207 | 1.6 | 10X | 4000 | 0.4 (typical) | 100 k | ±4.0 | ±5.0 | ±40 | TPS/Y/N | TDS 820 |

**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., DSA600 / CSA400 / 11400 / Etc.*
**5 P6204 and P6217 DC Offset Functions are not incorporated into the TDS400.*

P6217
P6205
1103

P6204
P6231

# Active FET Probes

## For TEKPROBE™ BNC Interfaces

*Easy to Use, Active Performance, Passive Simplicity.*

**P6217/P6205/ P6204/P6231**

- Ultra Low Input Capacitance
- High Input Resistance
- True Signal Fidelity up to 4 GHz
- Variable DC Offset
- Integral Probe Power TEKPROBE™ BNC

**P6217**

- DC to 4 GHz
- ≤0.40 pF Input C
- 100 kΩ Input R
- DC Offset
- Small Size

**P6205**

- DC to 750 MHz
- 2 pF Input C
- 1 MΩ Input R
- Low Price

**P6204**

- DC to 1 GHz
- 1.9 pF Input C
- 10 MΩ Input R
- DC Offset
- Identify Button

**P6231**

- DC to 1.5 GHz
- 1.6 pF Input C
- 450 Ω Input R
- Bias/Offset (Tip Nulling)
- Small Size

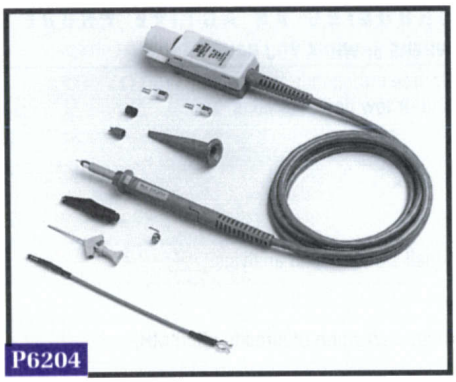
**1103**

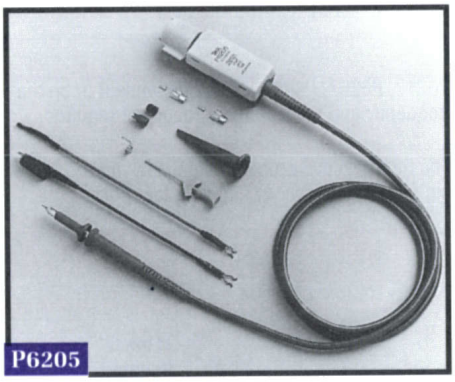
- Powers Up to Two Probes
- For Use With:
  - 11000 Series Probes on Non-TEKPROBE™ Interfaced Scopes
  - P6203, P6204, P6205, P6217, P6231
- Overload Protected

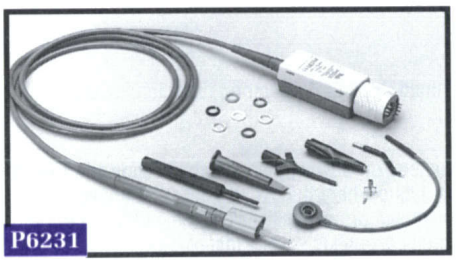
TD

Product available through an Authorized Tektronix Distributor (listed on pages 570-571). P6205 also available through TekDirect. Call 1-800-426-2200




The P6204, P6205, P6217 and P6231 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 P6231 is a specialty active probe that provides a higher impedance level to DC through an Bias/Offset capability which provides an adjustable tip nulling voltage.

The P6217 provides the widest bandwidth and lowest input capacitance at 100 kΩ available for a hand-held active voltage probe.

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, P6217 and P6231's 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.

The P6231 Bias/Offset probe acts as a standard 500 Ω passive divider voltage with the additional capability of having an adjustable tip nulling voltage. This feature reduces the DC-Loading effects of the probe when it is used to measure signals whose mid-voltage value is not at zero volts, or in circuits where the termination impedance is not returned to ground level. The Input Bias/Offset Voltage may be adjusted so that the voltage at the probe input resistor is equal to the test signal potential: thus no DC current flows through the probes input resistor.



# Active FET Probes
## For TEKPROBE™ BNC Interfaces

**P6217 P6205 1103** | **P6204 P6231**

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.

Remote Control of several 11000 Series Programmable Functions/Actions is possible using the "Identify Button" on the P6204 and P6231 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™ SMA Interfaces –** Means no additional cables or power supplies required*1.
- **Variable DC Offset (Except P6205/P6231) –** 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/P6231) –** 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 CSA800 Series, requires a 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 –3dB 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*1 | Recommended Instrument |
|---|---|---|---|---|---|---|---|---|---|---|
| P6204 | 1.5 | 10X | 1000 | 1.9 | 10 M | ±10 | ±15 | ±40 | TPB/Y/Y | 11000 *2 |
| P6205 | 1.5 | 10X | 750 | 2 | 1 M | ±10 | NA | ±40 | TPB/Y/N | TDS400/500/600 |
| P6217 | 1.5 | 10X | 4000 | 0.40 Typical | 100 k | ±4.0 | ±5.0 | ±40 | TPB/Y/N | 11000 *2<br>TDS500/600*3 |
| P6231 | 1.5 | 10X | 1500 | 1.6 | 450 | ±5.0 | ±5.0 | ±30 | TPB/Y/Y | 11000 *2 |

**1 Interface / Readout / Identify Code: (TPB=TEKPROBE™ BNC) / (TPS=TEKPROBE™ SMA) / (BNC=CONVENTIONAL BNC) / (Y=Yes) / (N=No).*
**2 11000 SERIES = 11A32/11A34/11A52/11A71/11A72/11A81*
**3 P6204 and P6217 DC Offset functions are not incorporated into the TDS400/500/600 Families*

### ORDERING INFORMATION

**P6204**
10X, 1 GHz Active FET Probe ..... TD **$1,550**
**Includes:** Retractable Hook Tip (013-0107-07); 6 in Ground Lead w/Alligator (196-3120-00); 6 in Ground Lead w/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; 2 Probe Tip to Circuit Board Adapters; Carrying Case; Instruction Manual (070-6949-00).

**P6205**
10X, 750 MHz Active FET Probe ..... TD **$495**
**Includes:** Same as P6204 Except Instruction Manual (070-8202-00).

**P6217**
4 GHz Active FET Probe..... TD **$3,495**
**Includes:** 4-post ECB mount ground socket (151-5308-00); 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).

**P6231**
10X, 1.5 GHz Bias/Offset Probe..... TD **$750**
**Includes:** Retractable probe tip (013-0208-02); Probe Tip-to-Circuit Board Connector (131-2766-03); 6 in Ground Lead w/Alligator (196-3305-00); 6 in Ground Lead w/Square Pin Receptacle (196-3113-02); 2 in Ground Lead (195-4240-00); SMT KlipChip™ (206-0364-00); Probe Adjustment Tool (003-1433-00); Probe Holder (352-0351-00); Cable Markers, 2 Each of 4 Colors; Carrying Case; Instruction Manual (070-6027-00).

**RECOMMENDED ACCESSORIES**
See page 452-465 for complete selection information.

**Probe Tip Adapter –** For P6207, P6217 and SD-14 Active Probes Instruction Sheet Plus SMA Male 50 Ω Termination provided. Order 013-0271-00.....**$495**

**1103**
TEKPROBE™ Power Supply..... TD **$600**
For P6203, P6204, P6205. P6231 and P6217. 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 Inch Precision 50 Ω BNC cable –** Order 012-0482-00 .....**$35**
**50 Ω Feedthrough Termination –** Order 011-0049-01 .....**$37**

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571). P6205 also available through TekDirect. Call 1-800-426-2200

# Active FET Probe

## For TEKPROBE™ SMA Interfaces



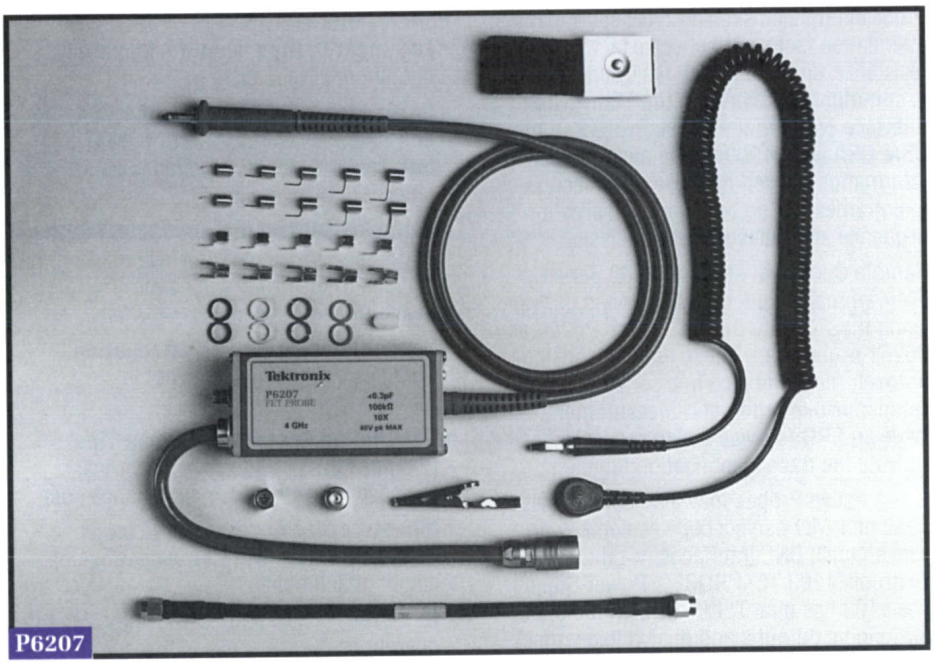
*High Performance Active Probes for the TDS 820 Series Oscilloscopes.*

**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

**P6207**

- DC to 4 GHz
- 0.4 pF Input C
- 100 kΩ Input R
- DC Offset
- Small Size



P6207

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 hand-held 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 reduced input capacitance for this active FET probe reduces the AC current flow and reduces the sensitivity to the ground loop, thereby easing ground lead length requirements.

The P6207 provides a variable DC Offset function which is controlled through the TDS800 Series mainframe to bring signals (those within the offset control range) into the dynamic range of the probe.

Probe information such as: type; serial number; attenuation factor; offset scale factor; input resistance; and termination resistance required, is communicated through the TEKPROBE™ SMA Interface between the Active Probe and the TDS 820 Series mainframe. This information is used by the oscilloscope mainframe during the scope initialization sequence and measurement analysis.

Power for the P6207 is supplied by the TDS 820 Series mainframes through the TEKPROBE™ SMA Interface, eliminating the need for extra cabling and/or external power supplies.

**BENEFIT HIGHLIGHTS**

- **Low Input C, High Input R** – Minimizes circuit under test loading.
- **Probe Power Directly from TDS820 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.

TD

Product available through an Authorized Tektronix Distributor (listed on pages 570-571).

# Active FET Probe
## For TEKPROBE™ SMA Interfaces

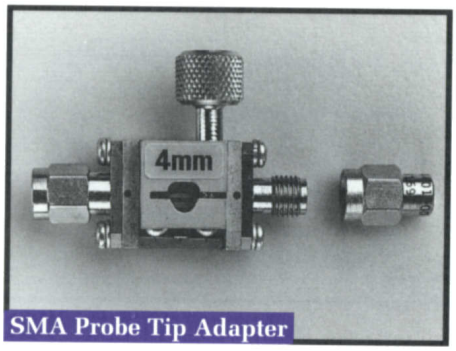




### PROBE TIP ADAPTER

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.



SMA Probe Tip Adapter

### 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

### CHARACTERISTICS

| Probe Type | Nominal Cable Length in meters | Attenuation | Bandwidth 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*[1] | Recommended Instrument |
|---|---|---|---|---|---|---|---|---|---|---|
| P6207 | 1.6 | 10X | 4000 | 0.4 Typical | 100 k | ±4.0 | ±5.0 | ±40 | TPS/Y/N | TDS820 |

*[1]Interface / Readout / Identify-AutoProbe Code: (TPB=TEKPROBE™ BNC) / (TPS=TEKPROBE™ SMA) / (BNC=Conventional BNC) / (Y=Yes) / (N=No).

### ORDERING INFORMATION

**P6207**
4 GHz Active FET Probe, SMA ..... TD **$3,495**
**Includes:** 1 RF Cable Assembly, 8.5 in. (174-1120-00); 4-post ECB mount ground socket (151-5308-00); 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).

**P6207 RECOMMENDED ACCESSORIES**
See page 452-465 for complete selection information.

**Probe Tip Adapter** – For P6207, P6217, SD-14. Active probes. Instruction sheet plus SMA Male 50 Ω termination provided (015-1022-00). Order 013-0271-00 ..... **$560**

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571).

**P6201**
**P6202A**
**1101A**

# Active FET Probes

## For 50 Ω and 1 MΩ Interfaces

*Large and Small Signal Measurements while Maintaining Low Capacitive Loading*

**P6201/ P6202A**

- True Signal Fidelity, DC up to 900 MHz
- Low Input Capacitance, <1.5 pF
- High Input Resistance10 MΩ
- Variable DC Offset, Up to ±200 V
- Selectable 50 Ω, Termination For Use with 50 Ω or 1 MΩ Inputs

**P6201**

- DC to 900 MHz
- 1.5 pF Input C*[1]
- 1 MΩ Input R*[1]
- Unity Gain
- 1X/10X/100X
- DC Offset
- AC-DC Coupling

**P6202A**

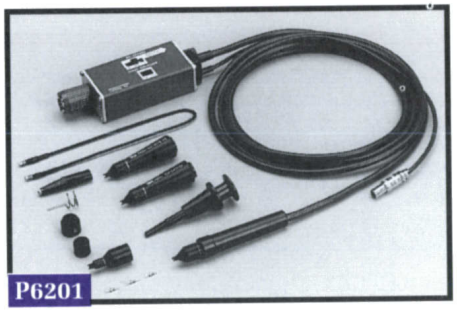
- DC to 500 MHz
- 2 pF Input C
- 10 M Ω Input R
- 10X/Optional 100X
- DC Offset
- AC-DC Coupling

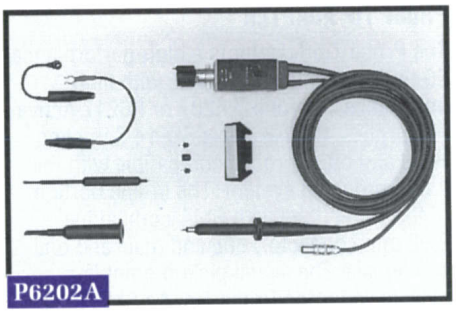
**1101A**

- Powers Up to Two Probes
- For Probe Use with Oscilloscopes that Do Not have Probe Power
- Compatible with the P6201, P602A, and P6230
- Overload Protected

*[1] See Specifications.*

TD
Product available through an Authorized Tektronix Distributor (listed on pages 570-571). P6201 and P6202A also available through TekDirect. Call 1-800-426-2200


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 controlled 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 super-imposed 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.

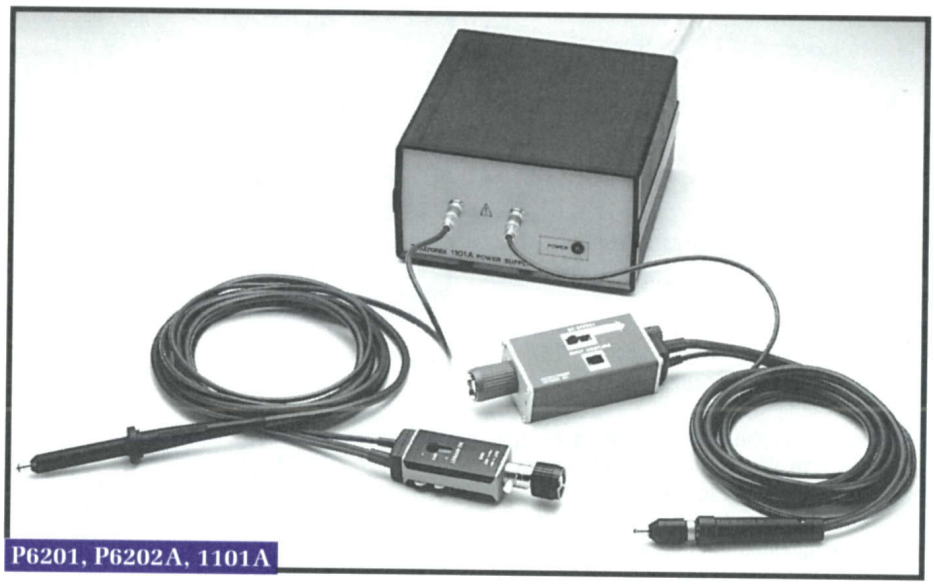
The 1101A has two power receptacles that will power up to two independent probes, such as the P6201, P6202A, and P6230.

# Active FET Probes

## For 50 Ω and 1 MΩ Interfaces

**P6201**
**P6202A**
**1101A**





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

### Characteristics

| Probe Type | Nominal Cable Length in meters | Attenuation | Bandwidth 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*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 *3 | 2 | 10X | 500 | 2 | 10 M | ±6.0 | ±55 | ±200 | BNC/Y/N | 400 / 2400 / 7000 series *2 |
| | | 100X | 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 ProbePower connector on mainframe or 1101A Power Supply.*

*3 *Optional Accessory. Order 010-0384-00.*

## ORDERING INFORMATION

**P6201**
1X, 900 MHz FET Probe ..... TD **$1,550**
**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 (166-0577-00); Ground Contact Insulator (342-0180-00); Probe Holder (352-0351-00); Carrying Case; Instruction Manual (070-1306-00).

**P6202A**
10X, 500 MHz FET Probe ..... TD **$1,025**
**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 (206-0230-00); Electrical Insulating Sleeve (166-0404-01); Carrying Case; Instruction Manual (070-3642-00).

**ADDITIONAL ACCESSORIES**
Also see pages 456-467, 492-495 for complete selection information.

**10X Attenuator –** (P6202A only) For a total of 100X attenuation.
Order 010-0384-00 ..... **$130**

**AC Coupling Capacitor –** (P6202A only)
Order 010-0360-00 ..... **$55**

**1101A Power Supply –**
For P6201, P6202A Powers 2 Probes ..... TD **$625**

**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1 –** Universal Euro, 220 V 50 Hz ..... **NC**
**Opt. A2 –** United Kingdom, 240 V 50 Hz ..... **NC**
**Opt. A3 –** Australian, 240 V 50 Hz ..... **NC**
**Opt. A4 –** North American, 240 V 60 Hz ..... **NC**
**Opt. A5 –** Switzerland, 220 V 50 Hz ..... **NC**
See General Customer Information Section for additional description.

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571). P6201 and P6202A also available through TekDirect. Call 1-800-426-2200

**P6150**
**P6156**

# 50Ω Divider (Zo)

## Low Impedance Zo TDR Passive Probes

*50 Ω divider probes for high speed edge measurements and propagation delays.*

**P6150**
- 9 GHZ

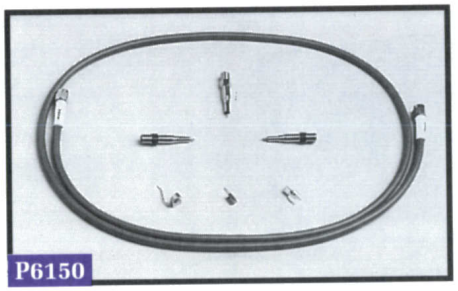
**P6156**
- 3.5 GHz

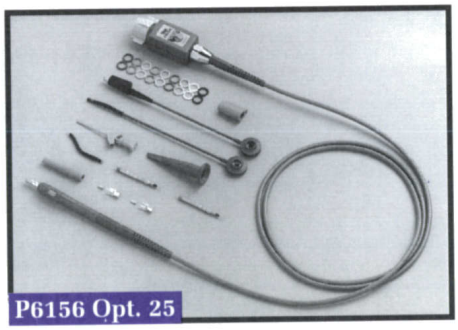
### TYPICAL APPLICATIONS

- 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

### FEATURES/BENEFITS

- Low Capacitive Loading to Extremely High Frequencies
- Interchangeable Attenuator Tip Assemblies, 1X and 10X (20X and 100X P6156 only)


P6150


P6156 Opt. 25

### 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 a SMA-to-SMA probe cable. An assortment of circuit and grounding attachments are included to optimize attachment to the device under test, while maintaining high signal integrity.

### 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 subassemblies. Although designed for the 11A52, 11A72, and 11A82, 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 1100-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. Check the instruction sheet for proper usage. 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 compact tip size is perfect for accessing small geometry circuits. 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.*

## ORDERING INFORMATION

**P6150**
10X, 9 GHz, 1.0 m, Low Impedance Probe ..... **$995**
**Includes:** One 1X attenuator head (206-0398-00); Two 10X attenuator heads (206-0399-02); 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**
Also see pages 456-467, 492-495 for complete selection information.
**SMA Male to BNC Female** – Order 015-0554-00 ..... **$47**
**SMA Female to BNC Male** – Order 015-0572-00 ..... **$28**
**SMA to Probe Tip** – Order 013-0237-00 ..... **$365**

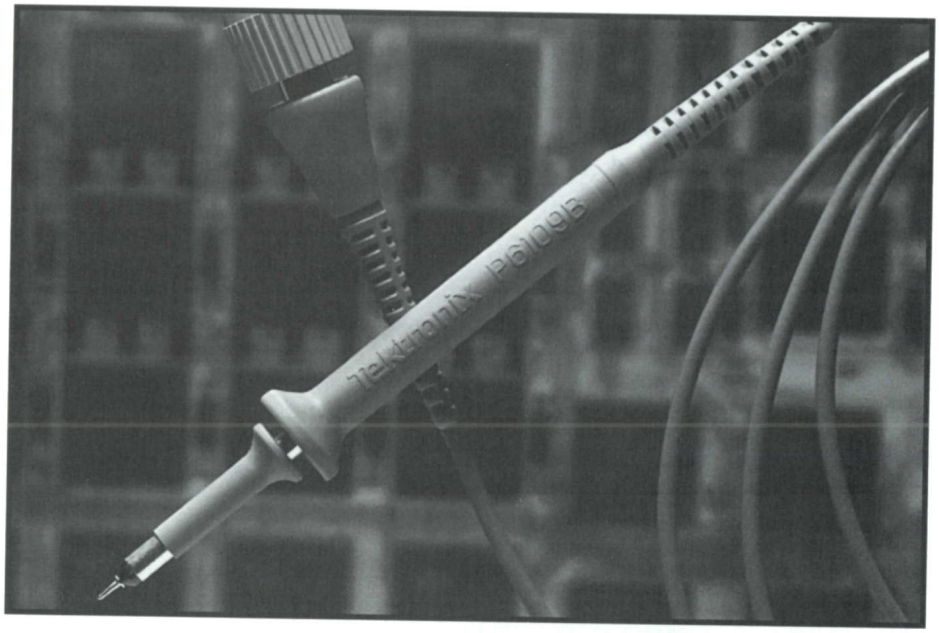
**P6156**
3.5 GHz (10X), 1.5 m Low Impedance Probe ..... TD **$265**
**Includes:** 10X Attenuator head (206-0380-00), 6 in. ground lead w/alligator clip (196-3305-00) Retractable hook tip (013-0107-07); 2 Circuit board connectors; 2 in. Ground lead (195-4240-00); 6 in. Ground lead (196-3113-02); Ground 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 ..... **+$70**

**Probe Tips** – For P6156 only
(1X) Order 206-0379-00 ..... **$70**
(10X) Order 206-0380-00 ..... **$70**
(20X) Order 206-0381-00 ..... **$70**
(100X) Order 206-0382-00 ..... **$70**

TD P6156 also available through an Authorized Tektronix Distributor (listed on pages 570-571).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Passive Voltage Probes




**PASSIVE VOLTAGE PROBES**

- Every Scope Needs at Least a Pair of General Purpose Probes.

*General purpose probes for Tektronix Oscilloscopes, Portables, the Classics, TDS, and TAS.*



## 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.

## What to Consider When Selecting Probes

**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. (See page 431).

**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.

**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 risetime?** 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.

**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 probe have to attached in close proximity.
- **Environmental conditions?** Probes are expected to be exposed to harsh conditions in the field, but often over looked are the rigors of daily use and abuse that general purpose probes are most likely to experience.

# P6101B P6111B P6103B P6119B P6109B P6129B Passive Voltage Probes

## B-Series 1 MΩ Inputs

*Guaranteed compatibility & performance with Tektronix portable oscilloscopes.*

**P6101B**
- 1X, 15 MHz

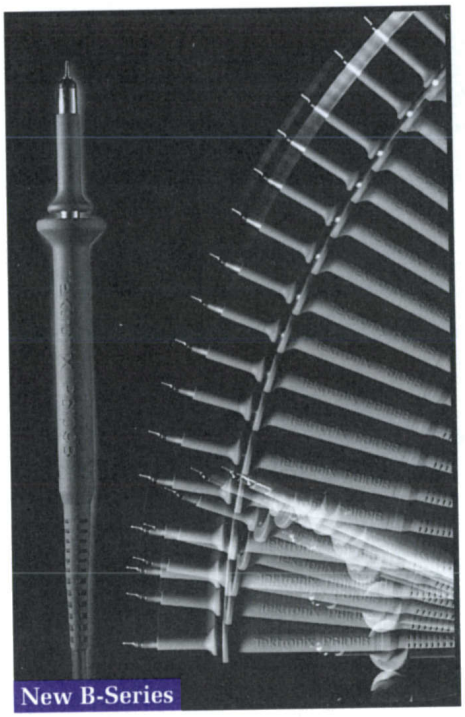
**P6103B**
- 10X, 60 MHz

**P6109B**
- 10X, 100 MHz
- Readout

**P6111B**
- 10X, 200 MHz
- Readout

**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.
- Light weight 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 are 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 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 |
| P6109B | 2211, 2221, 2224, 2230, 2232, 2235A, 2236A, 2245A, 2246A, 2247A, 2252, TAS 455, TAS 465, TAS 475, TDS 320 |
| NEW P6111B | TAS 485, TDS 350 |
| P6119B | 2201, 2205, 2212, 2214, 2225 |
| P6129B | 2211, 2221, 2224, 2230, 2232, 2235, 2236A, 2245A, 2246A, 2247A, 2225, TAS 455, TAS 465, TAS 475, TDS 320, TDS 350 |

TD

Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200

# Passive Voltage Probes

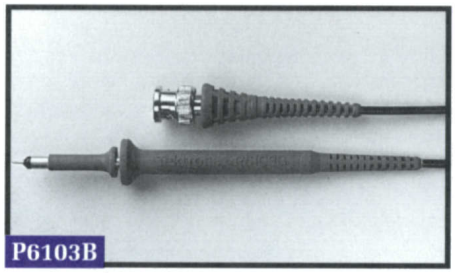
## B-Series 1 MΩ Inputs

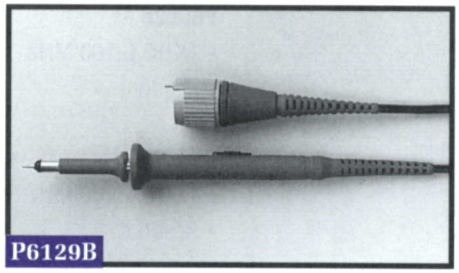
**P6101B** **P6111B**
**P6103B** **P6119B**
**P6109B** **P6129B**

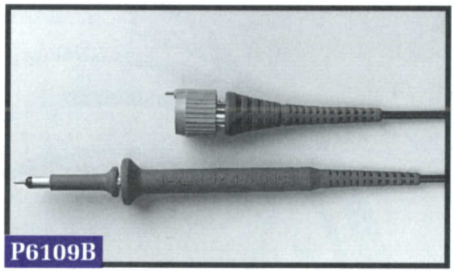


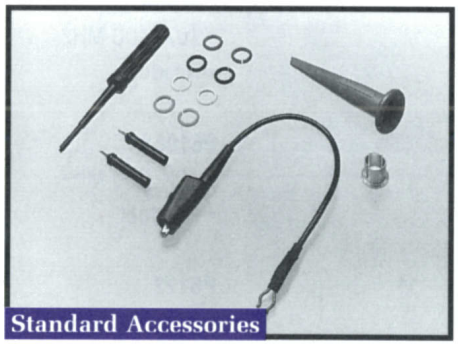
The P6101B, P6103B, P6109B, P6111B, P6119B and P6129B probes are designed to complement Tektronix' family of portable DSO and ART instruments. The core of each probe's performance is supplied by a Tektronix' HYBRID/SMT device. Tektronix' instrumentation experience provides an extra margin of quality 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 oscilloscope's 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

| Type | Attenuation | Bandwidth Megahertz (MHz) | Comp. Range pico Farads (pF) | System Input Resistance Mega Ohms (MΩ) | Typical Input C pico Farads (pF) | Maximum Voltage DC+pk AC (Volts) | Read Out |
|---|---|---|---|---|---|---|---|
| **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 | √ |
| **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 | √ |

*All probe cables are 2 meters.*

### ORDERING INFORMATION

**P6101B**
1X, 15 MHz Passive Voltage Probe..... TD **$65**
**Includes:** 4 pairs of Colored Cable Markers; Retractable Hook Tip; 6 in. Ground Lead; 2 replacement Probe Tips; BNC to Probetip Adapter; Adjustment Tool; Storage Pouch; Instruction Manual (070-7819-00).

**P6103B**
10X, 60 MHz Passive Voltage Probe..... TD **$55**
**Includes:** 4 pairs of Colored Cable Markers; Retractable Hook Tip; 6 in. Ground Lead; 2 replacement Probe Tips; BNC to Probetip Adapter; Adjustment Tool; Storage Pouch; Instruction Manual (070-7847-00).

**P6109B**
10X, 100 MHz Passive Voltage Probe with readout..... TD **$80**
**Includes:** 4 pairs of Colored Cable Markers; Retractable Hook Tip; 6 in. Ground Lead; 2 replacement Probe Tips; BNC to Probetip Adapter; an Adjustment Tool; Storage Pouch; Instruction Manual (070-7849-00).

**P6111B**
10X, 200 MHz Passive Voltage Probe ..... TD **$130**
**Includes:** 4 pairs of Colored Cable Markers; Retractable Hook Tip; 6 in. Ground Lead; 2 replacement Probe Tips; BNC to Probetip Adapter; an Adjustment Tool; Storage Pouch; Instruction Manual (070-8543-00).

**P6119B**
1X/10X, 10/100 MHz Passive Voltage Probe ..... TD **$85**
**Includes:** 4 pairs of Colored Cable Markers; Retractable Hook Tip; 6 in. Ground Lead; 2 replacement Probe Tips; BNC to Probetip Adapter; Adjustment Tool; Storage Pouch; Instruction Manual (070-8547-00).

**P6129B**
1X/10X,10/100 MHz Passive Voltage Probe with readout .. TD **$100**
**Includes:** 4 pairs of Colored Cable Markers; Retractable Hook Tip; 6 in. Ground Lead; 2 replacement Probe Tips; BNC to Probetip Adapter; Adjustment Tool; Storage Pouch; Instruction Manual (070-8000-00).

**RECOMMENDED ACCESSORIES**
See page 452-455 and 464 for complete selection information.

TD
Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200

P6062B
P6063B
P6105A
P6106A
P6122

# Passive Voltage Probes

## For the Classic Oscilloscopes

*For the classic oscilloscopes.*

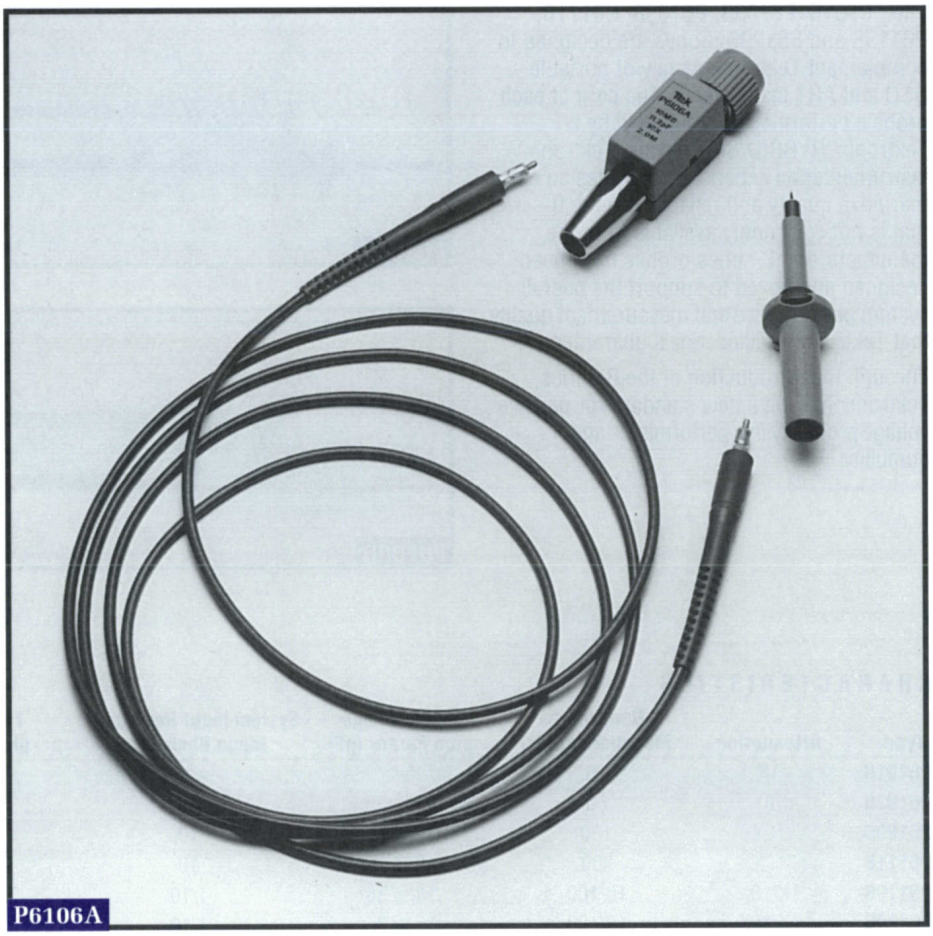
**P6062B**
- 1X/10X, 100 MHz
- Readout

**P6063B**
- 1X/10X, 200 MHz
- Readout

**P6105A**
- 10X, 100 MHz
- Readout

**P6106A**
- 10X, 250 MHz
- Readout

**P6122**
- 10X, 100 MHz
- Readout



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 10 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. Additionally 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, TM500 Series, TM5000 Series, 7A19, 7D20, 7L5 |
| P6063B | 400 Series, 7A13, 7A15A, 7A26 |
| P6105A | 434, 455, 464, 464M, 465, 466, 468, 475, 485, 7A16, SC504 |
| P6106A | 475, 485, DC503A, DC5009, DC5010 |
| P6122 | 2201, 2205, 2212, 2214, 2225 |

TD
Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200

# Passive Voltage Probes

## For the Classic Oscilloscopes

**P6062B** **P6063B** **P6105A** **P6106A** **P6122**



### PROBE SPECIFICATIONS CHART

| Type | Cable Length meters (m) | Attenuation | Bandwidth Megahertz (MHz) | Comp. Range pico Farads (pF) | System Input Resistance Mega Ohms (MΩ) | Typical Input C pico Farads (pF) | Ground Reference | Read Out |
|---|---|---|---|---|---|---|---|---|
| **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 | | |

*Maximum voltage DC + peak AC ≤500*

### ORDERING INFORMATION

**P6062B**
1X/10X, 100 MHz Switchable Probe with ground reference and read out functions..... TD **$260**
**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 read out functions..... TD **$340**
**Includes:** Same as P6062B; Instruction Sheet (062-2928-01).

**P6105A**
1X, 100 MHz Modular Probe ..... TD **$165**
**Includes:** Retractable Hook Tip; Probe Tip Ground Cover; 5 in. Ground Lead, 12 in. Ground Lead; Alligator Clip; 4 pairs of Colored Cable Markers; an adjustment tool; Instruction Sheet (070-5516-00).

**P6106A**
10X, 250 MHz Modular Probe ..... TD **$200**
**Includes:** Same as P6105A except 3 in. ground lead instead of 12 in. ground lead; Instruction Sheet (070-5517-00).

**P6122**
10X, 100 MHz Modular Probe ..... TD **$110**
**Includes:** Same as P6105A; Instruction sheet (070-5512-00).

**OPTIONAL CABLE LENGTHS** (P6105A, P6106A, P6108A)
**Opt. 01** – 1.5 or 1 meter cable.....**+$35**
**Opt. 03** – 3 meter cable.....**+$40**

**RECOMMENDED ACCESSORIES**
See page 452-455 and 464 for complete selection information.

TD
Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200

P6131
P6133
P6134C
P6136
P6137
P6138
P6139A

# Passive Voltage Probes

## TDS Series & 2400 Series Oscilloscopes

*Probes for TDS Series & 2400 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

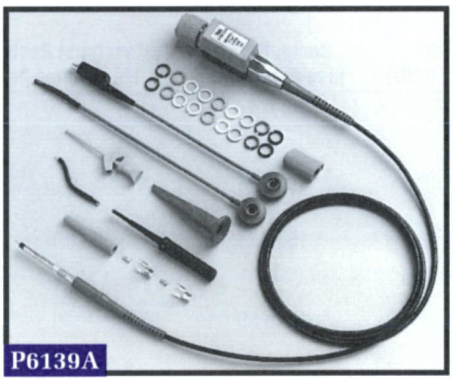
**P6136**
- 10X, 350 MHz
- 2.5 mm Subminiature Probe Tip
- 3.5 mm Compact Probe Tip Optional

**P6137**
- 10X, 400 MHz
- 3.5 mm Compact Probe Tip

**P6138**
- 10X, 350 MHz
- 3.5 mm Compact Probe Tip

**P6139A**
- 10X, 350 MHz
- 3.5 mm Compact Probe Tip

TD
Product available through an Authorized Tektronix Distributor (listed on pages 570-571). P6131, P6133, P6136, P6137, P6138, and P6139A also available through TekDirect. Call 1-800-426-2200


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 set 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 500 Series, and high performance portable oscilloscopes, the TDS 400 Series (with the introduction of the P6139A and P6138).

**PROBE/SCOPE COMPATIBILITY**

| Probe | Scope/Product |
|---|---|
| P6131 | 2400 Series |
| P6133 | 2400 Series |
| P6134C | 11000 Series |
| P6136 | 2400 Series |
| P6137 | 2400 Series |
| P6138 | TDS 400 Series |
| P6139A | TDS 500 Series, TDS 600 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 light weight 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 500/600 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 Series 350 MHz signal path requirements helping to ensure the highest accuracy ever in a general purpose oscilloscope.

# Passive Voltage Probes

## TDS Series & 2400 Series Oscilloscopes

**P6131** **P6136**
**P6133** **P6137**
**P6134C** **P6138**
**P6139A**



### Characteristics

| Type | Cable Length meters (m) | Bandwidth Megahertz (MHz) | Attenuation | Comp. Range pico Farads (pF) | Input C pico Farads (pF) | System Input Resistance Mega Ohms (MΩ) | Read Out | 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 | √ | √ |

*Maximum voltage DC + peak AC ≤ 500; Opt. 25 substitutes Compact for Subminiature Tip.*

## ORDERING INFORMATION

**P6131**
10X, 300 MHz Modular Subminiature Probe ..... TD **$190**
**Includes:** Retractable Hook Tip; Adjustment Tool; Circuit Board Connector; 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..... **+$35**
**Opt. 03 –** 3 Meter Cable..... **+$40**

**P6133**
10X, 150 MHz Modular Subminiature Probe ..... TD **$170**
**Includes:** Same as P6130 except instruction sheet (070-5795-01).
**Opt. 01 –** 1.3 Meter Cable..... **+$35**
**Opt. 03 –** 3 Meter Cable..... **+$40**
**Opt. 25 –** 1.3 Meter Cable & Compact Tip ..... **+$35**
**Includes:** Same as P6137 except Instruction Sheet (070-5795-00).

**P6134C**
10X, 400 MHz Modular Compact Probe ..... TD **$230**
**Includes:** Adjustment Tool; Retractable Hook Tip; Two Probe Tip to Circuit Board Adapters; 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 ..... TD **$195**
**Includes:** Same as P6130 except instruction sheet (070-6025-01).
**Opt. 25 –** 1.3 meter cable & compact tip ..... **+$35**
**Includes:** Same as P6137 except Instruction Sheet (070-6025-00).

**P6137**
10X, 400 MHz Modular Compact Probe ..... TD **$205**
**Includes:** Adjustment Tool; Retractable Hook Tip; Two Circuit Board Connectors; 2 in. Ground Lead; 6 in. Ground Lead with 0.025 in. Square Pin Receptacle; 6 in. Ground Lead w/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 ..... TD **$185**
**Includes:** Adjustment Tool; Retractable Hook Tip; Two Circuit Board Connectors; 2 in. Ground Lead; 6 in. Ground Lead with 0.025 in. Square Pin Receptacle; 6 in. Ground Lead w/Alligator Clip; SMT KlipChip™; Low Inductance Lead Ground Collar; 2 in. Low Inductance Ground Lead; two Probe Tip to Circuit Board Adapters; 4 pairs of Colored Cable Markers; Accessory Pouch; Instruction Sheet (063-0835-00).

**P6139A**
10X, 500 MHz Modular Compact Probe ..... TD **$275**
**Includes:** Same as P6138 except instruction sheet (063-0870-00).

**OPTIONAL ACCESSORIES**
**Conversion Kit –** Subminiature Tip to Compact Tip.
P6130. Order 040-1252-02 ..... **$70**
P6131. Order 040-1251-02 ..... **$70**
P6133. Opt. 01. Order 040-1250-02 ..... **$70**
P6136. Order 040-1253-02 ..... **$75**

**RECOMMENDED ACCESSORIES**
See page 452-455 and 460-464 for complete selection information.

TD
Product available through an Authorized Tektronix Distributor (listed on pages 570-571). P6131, P6133, P6136, P6137, P6138, and P6139A also available through TekDirect. Call 1-800-426-2200

# P6561AS
# P6562AS
# P6563AS

# Small Geometry Probes for Surface Mount Devices

*Created to fit the work style of circuit designers.*

*Scaled for surface mounted IC packages.*

*Low-mass probe body only 1.5 inches long and 100 mils wide.*

*Solutions for the most popular EIAJ and JEDEC surface mount packages.*

*Provided in sets matched to the oscilloscope's performance and channel count.*

**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

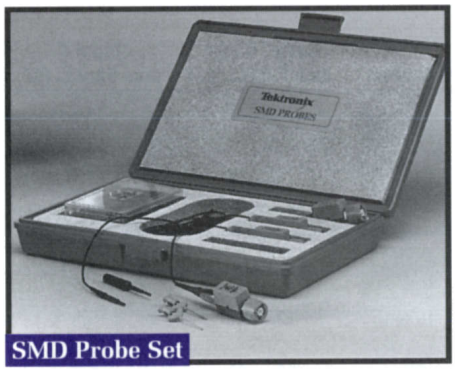
**P6561AS**
- 10X – 200 MHz
- <11 pF Loading
- Readout

**P6562AS**
- 10X – 350 MHz
- <11 pF Loading
- Readout

**P6563AS**
- 20X – 500 MHz
- <5 pF Loading
- Readout

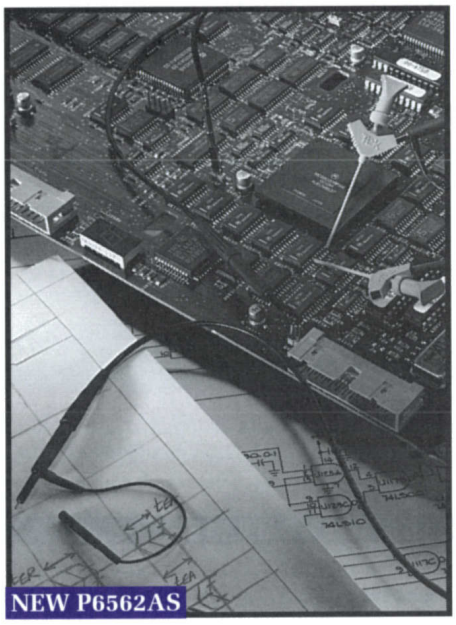
TD

P6561AS and P6562AS available through an Authorized Tektronix Distributor (listed on pages 570-571). P6561AS, P6562AS, P6563AS available through TekDirect. Call 1-800-426-2200



SMD Probe Set


SMD Standard Accessories


NEW P6562AS

The New 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.

**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 permit 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 optomized for circuit designers by providing fast transient responsive, high system bandwidth, and low capacitive circuit loading.

**EQUIVALENT PROBE LOADING IN A CMOS CIRCUIT**

Below is 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 effect of probe loading on the circuit under test can eliminate chasing false indicators, reduce test times, and lead to more accurate and repeatable measurements.

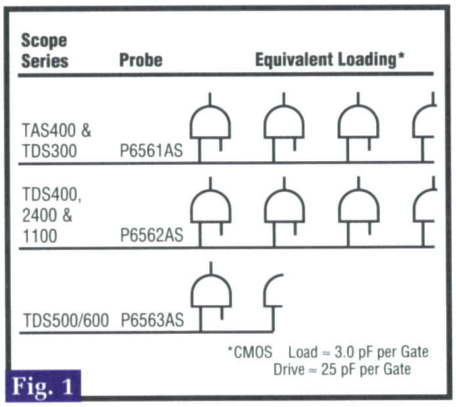


Fig. 1

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.

# Small Geometry Probes for Surface Mount Devices

**P6561AS**
**P6562AS**
**P6563AS**



## PROBE TO OSCILLOSCOPE SELECTION CHART

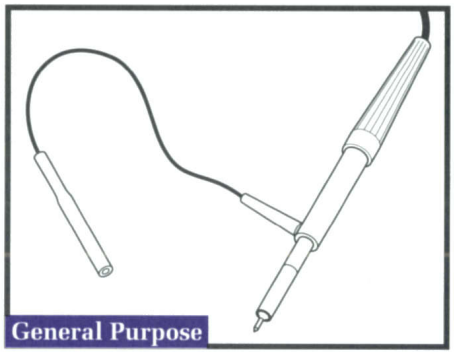
| Oscilloscope Type | P6561AS | P6562AS | P6563AS |
|---|---|---|---|
| Digitizing | TDS320 | TDS440A | TDS520A |
| | TDS350 | TDS460A | TDS540A |
| | | 2430A | TDS544A |
| | | 2430M | TDS620A |
| | | 2440 | TDS640A |
| | | 2440M | TDS644A |
| Analog | TAS465 | 2445B | |
| | TAS475 | 2465B | |
| | TAS485 | 2467B | |
| | | 2467BHD | |
| Plug-Ins | | 11A32 | |
| | | 11A34 | |
| | | 11A34V | |

## SMD PROBE CHARACTERISTICS

| Probe Set (Replacement Probe) | P6561AS (P6561A) | P6562AS (P6562A) | P6563AS (P6563A) |
|---|---|---|---|
| Probes per Set | 2 | 4 | 4 |
| Oscilloscope Series | TDS300 TAS400 | TDS400 2400 & 11000 | TDS500 TDS600 |
| Bandwidth (-3dB) | 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 |

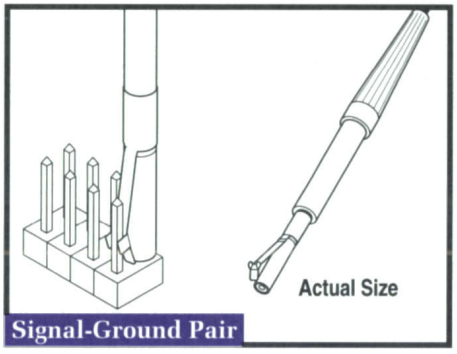
*For improved signal fidelity and probing convenience, a short ground blade is included. To use it, form a ground plane of copper clad on top of the IC to be probed. Attach short jumper wires from the device ground to the copper clad. Then, with the SureFoot probe tip installed, probe the device and display a cleaner signal on the scope.*

**Probing Tip**



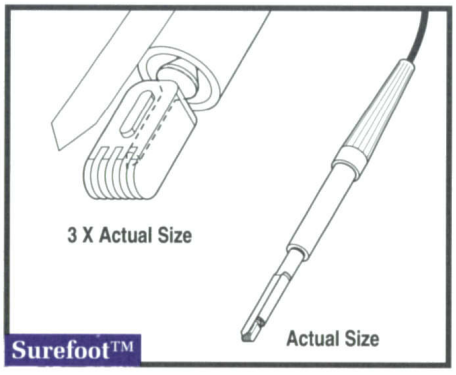
**General Purpose**

*General purpose hand-held probing.*



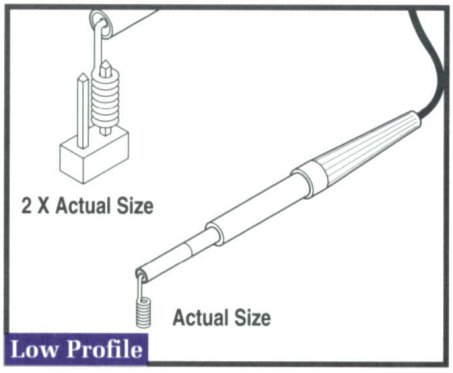

**Signal-Ground Pair**

*Signal-Ground Pair - 25 mil square-pin headers on 100 mil centers.*



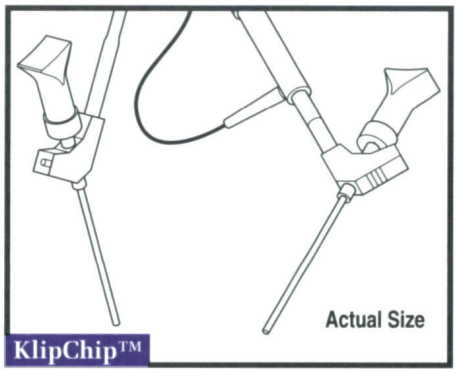

**Surefoot™**

*PQFP and Quad Packages - JEDEC 25 mil center lead spacing EIAJ 0.5 and 0.65 mm center lead spacing.*




**Low Profile**

*Circuit Boards in System Enclosures - 25 mil square-pin headers on 100 mil centers.*




**KlipChip™**

*SOIC/SOP Small Outline Packages - 50 mil centers lead spacing.*

## ORDERING INFORMATION

**P6561AS**
200 MHz, 10X, SMD Probe..... TD **$350**

**Includes:** 2 ea. P6561A Probe, Probe Tips, 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..... TD **$740**

**Includes:** 4 ea. P6562A Probe, Probe Tips, 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..... TD **$790**

**Includes:** 4 ea. P6563A Probes, Probe Tips, SureFoot Tip Guides, 4-in. Ground Leads, Signal-Ground Adapters, Blade-Ground Adapters, and 1 ea. Adjustment Tool and Instruction Sheet.

**RECOMMENDED ACCESSORIES**
See page 452-455 and 458 for complete selection and ordering information.

TD
P6561AS and P6562AS also available through an Authorized Tektronix Distributor (listed on pages 570-571). P6561AS, P6562AS, P6563AS also available through TekDirect. Call 1-800-426-2200

**FlexLead™ SERIES**

**PJ (JEDEC) PE (EIAJ)**

# FlexLead™ Adapters

## Fine Pitch Surface Mounted Devices

*Low Cost*

*Adapts to the most popular EIAJ and JEDEC QFP Gull-wing surface mount packages.*

*Universal 25 mil square pin interface compatible with any oscilloscope or logic analyzer probe/podlet.*

**FlexLead™ FAMILY**

**25 mil JEDEC**
**0.65 mm EIAJ**
**0.5 mm EIAJ**

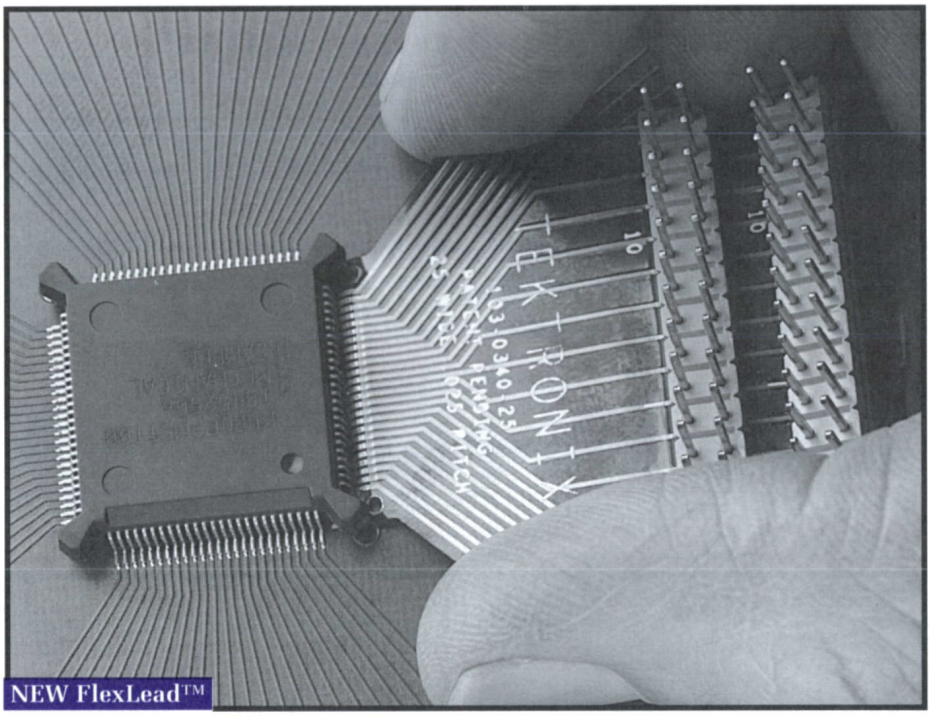
- Convenient Probing of 25 mil Pitch and Smaller Packages
- Minimum Circuit Loading
- Adapts to Many of the Most Common JEDEC and EIAJ Packages
- Compatible with any Oscilloscope or Logic Analyzer Probe or Podlet

**INITIAL ADAPTERS AVAILABLE**

- 25 mil JEDEC
  68 lead (17 x 17)
  84 lead (21 x 21)
  100 lead (25 x 25)
  132 lead (33 x 33)
  164 lead (41 x 41)
  196 lead (49 x 49)

- 0.65 mm EIAJ
  112 lead (28 x 28)
  144 lead (36 x 36)

- 0.5 mm EIAJ
  80 lead (20 x 20)
  100 lead (25 x 25)
  144 lead (36 x 36)
  208 lead (52 x 52)
  304 lead (76 x 76)



NEW FlexLead™

### Surface Mount Device Probing

As the pitch, 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 new 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.

| Nomenclature (Package of 8) | Adapter Leads | Package Type |
|---|---|---|
| PJ25X17 | 17 | JEDEC, 0.025 in. Pitch, 68 lead (17 x 17) |
| PJ25X21 | 21 | JEDEC, 0.025 in. Pitch, 84 lead (21 x 21) |
| PJ25X25 | 25 | JEDEC, 0.025 in. Pitch, 100 lead (25 x 25) |
| PJ25X33 | 33 | JEDEC, 0.025 in. Pitch, 132 lead (33 x 33) |
| PJ25X41 | 41 | JEDEC, 0.025 in. Pitch, 164 lead (41 x 41) |
| PJ25X49 | 49 | JEDEC, 0.025 in. Pitch, 196 lead (49 x 49) |
| PE50X20 | 20 | EIAJ, 0.5 mm Pitch, 80 lead (20 x 20) |
| PE50X25 | 25 | EIAJ, 0.5 mm Pitch, 100 lead (25 x 25) |
| PE50X36 | 36 | EIAJ, 0.5 mm Pitch, 144 lead (36 x 36) |
| PE50X52 | 52 | EIAJ, 0.5 mm Pitch, 208 lead (52 x 52) |
| PE50X76 | 76 | EIAJ, 0.5 mm Pitch, 304 lead (76 x 76) |
| PE65X28 | 28 | EIAJ, 0.65 mm Pitch, 112 lead (28 x 28) |
| PE65X36 | 36 | EIAJ, 0.65 mm Pitch, 144 lead (36 x 36) |

TD

Product available within 24 hours through TekDirect Call 1-800-426-2200.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

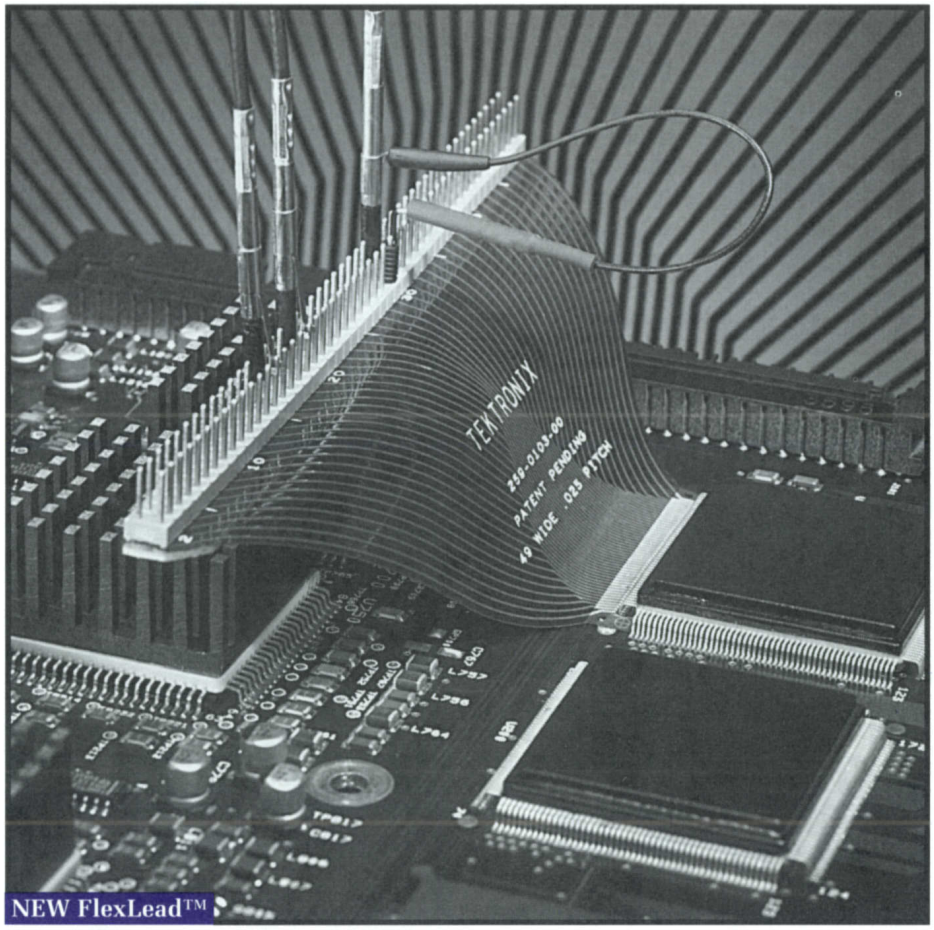
# FlexLead™ Adapters

## Fine Pitch Surface Mounted Devices



**FlexLead™ ADAPTERS**
The FlexLead™ Adapter has a standard 0.1 in. interface on one end to which any oscilloscope probe or logic analyzer podlet can be connected, both signal and ground leads. The opposite end of the adapter has a row of solder pads that are soldered to the package leads.

**INITIAL AVAILABLE FlexLead™ ADAPTERS**
Initially there are thirteen 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 mΩ (typical).

**Inductance –** Less than 100 nH (typical).

**Capacitance –** Less than 2 pF (typical).

**Maximum Voltage –** 42 Volts.

**Maximum Current –** 750 mA.

## ORDERING INFORMATION

**FlexLead™ ADAPTERS**
Fine Pitch Surface Mounted Devices
**Includes:** 8 each Adapters, Instruction Sheet

**SELECT FROM THE FOLLOWING:**

**PJ SERIES (0.025 PITCH)**

PJ25X17 - JEDEC, 0.025 in. Pitch, 68 Lead (17 x 17) ..... TD **$135**
PJ25X21 - JEDEC, 0.025 in. Pitch, 84 Lead (21 x 21) ..... TD **$150**
PJ25X25 - JEDEC, 0.025 in. Pitch, 100 Lead (25 x 25) ... TD **$160**
PJ25X33 - JEDEC, 0.025 in. Pitch, 132 Lead (33 x 33) ... TD **$175**
PJ25X41 - JEDEC, 0.025 in. Pitch, 164 Lead (41 x 41) ... TD **$190**
PJ25X49 - JEDEC, 0.025 in. Pitch, 196 Lead (49 x 49) ... TD **$210**

**PE SERIES (0.5 mm PITCH)**

PE50X20 - EIAJ, 0.5 mm Pitch, 80 Lead (20 x 20)..... TD **$160**
PE50X25 - EIAJ, 0.5 mm Pitch, 100 Lead (25 x 25)..... TD **$175**
PE50X36 - EIAJ, 0.5 mm Pitch, 144 Lead (36 x 36)..... TD **$190**
PE50X52 - EIAJ, 0.5 mm Pitch, 208 Lead (52 x 52)..... TD **$250**
PE50X76 - EIAJ, 0.5 mm Pitch, 304 Lead (76 x 76)..... TD **$325**

**PE SERIES (0.65 mm PITCH)**

PE65X28 - EIAJ, 0.65 mm Pitch, 112 Lead (28 x 28)..... TD **$160**
PE65X36 - EIAJ, 0.65 mm Pitch, 144 Lead (36 x 36)..... TD **$180**

**Note:** For further information and package updates, contact you local sales office.

TD
Product available within 24 hours through TekDirect
Call 1-800-426-2200.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# SMG50 SMCK1 SMQK1 SureFoot™ PQFP100 PQFP132 Surface Mount Device Interconnects

*Now safely attach to a variety of fine pitch surface mount devices.*

**APPLICATIONS**

- Research and Design
- Manufacturing Test of SMD Circuitry
- Servicing of SMD Circuitry
- Prototype Debug and Design

**SureFoot™**

- Hand Probe Fine Pitch SMD Packages
  - 25 mil JEDEC
  - 0.65 mm EIAJ
  - 0.5 mm EIAJ
- For P656XAS, P6205, and P6204

**SMG50/ SMT KlipChip™ KITS**

- Access to 0.050 in. Centers PLCC, SOIC, and other Packages

**PQFP100/132 PQFP ADAPTER CLIPS**

- 386SX Attachment with PQFP100
- 68020/68030 Attachment with PQFP132
- 350 MHz Bandwidth
- Small Low-Profile Design Fits in Tight Spaces

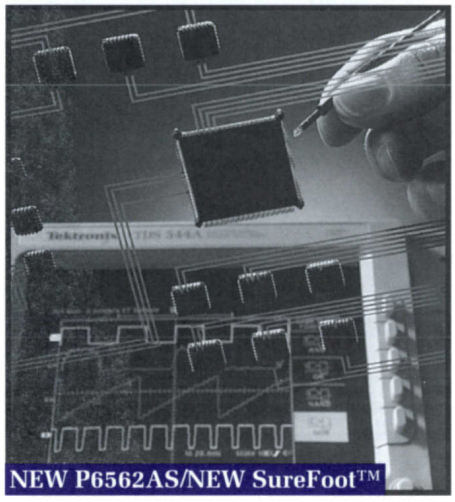
**SMCK1/SMQK1 SOIC/PLCC ADAPTER KITS**

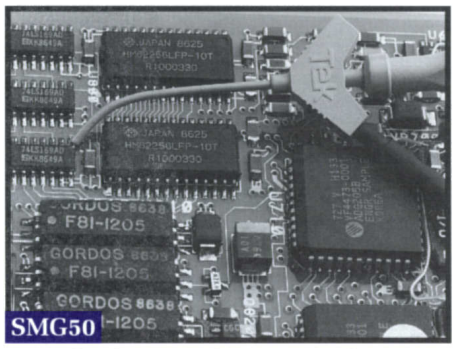
- Assortment of SOIC or PLCC Clips
- Leads and SMT KlipChips Included
- Signal Insertion and Temporary Lead Jumpers without Soldering

TD

SMG50, SMCK1, SMQK1, PQFP100, PQFP132 also available through an Authorized Tektronix Distributor (listed on pages 570-571). SMG50, SMCK1, SMQK1, SureFoot™, PQFP100, PQFP132 available through TekDirect. Call 1-800-426-2200


NEW SureFoot™ SF Series


NEW P6562AS/NEW SureFoot™


SMG50

*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' new 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.

**STYLES TO MATCH TEKTRONIX PROBES**

Tektronix probes have replaceable probe tips. The low-loading, high-speed FET probes have an 0-80 threaded probe tip. The basic contact of the new SMD probe family is a 25 mil socket that accepts square or round pins. SureFoot probe tips are available in styles to match each of these high-performance probe families.

**SureFoot™ SELECTION CHART**

| Package Lead Spacing | Package Standard | Color Code | SureFoot™ Compatibility P6204/ P6205 | SureFoot™ Compatibility SMD Probes (P6561AS/2AS/3AS) |
|---|---|---|---|---|
| 50 mil | JEDEC | Yellow | SF201 | SF501 |
| 25 mil | JEDEC | Blue | SF202 | SF502 |
| 0.65 mm | EIAJ | Blue | SF202 | SF502 |
| 0.5 mm | EIAJ | Red | SF203 | SF503 |

# Surface Mount Device Interconnects

**SMG50**
**SMCK1**
**SMQK1**

**SureFoot™**
**PQFP100**
**PQFP132**

## SMT KlipChip™

The SMT KlipChip™ is an interface device for attachment of logic and analog probes to today's SMD's, DIP's, 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.

## PLCC Quad Clips

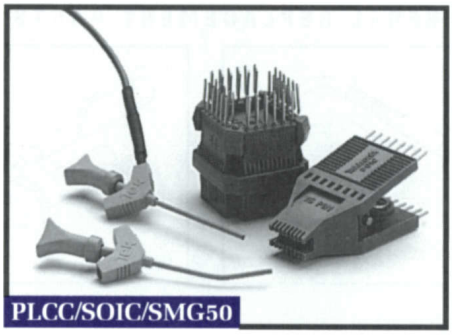
For easy connection to Plastic Leaded Chip Carriers (PLCC) with "J" leads on .050 inch centers. Gold plated contacts maintain low contact resistance. .025 inch square pins provide contact for probes, flying leads, etc.

## SOIC Clips

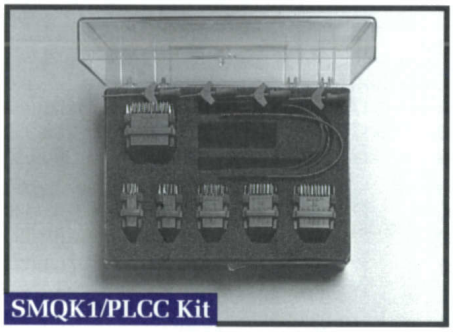
Simplify connection to Small Outline Integrated Circuits (SOIC). The spring design provides a strong and accurate fit. Compatible with gull-wing or "J" leads on .050 inch centers. Gold plated contacts for low contact resistances; .025 inch upper square pins provides access for probe or flying lead connection.

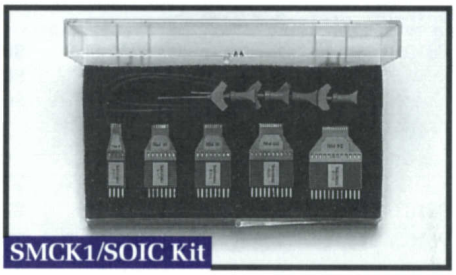
## PQFP100/132

The PQFP100 and PQFP132 provide easy probe access to soldered-in 100 or 132-Pin Plastic Quad Flat Pack (PQFP) Jedec standard devices. The molded bottom of the clip fits snugly to the PQFP device allowing single or multiple probe interconnects without risk of detachment.


PLCC/SOIC/SMG50


PQFP100/PQFP132


SMQK1/PLCC Kit


SMCK1/SOIC Kit

The top of the clip is a pin grid array socket which provides simple attachment for various probing options such as:

- P656XAS as SMD Probe Family; also P6139A or P613X Family
- Conventional Probes using included Signal/Ground Pins
- Matching PGA Adapter
- Available Male PGA Adapter for Square Pin Connections

The compact, low profile design makes it possible to probe devices on densely populated ECB's or where access space is limited.

Loading and crosstalk are minimized and bandwidth is greater than 350 MHz for high measurement precision.

## ORDERING INFORMATION

**SMG50**
SMT KlipChip™ ..... TD **$99**
**Includes:** 20 SMT KlipChip™.

**SMCK1**
SOIC Engineering Kit ..... TD **$99**
**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 ..... TD **$270**
**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.

**PQFP100**
Converter Clip ..... TD **$260**
**Includes:** Convenient Storage Case; 5 each Signal/Ground Adapter Pins (131-5336-01); Instruction Sheet (070-8171-00).

**PQFP132**
Converter Clip ..... TD **$300**
**Includes:** Convenient Storage Case; 5 each Signal/Ground Adapter Pins (131-5336-01); Instruction Sheet (070-8171-00).

**PQFP100/PQFP132 RECOMMENDED ACCESSORIES**
**Adapter Shim for PQFP132 Pin Packages –**
Order 361-1599-00 ..... **$1.65**
**Signal/Ground Adapter Pins** – Pkg of 25.
Order 131-5336-01 ..... **$9.25**

**PQFP100 Pin Male PGA Adapter to 0.030 in. Round Pin –**
Order 103-0278-00 ..... **$21**
**PQFP132 Pin Male PGA Adapter to 0.030 in. Round Pin –**
Order 103-0324-00 ..... **$40**

**SF201** (50 mil)
SureFoot™ For P6203, P6204, P6205 FET Probes ..... **$36**
**Includes:** 12 Clear 50 mil (0-80 thread) SureFoot™ Tip Guides.

**SF202** (25 mil/0.65 mm pitch)
SureFoot™ For P6203, P6204, P6205 FET Probes ..... **$36**
**Includes:** 12 Blue 25 mil/0.65 mm (0-80 thread) SureFoot™ Tip Guides.

**SF203** (0.5 mm pitch)
SureFoot™ For P6203, P6204, P6205 FET Probes ..... **$36**
**Includes:** 12 Orange 0.5 mm (0-80 thread) SureFoot™ Tip Guides.

**SF501** (50 mil)
SureFoot™ For P6561AS, P6562AS, P6563AS SMD Probes... TD **$36**
**Includes:** 12 Yellow 50 mil (25 mil pin) SureFoot™ Tip Guides.

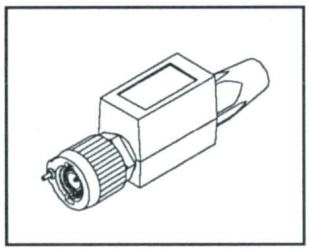
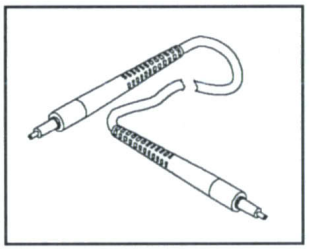
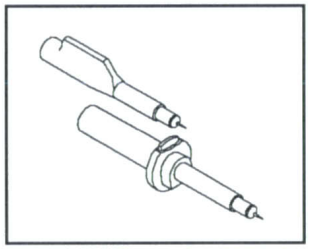
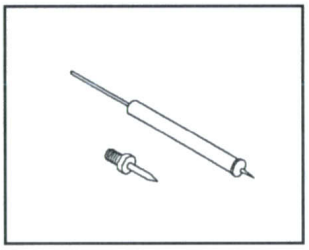
**SF502** (25 mil/0.65 mm pitch)
SureFoot™ For P6561AS, P6562AS, P6563AS SMD Probes... TD **$36**
**Includes:** 12 Blue 25 mil/0.65 mm (25 mil pin) SureFoot™ Tip Guides.

**SF503** (0.5 mm pitch)
SureFoot™ For P6561AS, P6562AS, P6563AS SMD Probes... TD **$36**
**Includes:** 12 Red 0.5 mm (25 mil pin) SureFoot™ Tip Guides.

TD
SMG50, SMCK1, SMQK1, PQFP100, PQFP132 also available through an Authorized Tektronix Distributor (listed on pages 570-571). SMG50, SMCK1, SMQK1, SureFoot™, PQFP100, PQFP132 available through TekDirect. Call 1-800-426-2200

# Replacement Parts

## PASSIVE AND ACTIVE PROBE GENERAL REPLACEMENT PARTS

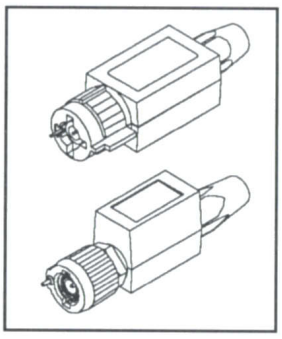
| Probe | Length(m) | Connector/ Comp Box | Price | Probe Cable | Price | Probe Head | Price | Probe Tip/ Hybrid Tip | Price |
|---|---|---|---|---|---|---|---|---|---|
| P6101B | 2 | N/A | | N/A | | N/A | | 131-4997-01*3 | **$5.00** |
| P6102A | 2 | 206-0352-00 | **$55.00** | 174-0976-00 | **$25.00** | 206-0302-00 | **$30.00** | 206-0338-01*3 | **$47.00** |
| P6103B | 2 | N/A | | N/A | | N/A | | 131-4997-01*3 | **$5.00** |
| P6105A | 1 | 206-0331-00 | **$80.00** | 174-0975-00 | **$21.00** | 206-0328-00 | **$28.00** | 206-0336-01*3 | **$47.00** |
| | 2 | 206-0334-00 | **$85.00** | 174-0976-00 | **$25.00** | 206-0301-00 | **$28.00** | 206-0337-01*3 | **$41.00** |
| | 3 | 206-0320-02 | **$66.00** | 174-0977-00 | **$27.00** | 206-0302-00 | **$30.00** | 206-0338-01*3 | **$47.00** |
| P6106A | 1 | 206-0313-01 | **$100** | 174-0975-00 | **$21.00** | 206-0328-00 | **$28.00** | 206-0336-01*3 | **$47.00** |
| | 2 | 206-0319-01 | **$100** | 174-0976-00 | **$25.00** | 206-0301-00 | **$28.00** | 206-0337-01*3 | **$41.00** |
| | 3 | 206-0320-01 | **$95.00** | 174-0977-00 | **$27.00** | 206-0302-00 | **$30.00** | 206-0338-01*3 | **$47.00** |
| P6107A | 2 | 206-0247-02 | **$77.00** | 174-0976-00 | **$25.00** | 206-0217-02 | **$30.00** | 206-0339-03*3 | **$27.00** |
| P6108A | 1 | 206-0332-01 | **$50.00** | 174-0975-00 | **$21.00** | 206-0303-00 | **$22.00** | 206-0336-01*3 | **$47.00** |
| | 2 | 206-0318-02 | **$60.00** | 174-0976-00 | **$25.00** | 206-0304-00 | **$29.00** | 206-0337-01*3 | **$41.00** |
| | 3 | 206-0333-00 | **$50.00** | 174-0977-00 | **$27.00** | 206-0305-00 | **$24.00** | 206-0338-01*3 | **$47.00** |
| P6109B | 2 | N/A | | N/A | | N/A | | 131-4997-01*3 | **$5.00** |
| P6111B | 2 | N/A | | N/A | | N/A | | 131-4997-01*3 | **$5.00** |
| P6119B | 2 | N/A | | N/A | | N/A | | 131-4997-01*3 | **$5.00** |
| P6121 | 1.5 | 206-0311-00 | **$80.00** | 174-0967-00 | **$21.00** | 206-0323-00 | **$31.00** | 206-0341-01*3 | **$55.00** |
| P6122 | 1.5 | 206-0312-00 | **$65.00** | 174-0967-00 | **$21.00** | 206-0324-00 | **$27.00** | 206-0342-01*3 | **$47.00** |
| | 2 | 206-0318-00 | **$55.00** | 174-0968-00 | **$24.00** | 206-0325-00 | **$25.00** | 206-0343-01*3 | **$34.00** |
| | 3 | 206-0318-01 | **$55.00** | 174-0969-00 | **$25.00** | 206-0326-00 | **$24.00** | 206-0344-01*3 | **$34.00** |
| P6129B | 2 | N/A | | N/A | | N/A | | 131-4997-01*3 | **$5.00** |
| P6148A | 2 | 206-0255-02 | **$90.00** | 174-0976-00 | **$25.00** | 206-0217-02 | **$30.00** | 206-0339-03*3 | **$27.00** |
| P6149A | 2 | 206-0255-02 | **$90.00** | 174-0976-00 | **$25.00** | 206-0217-02 | **$30.00** | 206-0339-03*3 | **$27.00** |
| P6202A | 2 | N/A | | N/A | | N/A | | 206-0230-03*2 | **$35.00** |
| P6203 | 1.5 | N/A | | N/A | | 206-0391-00 | **$175** | 131-4280-00*4 | **$2.00** |
| P6204 | 1.5 | N/A | | N/A | | 206-0390-00 | **$665** | 131-4280-00*4 | **$2.00** |
| P6205 | 1.5 | N/A | | N/A | | N/A | | 131-4280-00*4 | **$2.00** |
| P6206 | 1.7 | N/A | | N/A | | N/A | | 131-4280-00*4 | **$2.00** |
| P6420 | 1 | N/A | | 174-0975-00 | **$21.00** | 206-0236-01 | **$55.00** | 206-0230-03*2 | **$35.00** |
| | 2 | N/A | | 174-0976-00 | **$25.00** | 206-0236-01 | **$55.00** | 206-0230-03*2 | **$35.00** |
| | 3 | N/A | | 174-0977-00 | **$27.00** | 206-0236-01 | **$55.00** | 206-0230-03*2 | **$35.00** |
| P6561A | 1.3 | N/A | | 206-0417-10 | *7 | 206-0417-10 | *7 | 131-5638-10 | **$20.00** |
| P6562A | 1.3 | N/A | | 206-0417-10 | *7 | 206-0417-10 | *7 | 131-5638-10 | **$20.00** |
| P6563A | 1.3 | N/A | | 206-0459-00 | *7 | 206-0459-00 | *7 | 131-5638-10 | **$20.00** |

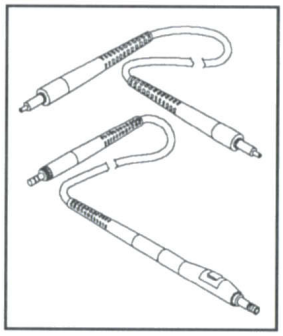
**1 Not pictured above*
**2 Probe tips in package of ten*
**3 Probe hybrid tip assemblies in packages of five*
**4 Probe hybrid tip assembly in quantities of one*
**5 Consists of a Matched pair*
**6 Scope Input Capacitance Range*
**7 Contact your local Tektronix Account Manager for Information*

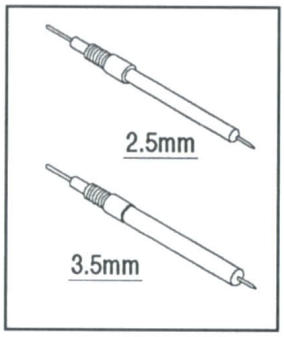
# Replacement Parts



## PASSIVE AND ACTIVE PROBE GENERAL REPLACEMENT PARTS








| Probe | Length(m) | Connector/ Comp Box | Price | Probe Cable | Price | Probe Tip/ Hybrid Tip | Probe Tip/ Hybrid Tip Color | Price |
|---|---|---|---|---|---|---|---|---|
| P6053C | 6 | 206-0421-00 | **$115.00** | 174-2132-01 | **$75.00** | 206-0422-01 | tip - gray / tail - red | **$14.00** |
| Opt. 01 | 3.5 | 206-0421-01 | **$110.00** | 174-2133-01 | **$42.00** | 206-0392-00 | tip - gray / tail - blue | **$18.25** |
| Opt. 03 | 9 | 206-0421-02 | *7 | 174-2134-01 | **$75.00** | 206-0422-02 | tip - blue / tail - red | **$18.25** |
| P6130 | 1.5 | 206-0313-00 | **$90.00** | 174-0970-00 | **$27.00** | 206-0270-10*4 | tip - brown / tail - yellow | **$20.00** |
| | 2 | 206-0319-00 | **$90.00** | 174-0971-00 | **$32.00** | 206-0270-12*4 | tip - brown / tail - blue | **$19.00** |
| | 3 | 206-0320-00 | **$90.00** | 174-0972-00 | **$37.00** | 206-0270-11*4 | tip - brown / tail - red | **$19.00** |
| P6131 | 1.3 | 206-0314-00 | **$100.00** | 174-0973-00 | **$27.00** | 206-0265-10*4 | tip - clear / tail - blue | **$19.00** |
| | 2 | 206-0321-00 | **$100.00** | 174-0971-00 | **$32.00** | 206-0265-12*4 | tip - clear / tail - yellow | **$19.00** |
| | 3 | 206-0322-00 | **$105.00** | 174-0972-00 | **$37.00** | 206-0265-11*4 | tip - clear / tail - red | **$19.00** |
| P6133 | 2 | 206-0350-00 | **$75.00** | 174-0971-00 | **$32.00** | 206-0265-12*4 | tip - clear / tail - yellow | **$19.00** |
| Opt. 01 | 1.3 | 206-0349-00 | **$80.00** | 174-0973-00 | **$27.00** | 206-0265-13*4 | tip - clear / tail - clear | **$19.00** |
| Opt. 03 | 3 | 206-0351-00 | **$75.00** | 174-0972-00 | **$37.00** | 206-0265-11*4 | tip - clear / tail - red | **$19.00** |
| Opt. 25 | 1.3 | 206-0349-00 | **$80.00** | 174-0973-00 | **$27.00** | 206-0393-00*4 | tip - clear / tail - natural | **$18.50** |
| P6134C | 1.5 | 206-0420-00 | **$90.00** | 174-1081-04 | **$55.00** | 206-0418-00*4 | tip - black / tail - red | **$18.00** |
| P6135A (13-17pF)*6 | 1.5 | N/A | | N/A | | 206-0416-00 | tip - red / tail - natural | **$25.00** |
| (18-22pF)*6 | | N/A | | N/A | | 206-0419-00*5 | tip - black / tail - yellow | **$25.00** |
| (45-49pF)*6 | | N/A | | N/A | | 206-0415-00*5 | tip - blue / tail - natural | **$25.00** |
| P6136 | 1.3 | 206-0359-00 | **$105.00** | 174-0978-00 | **$30.00** | 206-0265-10*4 | tip - clear / tail - blue | **$19.00** |
| Opt. 25 | 1.3 | 206-0359-00 | **$105.00** | 174-0978-00 | **$30.00** | 206-0392-00*4 | tip - gray / tail - blue | **$18.25** |
| P6137 | 1.5 | 206-0389-01 | **$110.00** | 174-1081-04 | **$55.00** | 206-0378-00*4 | tip - black / tail - natural | **$18.00** |
| P6138 | 1.3 | 206-0439-00 | **$120.00** | 174-0978-00 | **$30.00** | 206-0392-00*4 | tip - gray / tail - blue | **$18.25** |
| P6139A | 1.3 | 206-0440-00 | **$70.00** | 174-0978-00 | **$30.00** | 206-0441-00*4 | tip - blue / tail - yellow | **$17.50** |
| P6150*1 (10X) | 1 | N/A | | 174-1341-00 | **$280.00** | 206-0399-03*4 | N/A | **$460.00** |
| (1X) | | N/A | | | | 206-0398-00*4 | N/A | **$215.00** |
| P6156 (10X) | 1.5 | N/A | | 174-1127-00 | *7 | 206-0380-00*4 | tip - blue / tail - black | **$70.00** |
| Opt. 25 adds 100X tip | | N/A | | N/A | | 206-0382-00*4 | tip - red / tail - black | **$70.00** |
| 20X tip | | N/A | | N/A | | 206-0381-00*4 | tip - gray / tail - black | **$70.00** |
| 1X tip | | N/A | | N/A | | 206-0379-00*4 | tip - black / tail - black | **$70.00** |
| P6230 | 1.6 | N/A | | N/A | | 206-0279-10*4 | tip - yellow / tail - blue | **$18.25** |
| P6231 | 1.5 | N/A | | N/A | | 206-0279-10*4 | tip - yellow / tail - blue | **$18.25** |
| P400 | | | | | | 206-0426-00 | | **$40.00** |
| P850 | | | | | | 206-0427-00 | | **$55.00** |

**1 Not pictured above*
**2 Probe tips in package of ten*
**3 Probe hybrid tip assemblies in packages of five*
**4 Probe hybrid tip assembly in quantities of one*
**5 Consists of a Matched pair*
**6 Scope Input Capacitance Range*
**7 Contact your local Tektronix Account Manager for information*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Probe Accessories

## SMD (P656XAS) and P6240

### ORDERING INFORMATION – SELECTION GUIDE

**P6561AS/P6562AS/P6563AS**

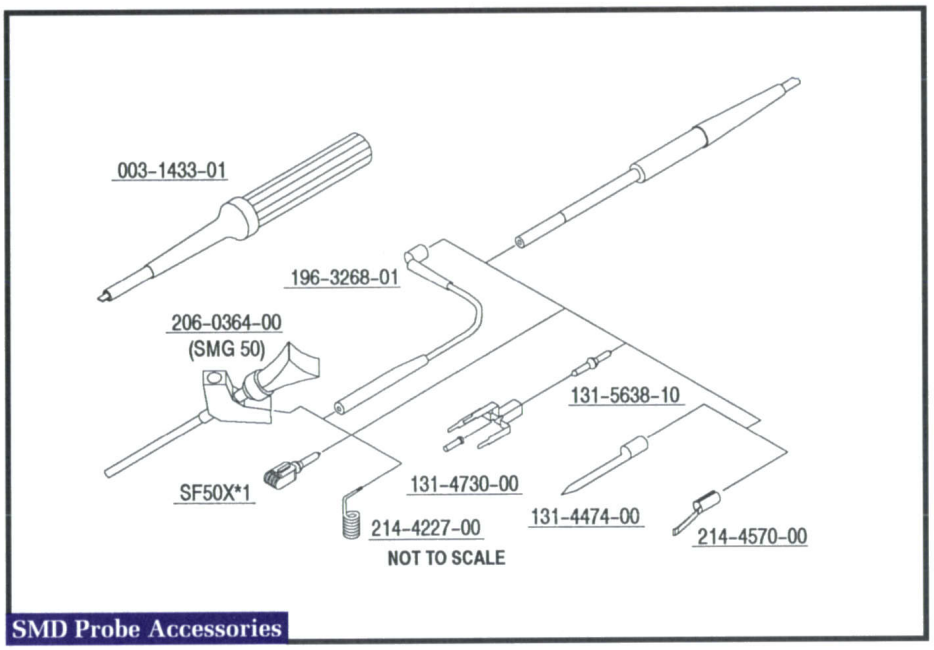
| Part Number | Description | Price |
|---|---|---|
| 003-1433-00 | Adjustment Tool for P610x/A/B, P612x, P613x, and P656x/AS Families | **$1.05** |
| 003-1433-01 | Adjustment Tool pkg. of 5 for P610x/A/B, P612x, P613x, and P656x/AS Families | **$1.05** |
| 131-4474-00 | Low Inductance Ground Lead | **$1.45** |
| 131-4730-00 | SMT Probe Tip Circuit Board Test Points, pkg. of 5 | **$15.75** |
| 131-5638-10 | Receptacle Tip for P656(X)AS (pkg. of 10) | **$20.00** |
| 196-3268-01 | Ground Lead with 0.025 in. Receptacle, pkg. of 5. | **$42.00** |
| 206-0364-00 | SMT KlipChip™, 1 each | **$5.25** |
| 214-4227-00 | Right Angle Square Pin Adapter | **$5.75** |
| 214-4570-00 | 100 mil Square Pin Ground Adapter | *2 |
| FlexLead™ | (See FlexLead section below) | |
| SMG50 | SMT KlipChip™, 20 each | **$99.00** |
| SF501 | SureFoot™ Probe Tip Adapter Pkg. of 12, Yellow, 50 mil pitch | **$36.00** |
| SF502 | SureFoot™ Probe Tip Adapter Pkg. of 12, Blue, 25 mil/0.65 mm pitch | **$36.00** |
| SF503 | SureFoot™ Probe Tip Adapter Pkg. of 12, Red, 0.5 mm pitch | **$36.00** |

**1 See SF501/SF502/SF503 above or page 455 for complete selection information*

**P6240 PROBE SYSTEM FOR TLS216**

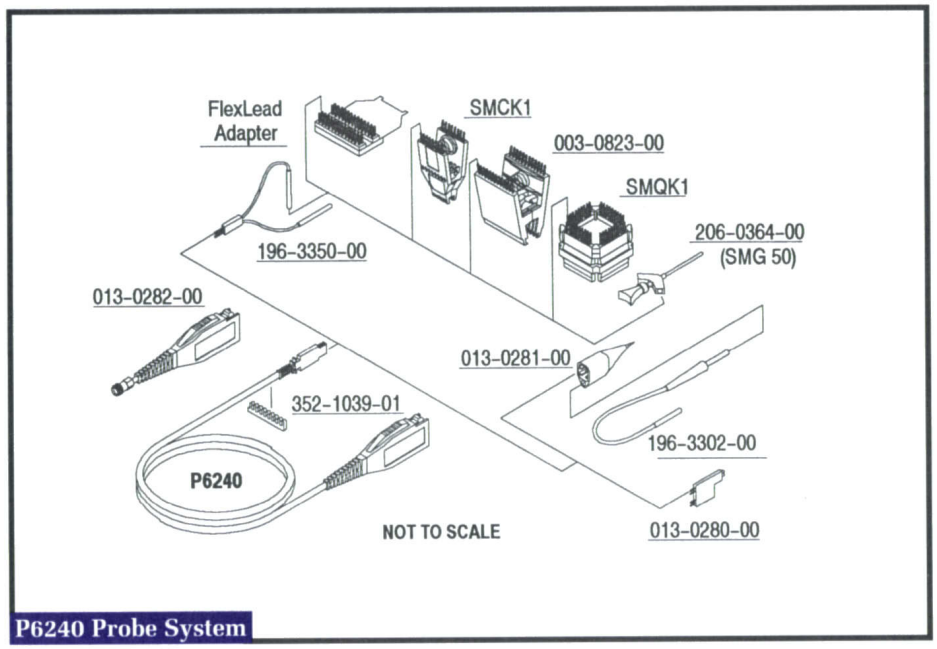
| Part Number | Description | Price |
|---|---|---|
| 003-0823-00 | 24-Pin DIP, Clothes Pin Style | **$39.00** |
| 013-0280-00 | One to Two Adapter | **$15.00** |
| 013-0281-00 | Hand Held Probe Tip Adapter w/ Tips | **$20.00** |
| 013-0282-00 | 50 to 75 ohm Converter | *2 |
| 196-3302-00 | 6 in. Ground Lead | **$15.50** |
| 196-3350-00 | Y Lead Adapter, 1 each | *2 |
| 020-2008-00 | Y Lead Adapter, Pkg. of 10 | **$135.00** |
| 206-0364-00 | SMT KlipChip™, 1 each | **$5.25** |
| 352-1039-01 | Probe Cable Loom, pkg. of 6 | **$15.00** |

**2 Contact your local Tektronix Representative for price information.*




**SMD Probe Accessories**

*Accessories for P6561AS/P6562AS/P6563AS.*




**P6240 Probe System**

| | | | |
|---|---|---|---|
| SMG50 | SMT KlipChip™, 20 each **$99.00** | FlexLead™ Adapter | PJ (JEDEC) and PE (EIAJ) series. Includes Instruction Sheet, 8 each Adapters (See Page 453 For Complete Selection And Ordering Information) |
| SMCK1 | SOIC Engineering Kit (See page 455 for included items) **$99.00** | | |
| SMQK1 | PLCC Engineering Kit (See page 455 for included items) **$270.00** | | |

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

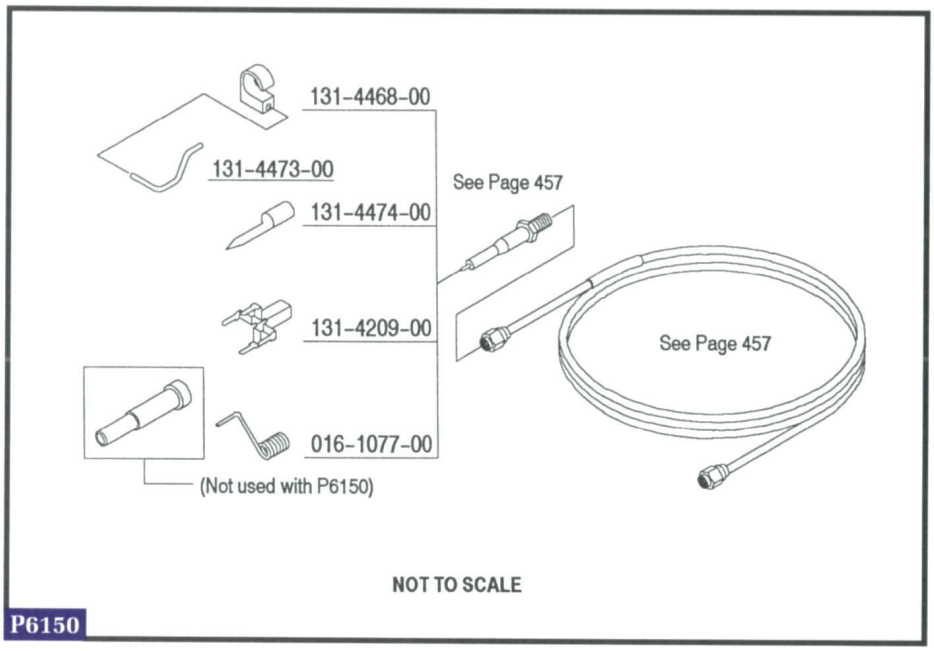
# Probe Accessories
## P6150 and 4mm



### ORDERING INFORMATION – SELECTION GUIDE

**P6150**

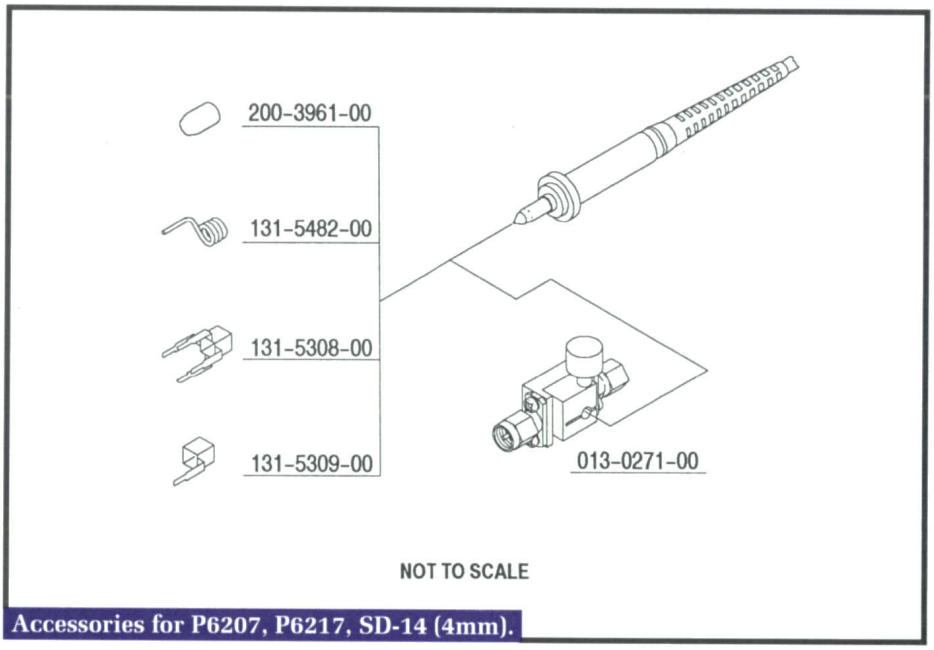
| Part Number | Description | Price |
|---|---|---|
| 016-1077-00 | Spring Ground Contact, 2 each of 5 lengths | **$15.75** |
| 131-4209-00 | Probe Tip to CKT BD Adapter | **$0.35** |
| 131-4468-00 | Ground Collar | **$11.25** |
| 131-4473-00 | 1/4 in. Ground Lead | **$1.50** |
| 131-4474-00 | 1 Leg Ground Contact | **$1.45** |




**P6150**

**P6207, P6217, SD-14**

| Part Number | Description | Price |
|---|---|---|
| 013-0271-00 | SMA Adapter to SD-14 | **$560.00** |
| 131-5308-00 | 4 Leg Ground Contact | **$1.45** |
| 131-5309-00 | 1 Leg Ground Contact | **$1.45** |
| 131-5482-00 | Spring Ground Contact 2 each of 5 lengths | **$18.25** |
| 200-3961-00 | ESD Protective Probe Tip Cover | **$1.45** |

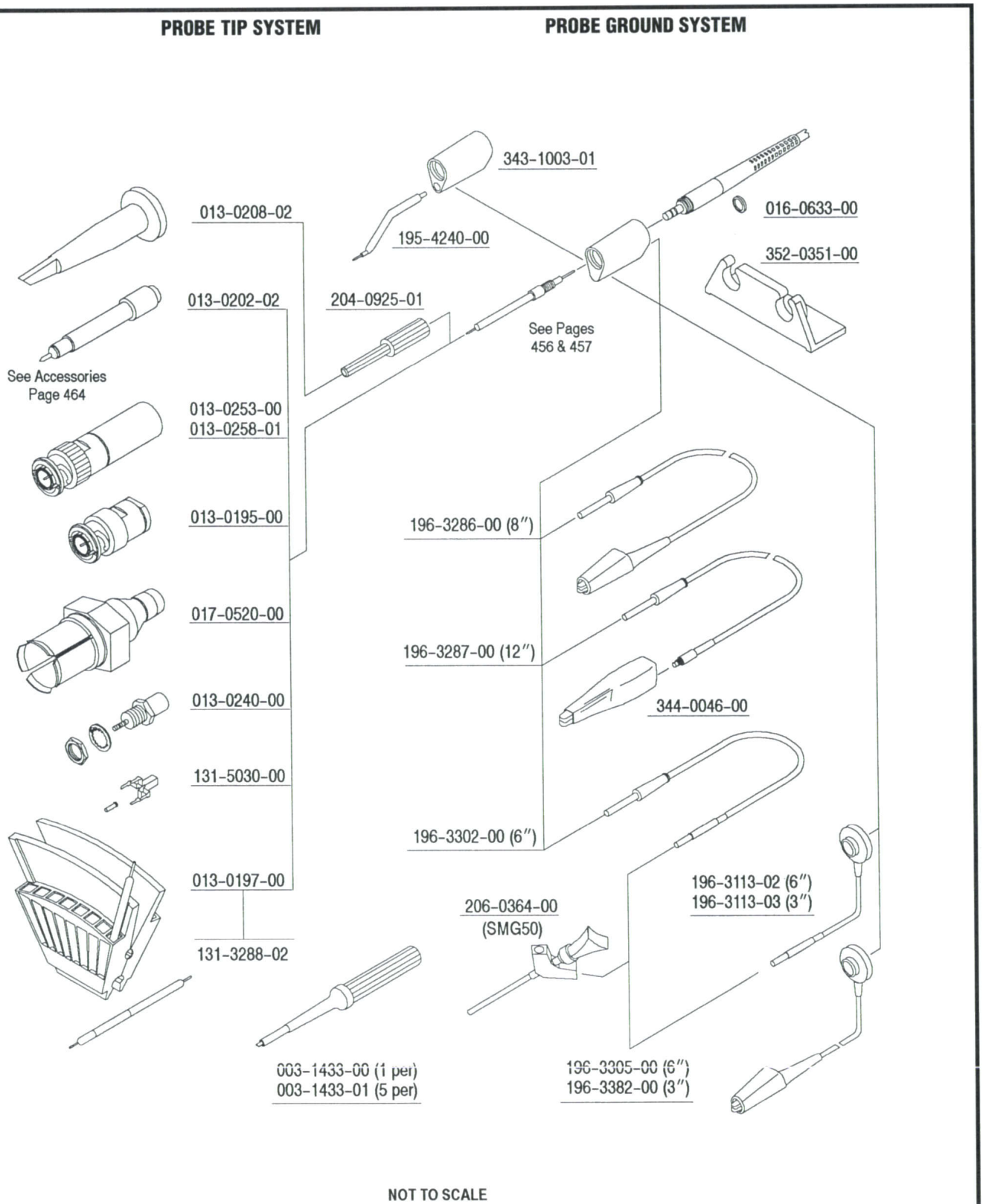



**Accessories for P6207, P6217, SD-14 (4mm).**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# Probe Accessories

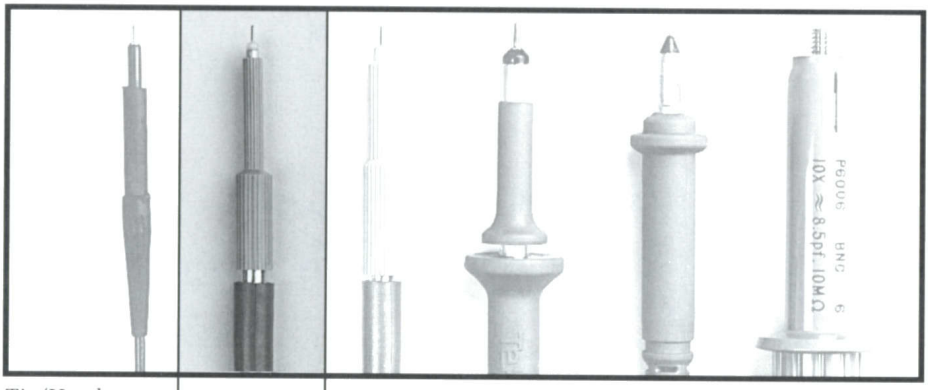
## 2.5mm (Subminiature) Probe System




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 – SELECTION GUIDE

| Part Number | Description | Price |
|---|---|---|
| 003-1433-00 | Adjustment Tool for P601X/A, P612X, and P613X family | **$1.15** |
| 003-1433-01 | Package of 5 each of 003-1433-00, above | **$6.50** |
| 013-0195-00 | Subminiature Probe Tip to BNC Adapter. | **$13.00** |
| 013-0197-00 | KLIP-KIT (includes two 16-Pin DIP Clips and four signal/ground pins)*1 TD | **$70.00** |
| 013-0202-02 | Subminiature/Compact to-Miniature Probe to Adapter (allows use of miniature probe tip accessories. See page 464) TD | **$7.25** |
| 013-0208-02 | Retractable Hook Tip for Subminiature Tip Probes. | **$6.50** |
| 013-0240-00 | Subminiature probe tip Chassis mount test jack. TD | **$7.00** |
| 013-0253-00 | Subminiature Probe Tip to BNC Adapter Thread Locking (non-terminated) | **30.00** |
| 013-0258-01 | P6562 Subminiature Probe Tip to BNC Adapter, 50 Ω terminated | **$105.00** |
| 016-0633-00 | Cable Marker Set for all Modular Cables (P610X/A/B, P612X, P613X/A, P62X, (Except P6201, P6202A)) | **$5.25** |
| 017-0520-00 | Subminiature Probe Tip to GR 50 Ω termination adapter | **$95.00** |
| 131-3288-02 | Signal/Ground Pins for KLIP-KIT (013-0197-00), (includes eight pins). | **$80.00** |
| 131-5030-00 | Subminiature Probe Tip Circuit Board Test Points (pkg 25). | **$55.00** |
| 195-4240-00 | Low Impedance Ground Contact. | **$3.05** |
| 196-3113-02 | 6 in. Slip On Ground Lead | **$11.25** |
| 196-3113-03 | 3 in. Slip On Ground Lead | **$9.00** |
| 196-3286-00 | 8 in. Alligator Ground Lead | **$9.50** |
| 196-3287-00 | 12 in. Slip On Ground Lead. | **$11.00** |
| 196-3302-00 | 6 in. Alligator Ground Lead (not compatible with P6137, P6134/C, P6053C or P6156). | **$15.50** |
| 196-3305-00 | 6 in. Alligator Ground Lead | **$15.00** |
| 196-3382-00 | 3 in. Alligator Ground Lead | **$16.75** |
| 204-0925-01 | Subminiature Probe Tip Attenuator Tip Cover. | **$1.55** |
| 206-0364-00 | SMT KlipChip™ Adapter | **$5.25** |
| 343-1003-01 | Ground Collar | **$3.15** |
| 344-0046-00 | #6-32 Thread Alligator Ground Clip TD | **$3.10** |
| 352-0351-00 | Probe Holder, self-adhesive back, black | **$2.10** |

**SMD ATTACHMENT TOOLS**

| | | |
|---|---|---|
| SMG50 | SMT KlipChip™ adapter, package of 2D | **$99.00** |

See pages 450-455 for complete selection of SMD Tools.

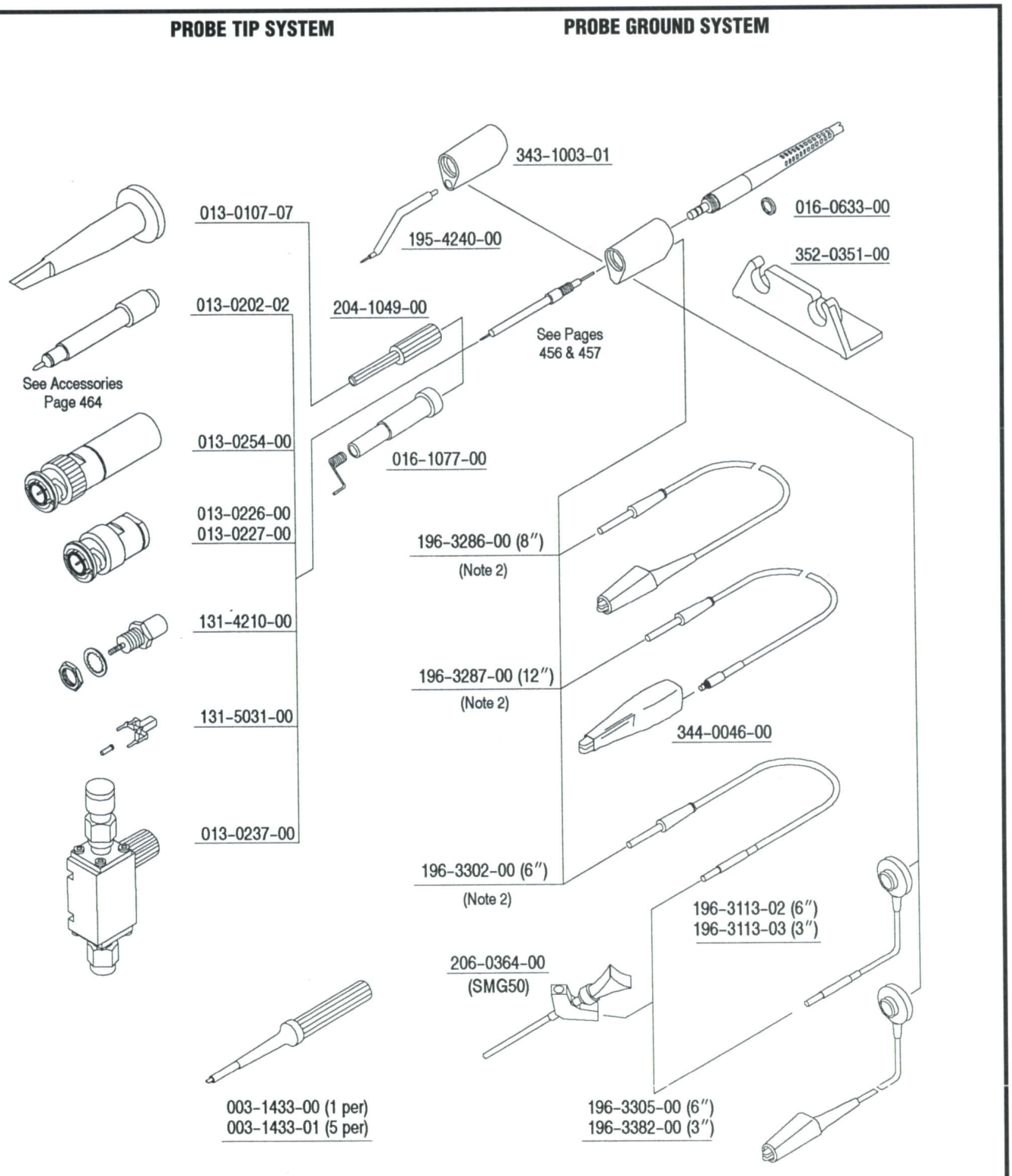
*1 Subminiature (2.5 mm) Probes can be used in place of the Signal/Ground pins.*

TD
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# Probe Accessories

## 3.5mm (Compact) Probe System

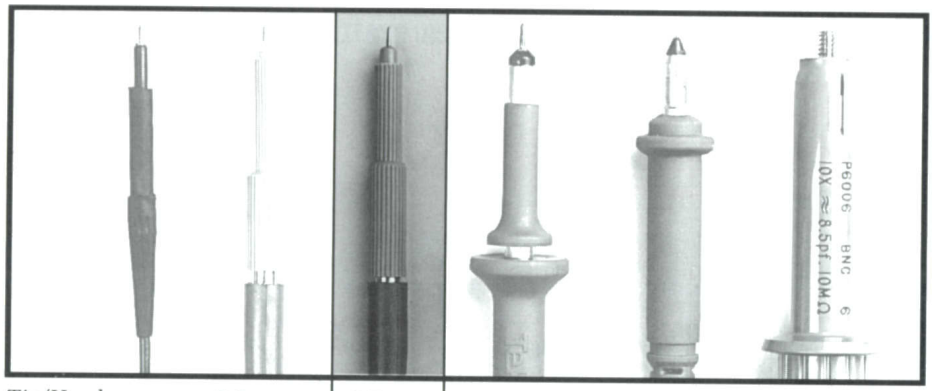



NOT TO SCALE

**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 – SELECTION GUIDE

| Part Number | Description | Price |
|---|---|---|
| 003-1433-00 | Adjustment Tool for P601X/A, P612X, and P613X family | **$1.15** |
| 003-1433-01 | Package of 5 each of 003-1433-00, above | **$6.50** |
| 013-0107-07 | Retractable Hook Tip for Compact Tip Probes. | **$5.75** |
| 013-0202-02 | Subminiature/Compact to-Miniature Probe to Adapter (allows use of miniature probe tip accessories. See page 464) TD | **$7.25** |
| 013-0226-00 | Compact Probe Tip to BNC Adapter (non-terminated) TD | **$14.00** |
| 013-0227-00 | 50 ΩCompact probe tip to BNC termination adapter | **$75.00** |
| 013-0237-00 | Compact probe tip to SMA adapter (50 Ω) | **$365.00** |
| 013-0254-00 | Compact Probe Tip to BNC Adapter Thread Locking (non-terminated) | **30.00** |
| 016-0633-00 | Cable Marker Set For all Modular Cables (P610X/A/B, P612X, P613X/A, P623X, P62XX (Except P6201, P6202A)) | **$5.25** |
| 016-1077-00 | Ground Tip Contact for Compact Tip Probes. 2 ea. five different probe tip to ground contact spacings. | **$15.75** |
| 131-4210-00 | Compact Probe Tip Chassis Mount Test Jack. | **$7.00** |
| 131-5031-00 | Compact Probe Tip Circuit Board Test Points (pkg 25). | **$55.00** |
| 195-4240-00 | Low Impedance Ground Contact. | **$3.05** |
| 196-3113-02 | 6 in. Slip On Ground Lead | **$11.25** |
| 196-3113-03 | 3 in. Slip On Ground Lead | **$9.00** |
| 196-3286-00 | 8 in. Alligator Ground Lead | **$9.50** |
| 196-3287-00 | 12 in. Slip On Ground Lead. | **$11.00** |
| 196-3302-00 | 6 in. Alligator Ground Lead (not compatible with P6137 P6134C, P6053C or P6156). | **$15.50** |
| 196-3305-00 | 6 in. Alligator Ground Lead | **$15.00** |
| 196-3382-00 | 3 in. Alligator Ground Lead | **$16.75** |
| 204-1049-00 | Compact Probe Tip Attenuator Tip Cover. | **$1.40** |
| 206-0364-00 | SMT KlipChip™ Adapter | **$5.25** |
| 343-1003-01 | Ground Collar | **$3.15** |
| 344-0046-00 | #6-32 Thread Alligator Ground Clip TD | **$3.10** |
| 352-0351-00 | Probe Holder, self-adhesive back, black | **$2.10** |

**SMD ATTACHMENT TOOLS**

| | | |
|---|---|---|
| SMG50 | SMT KlipChip™ adapter, package of 20 | **$99.00** |

See pages 450-455 for complete selection of SMD Tools.

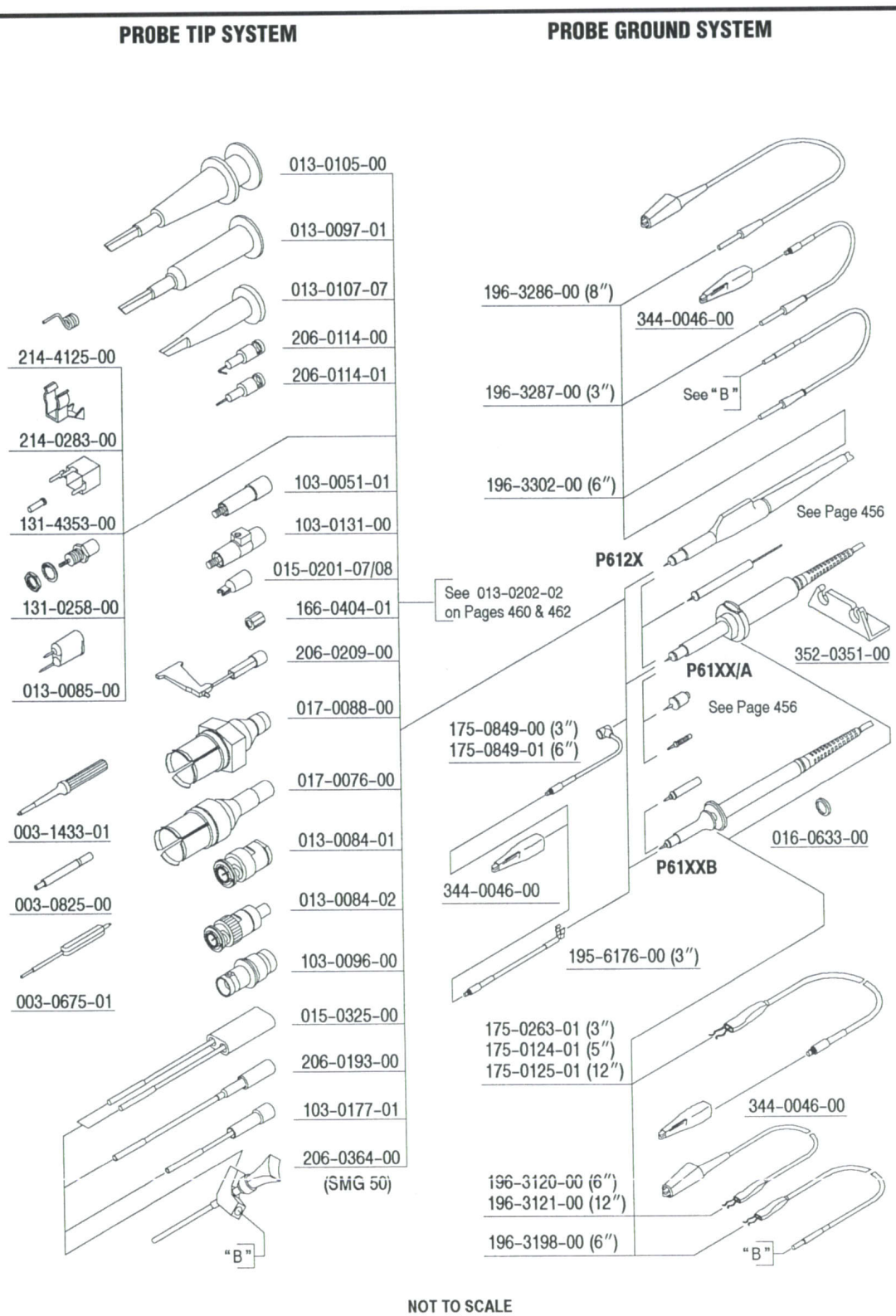
*[1] Contact your local Tektronix representative for price and ordering information.*

TD
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# Probe Accessories

## 5mm (Miniature) Probe System

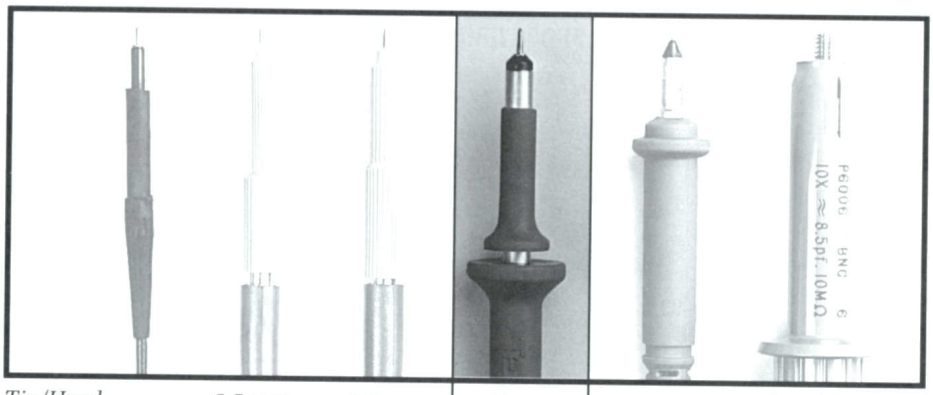



NOT TO SCALE

**Probe Accessories for P6048, P6053, P6053B, P6055, P6056, P6057, P6062B, P6063B, P61XX/A Family, P612X Family, P61XXB Family, P6202A w/ 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 – SELECTION GUIDE

### MINIATURE PROBE ACCESSORIES

| Part Number | Description | Price |
|---|---|---|
| 003-0675-01 | Adjustment Tool P6202A | $2.80 |
| 003-0825-00 | Tip Extractor for Miniature Probes (except for P610X "A" version and P612X family probes) | $7.50 |
| 003-1433-00 | Adjustment Tool for P601XA, P612X, and P613X family | $1.15 |
| 003-1433-01 | Package of 5 each of 003-1433-00, above | $6.50 |
| 013-0084-01 | Miniature Probe Tip to BNC Adapter (non-terminated) TD | $15.00 |
| 013-0084-02 | Miniature Probe Tip to BNC Adapter for all except P6202A, P6420, and P6201 Adapter TD | $15.25 |
| 013-0085-00 | Bayonet Ground Assembly | $14.00 |
| 013-0097-01 | Retractable Hook Tip for P6202A and P6420 | $16.75 |
| 013-0105-00 | Retractable Hook Tip (except P612X) | $18.75 |
| 013-0107-07 | Retractable Hook Tip (for all except P6202A and P6420) | $5.75 |
| 015-0201-07 | IC Test Ground Cover, gray (100 mil spacing) Package of 10 | $8.50 |
| 015-0201-08 | IC Test Ground Cover, gray (100 mil spacing) Package of 100 | $26.00 |
| 015-0325-00 | Dual Lead Adapter. | $21.00 |
| 016-0633-00 | Cable Marker Set For all Modular Cables (P610X/A/B, P612X, P613X/A, P623X, P62XX (Except P6201, P6202A)) | $5.25 |
| 017-0076-00 | Miniature Probe Tip to GR Adapter. | $115.00 |
| 017-0088-00 | Miniature Probe Tip GR 50 Ω Termination Adapter. | $95.00 |
| 103-0051-01 | Screw Tip (#6-32) | $6.50 |
| 103-0096-00 | Miniature Probe Tip to BNC Female Adapter | $20.00 |
| 103-0131-00 | Screw Tip with Ground Connection (#6-32) | $26.00 |
| 103-0177-01 | Flexible Tip | $10.00 |
| 131-0258-00 | Chassis Mount Test Jack | $3.70 |
| 131-4353-00 | Circuit Board Test Point, package of 25 | $55.00 |
| 166-0404-01 | Insulating Ground Cover | $1.75 |
| 175-0124-01 | 5 in. Clip on Ground Lead | $3.45 |
| 175-0125-01 | 12 in. Clip on Ground Lead | $3.70 |
| 175-0263-01 | 3 in. Clip on Ground Lead | $3.15 |
| 175-0849-00 | 3 in. Probe Tip Cap Lead for all miniature size probe tips | $9.25 |
| 175-0849-01 | 6 in. Probe Tip Cap Lead for all miniature size probe tips | $13.50 |
| 195-6176-00 | 3 in. Probe Tip Clip-On Lead for all miniature size probe tips | $8.25 |
| 196-3120-00 | 6 in. Clip-On Ground Lead | $3.50 |
| 196-3121-00 | 12 in. Clip-On Ground Lead | $5.00 |
| 196-3198-00 | 6 in. Clip-on Ground Lead (with 0.025 in. pin receptacle) | $5.75 |
| 196-3286-00 | 8 in. Ground Lead | $9.50 |
| 196-3287-00 | #6-32 Thread Ground Lead | $11.00 |
| 196-3302-00 | 6 in. Slip-On Ground Lead (with 0.025 in. pin receptacle) | $15.50 |
| 206-0114-00 | Hook Tip | $5.00 |
| 206-0114-01 | Straight Tip. | $6.50 |
| 206-0193-00 | Flex Tip for 0.025 in. square pin. | $20.00 |
| 206-0209-00 | Pin Tip (accepts 0.025 in. IBM SLT pin). | $7.50 |
| 214-0283-00 | Electrical Ground Contact | $2.30 |
| 214-4125-00 | Electrical Contact Ground. TD | $2.80 |
| 344-0046-00 | #6-32 Thread Alligator Ground Clip. TD | $3.10 |
| 352-0351-00 | Probe Holder, self-adhesive back, black. | $2.10 |

### SMD ATTACHMENT TOOLS

| | | |
|---|---|---|
| 206-0364-00 | SMT KlipChip™ (used with 0.025 pin receptacles) | $5.25 |
| SMG 50 | Package of 20 each SMT KlipChip™ Adapters. | $99.00 |

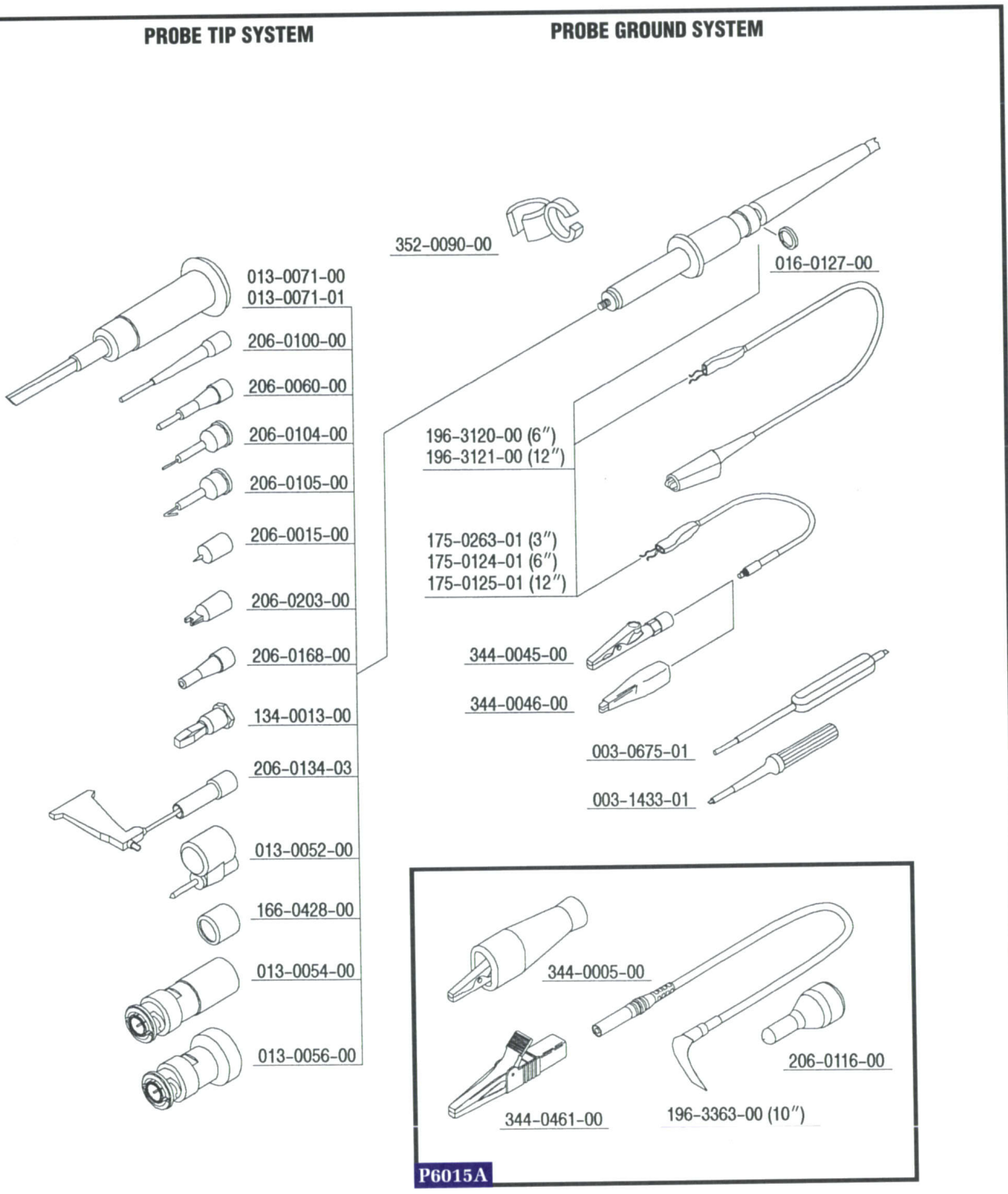
See pages 450-455 for complete selection of SMD Tools.

TD
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# Probe Accessories

## 6/32 Thread (Monolithic), P6015A and P6201

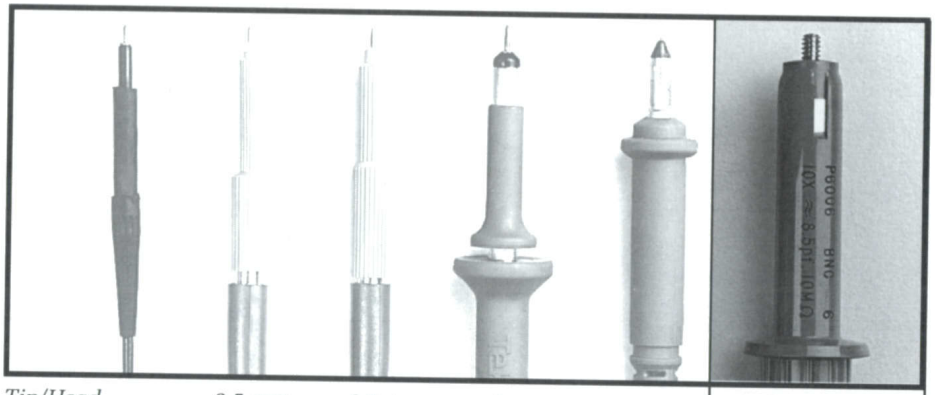



NOT TO SCALE

**Accessories for P6006, P6007, P6008, P6009, P6028, P6060.**

# Probe Accessories

## 6/32 Thread (Monolithic), P6015A and P6201



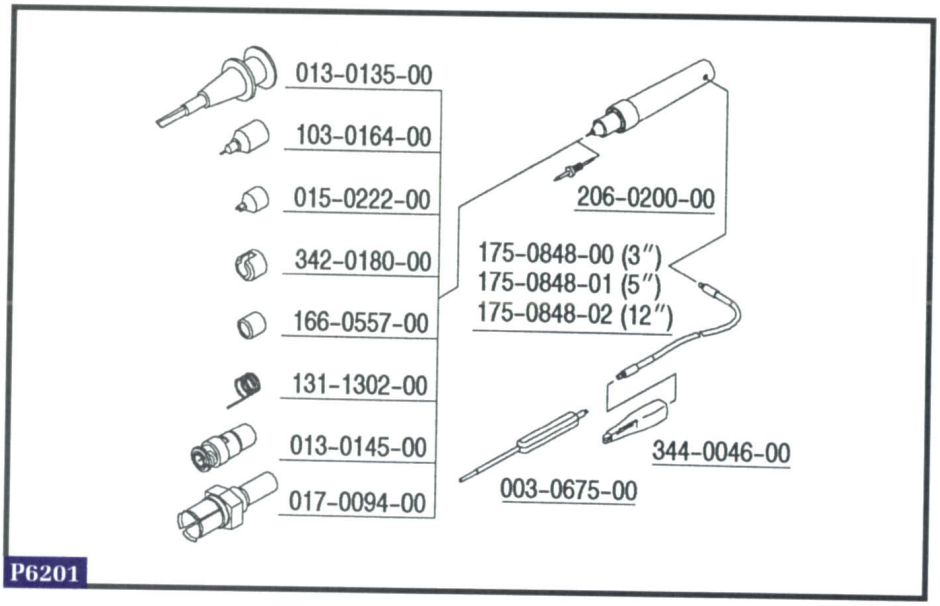

| Tip/Head Style: | SMD | 2.5 mm Subminiature | 3.5 mm Compact | 5 mm Miniature | 4 mm | 6/32 Thread Monolithic |
|---|---|---|---|---|---|---|



## ORDERING INFORMATION – SELECTION GUIDE

### MONOLITHIC PROBE ACCESSORIES
**(For probes with # 6-32 Screw Tips)**

| Part Number | Description | Price |
|---|---|---|
| 003-0675-01 | Adjust Tool | $2.80 |
| 003-1433-00 | Adjust Tool for P600X Family | $1.15 |
| 003-1433-01 | Adjust Tool for P600X Family Pkg of Five | $6.50 |
| 013-0052-00 | Bayonet Ground Assembly | $16.50 |
| 013-0054-00 | Probe Screw Tip to BNC Adapter. | $26.00 |
| 013-0056-00 | Probe Screw Tip to BNC Adapter for P6028 | $30.00 |
| 013-0071-00 | Retractable Hook Tip | $7.75 |
| 013-0071-01 | Retractable Hook for P6008 Environmental Probe. | $6.00 |
| 134-0013-00 | Banana Tip (#6-32) | $1.90 |
| 166-0428-00 | Insulating Ground Cover for P6009 | $1.40 |
| 175-0124-01 | 5 in. Ground Lead | $3.45 |
| 175-0125-01 | 12 in. Ground Lead | $3.70 |
| 175-0263-01 | 3 in. Ground Lead | $3.15 |
| 196-3120-00 | 6 in. Clip on Ground Lead | $3.50 |
| 196-3121-00 | 12 in. Clip on Ground Lead | $5.00 |
| 196-3363-00 | 10 in. Clip on Ground Lead for P6015A | $22.00 |
| 206-0015-00 | Straight Tip (0.055 in. dia). | $2.65 |
| 206-0060-00 | Spring Tip (0.08 in. dia). | $7.00 |
| 206-0100-00 | Calibration Tip (0.063 in. dia) | $14.50 |
| 206-0104-00 | Long Straight Tip (0.032 in. dia) | $1.90 |
| 206-0105-00 | Hook Tip | $2.10 |
| 206-0116-00 | Banana Tip (P6015 only) #10-32 | $3.85 |
| 206-0134-03 | Pin Tip (accepts 0.025 in. IBM SLT pin) | $9.25 |
| 206-0168-00 | Spring Tip (accepts 0.068 in. dia. pin) | $4.75 |
| 206-0185-00 | Right Angle Hook Tip. | $2.00 |
| 206-0203-00 | IC Test Tip | $2.30 |
| 344-0005-00 | Alligator Clip, # 10-32 Screw Thread (P6015 only) | $6.25 |




| Part Number | Description | Price |
|---|---|---|
| 344-0045-00 | Alligator Clip | $1.55 |
| 344-0046-00 | Miniature Alligator Clip with Boot | TD $3.10 |
| 344-0461-00 | Crocodile Clip, 4 mm socket | $11.50 |
| 352-0090-00 | P600X Probe Holder | $.65 |

### P6201 PROBE

| Part Number | Description | Price |
|---|---|---|
| 003-0675-00 | Adjustment Tool | $3.00 |
| 013-0135-00 | Retractable Hook Tip. | $9.25 |
| 013-0145-00 | Probe Tip to BNC Adapter. | $40.00 |
| 015-0222-00 | IC Test Ground Cover | $1.05 |
| 017-0094-00 | Probe Tip to GR 50 Ω Termination Adapter | $145.00 |
| 103-0164-00 | Probe Tip to Miniature Probe Tip Adapter (See page 464 for compatible accessories). | $17.75 |
| 131-1302-00 | Ground Contact. | $1.60 |
| 166-0557-00 | Insulating Ground Cover | $1.85 |
| 175-0848-00 | 3 in. Ground Lead | $7.75 |
| 175-0848-01 | 5 in. Ground Lead | $3.75 |
| 175-0848-02 | 12 in. Ground Lead | $3.95 |
| 206-0200-00 | Replaceable Probe Tip | $2.10 |
| 342-0180-00 | Ground Contact Insulator. | $2.40 |
| 344-0046-00 | #6-32 Thread Alligator Ground Clip | TD $3.10 |

### CABLE MARKER SETS

| | | |
|---|---|---|
| 016-0127-00 | For 3/16 in. dia. Cable | $35.00 |

TD
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# TMP9000 SERIES CAL93 CAL96 Microwave Probes

*Achieves high speed coplanar connections for microwave circuits, MMICs, or microwave packages.*

*A variety of connector schemes and foot prints accommodates your Metrology needs.*

**TMP9000 FAMILY**

- The TMP9200 Series is a DC to 26.5 GHz Probe with a Signal-Ground Footprint
- The TMP9300 Series is a DC to 26.5 GHz Probe with a Ground-Signal Footprint
- The TMP9600 Series is a DC to 40 GHz Probe with a Ground-Signal-Ground Footprint
- The TMP9800 Series is a DC to 60 GHz probe with a Ground-Signal-Ground Footprint
- Compatible with Industry-Standard Microwave Probe Stations, Including those Manufactured by Alessi

**APPLICATIONS**

- S-Parameter Measurements
- Noise Measurements
- TDR Measurements
- Characterization of Packages

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.



TMP9600 Series

## Microwave Probes

TMP9000 Microwave Probes are precision adapters that convert coaxial input into ground-signal configuration co-planar footprints which interface to hybrid microwave circuits, MMICs, or microwave packages. The superior performance of the Tektronix microwave probe is achieved by using photolithographic techniques to define the tapered co-planar transmission lines and contact bumps.

There are no needles for contacting the DUT pads as before with traditional probes and probe cards. Instead, each probe provides a 50 Ω transmission line between the coaxial connector and contacts at the probe tip. The replacement of contact needles by photolithographically-defined transmission line structures greatly improves the reflection, radiation, and crosstalk characteristics of probes at microwave frequencies.

## TMP9600 Series Characteristics

**Frequency Range –** DC to 40 GHz

**Insertion Loss –**
1.5 dB to 26 GHz (Typical).
Maximum 2.5 dB to 40 GHz.

**Return Loss –**
Greater than 10 dB to 40 GHz.

**Connection Repeatability*1 –** <-50 dB typical.

**Crosstalk*2 –** Less than 30 dB thru 40GHz.

**Planarity –** 1:100.

**Temperature Range –** –20°C to +125°C.

**Nominal Impedance –** 50 Ω.

**Maximum Overtravel –** 15 mils (0.38 mm).

**Recommended Overtravel –** 2-3 mils.

**Lifetime –** >500,000 cycles typical.

## TMP9200 & TMP9300 Series Characteristics

**Frequency Range –** DC to 26.5 GHz.

**Insertion Loss –** Less than 1.0 dB to 18 GHz (typical). Maximum 2.0 dB to 26.5 GHz.

**Return Loss –** Greater than 20 dB to 4 GHz Greater than 10 dB to 26.5 GHz.

**Crosstalk*2 –** Less than 30 dB to 26.5 GHz.

**Planarity –** 1:100.

**Temperature Range –** –20°C to +125°C.

**Nominal Impedance –** 50 Ω.

**Maximum Overtravel –** 15 mils (0.38 mm).

**Recommended Overtravel –** 2-3 mils.

**Lifetime –** >500,000 cycles typical.

## TMP 9800 Characteristics

**Insertion Loss –** 2.5 dB typical, 3 dB max to 60 GHz.

**Return Loss –** 20 dB to 4 GHz typical; 10 dB min to 60 GHz.

**Connection Repeatability[1] –** <-50 dB typical.

**Pitch Accuracy –** Better than 1%.

**Contact Width –** 2.0 mils typical.

**Planarity –** 1:100.

**Crosstalk[2] –** 30 dB max @ 60 GHz.

**Overtravel –** 2-3 mils recommended; 15 mils max. (0.38 mm)

**Lifetime –** >500,000 cycles typical.

**Temperature Range –** –20° to +125°C wafer or DUT temp.

**1 Connection repeatability is expressed as the magnitude of the vector difference between subsequent connections and is a strong function of the operator and probe positioning mechanics.*

**2 Crosstalk measured with two probes 4 mils apart contacting a bare alumina substrate.*

# Microwave Probes
## Calibration Substrates & Accessories

**TMP9000 SERIES** | **CAL93 / CAL96**



### CAL93 LRL Substrate

The CAL93 LRL substrate is intended for use with TMP9200/TMP9300 Series with 100 µm to 300 µm pitch.

**Substrate**

Single crystal Sapphire, "0" degree cut

| | |
|---|---|
| Dielectric constant | 9.39 perpendicular to c axis |
| Surface finish | <250 angstrom |
| Thickness | 20 ±1 mils |
| Camber | <2 µm/in. |

**Metalization**

Hard gold plate over evaporated thin-film gold

| | |
|---|---|
| Hardness | 150 Knoop typical |

**Match Standards.**

Passivated Nichrome, laser trimmed, Guaranteed sites:

| | |
|---|---|
| Pitches ≤200 µm | 40 loads plus 8 loads at 90 degree orientation. |
| Pitches >200 µm | 20 loads plus 4 loads at 90 degree orientation. |
| DC accuracy | 50 Ω ±1% |
| TCR | 35 ppm/degree C |
| Stability | 0.1%/1000 hrs at 150 degree C |
| Return loss | Better than –30 dB to 26.5 GHz with recommended overlap. |

**Line Standards**

Asymmetrical coplanar strips

| | |
|---|---|
| Frequency Range | 5-26.5 GHz |
| Frequency Response | ±0.25 Ω typical |
| Impedance | 50 Ω ±2 Ω typical |

**Reflect Standards**

Offset shorts and opens. Offset provided as a function of pitch.

| | |
|---|---|
| Pitch ≤200 µm | 125 µm nominal offset |
| Pitch >200 µm | 150 µm nominal offset |
| DPS Open $C_0$ = | +8fF typical |
| CPS Short offset = | 0.3 pS typical |

### CAL96 LRL Substrate

The CAL96 LRL substrate is intended for use with TMP9600 Series with 100 µm to 300µm pitch.

**Calibration Elements**
**Open-Short-Load-Thru**

| Pitch (microns) | Short*1 offset(ps) | Open 1*2 Co(fF) | Open 2*3 Co(fF) | Thru*4 delay(ps) |
|---|---|---|---|---|
| 100 | 0.1 | –1 | –10 | 0.8 |
| 125 | 0.1 | –2 | –11 | 0.8 |
| 150 | 0.2 | –2 | –11 | 0.8 |
| 175 | 0.2 | –2 | –12 | 0.8 |
| 200 | 0.2 | –2 | –12 | 0.8 |
| 250 | 0.2 | –2 | –12 | 0.8 |

**1 The short offsets above apply when the probe is positioned in the center of the shorting bar.*

**2 Open 1 is defined as the probe on the bare sapphire with no metal under the last 50 mils of probe tip and 1 to 2 mils of overtravel applied. Open 1 is recommended.*

**3 Open 2 is defined as the probe in air, 30 mils above the substrate.*

**4 The 0.8 ps Thru applies when the Thru is probed with 1 mil overlaps.*

**Line-Reflect-Line**

| Line (label) | Electrical Length (ps) | (Ω) |
|---|---|---|
| LT | 0.8 | 50 |
| L1 | 11.5 | 50 |
| L2 | 20.3 | 50 |
| Impedance | | Range of $Z_0$ 47-50 Ω Frequency response of $Z_0$ ±0.25 Ω from 5 to 26.5 GHz |

**50 Ω loads –** Minimum of 10 each Load type Trimmed to 50 Ω ±1%

Typical Return Loss:
>34 dB up to 26 GHz;
>30 dB up to 40 GHz;
>25 dB up to 60 GHz

**CAL93**

- Full NIST Compatibility for Multiple Line LRL Calibrations Permits Characterization of Secondary LRM Standards
- Complete Support for All Popular Calibration Methods Including LRL, LRM and SOLT
- High Stability Laser Trimmed 50 Ω Loads Provide the Lowest Inductance Available
- Durable Hard Plated Gold Metalization for Longer Life and Lowest Cost per Calibration
- LRL Elements Provide 1 to 26.5 GHz Calibrations, DC to 26.5 GHz with Lowband Load

**CAL96**

- LRL/LRM and SOLT Calibration for GSG Probes
- 40 Laser Trimmed Loads in Increments of 100, 150, 200, and 250 Microns (also Calibrates 125 and 175 Micron Probes)
- Line-reflect-line Elements Provide 2.5 to 20 GHz and 5 to 40 GHz Calibration
- LRM Elements Provide Calibration to 60 GHz

*High accuracy calibration methods including NIST multi-line LRL are offered by CAL93 and CAL96.*

### ORDERING INFORMATION

*All TMP 9000 Series Include: Storage Case and User's Guide.*

**TMP9200 SERIES MICROWAVE PROBES, SG CONTACTS**

**TMP9215** – 150 micron pitch.....**$1,025**
**TMP9225** – 250 micron pitch.....**$1,025**

**TMP9300 SERIES MICROWAVE PROBES, GS CONTACTS**

**TMP9315** – 150 micron pitch.....**$1,025**
**TMP9325** – 250 micron pitch.....**$1,025**

**CAL93 LRL**

Calibration Substrate .....**$995**
**Includes:** Resistor Trim Map, Wafer Tray

**TMP9600 SERIES MICROWAVE PROBES, GSG CONTACTS**

**TMP9612** – 125 micron pitch.....**$1,025**
**TMP9615** – 150 micron pitch.....**$1,025**
**TMP9620** – 200 micron pitch.....**$1,025**

**TMP9800 SERIES MICROWAVE PROBES, CSG CONTACTS**

**TMP9815** – 150 micron pitch.....**$2,195**

**CAL96 LRL**

Calibration Substrate .....**$995**
**Includes:** Resistor Trim Map, Wafer Tray.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# Differential Probes



*Measure two voltage points in a circuit and provide as an output the difference between two voltages.*

*Ideal for measuring:*

*Read/write signals in disk drives*

*Avoiding ground loop errors in mixed signal circuits*

*Testing twisted pair data links.*

**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

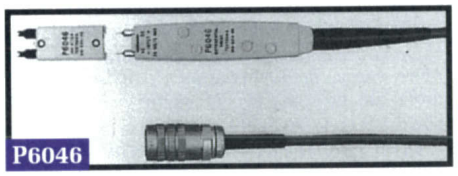
**APPLICATIONS**

- Power supplies
- Disk Drives
- Electric Ballast
- Intelligent Motion
- Single and Three Phase Adjustable Speed Drives

## 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 is a 100 MHz active differential amplifier in probe form which connects to one channel of a standard scope amplifier. The P6135A ia a passive probe pair designed to enhance the performance of a differential amplifier.




*P6046 with 10X Attenuator*

### 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 reduces 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/Division 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 8 calibrated steps, 1-2-5 sequence, accurate within 3% (with an oscilloscope deflection factor of 10 mV/div). Input RC 1 MΩ paralleled by 10 pF or less.

**Input Coupling –** AC or DC, selected by a switch on the probe. Low frequency response AC-coupled is –3 dB at 20 Hz, 2 Hz with 10X attenuator.

**Displayed Noise –** Typically 450 mV or less (tangentially measured).

**Maximum Input Voltage –** ±25 V (DC + peak AC), ±250 V with 10X attenuation, derated with frequency. The P6046 circuitry can be damaged by electrostatic discharge. Please refer to 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.

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.

## ORDERING INFORMATION

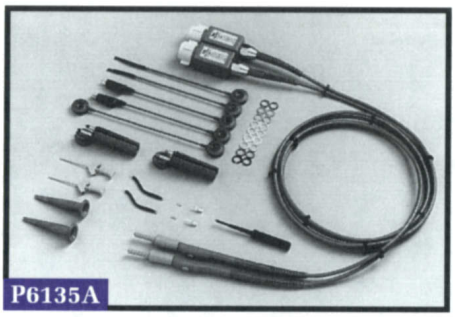
**P6046**
1X, 6 ft. FET Differential Probe with Amplifier and Power Supply ..... TD **$2,295**
**Includes:** 50 Ω Termination (011-0049-01); Amp and Power Supply (015-0106-00); 50 Ω Coaxial Cable (012-0076-00); Hanger Assembly (014- 0029-00); Carrying Case (016-0111 01); 10X Attenuator (010-0361-00); Dual Attenuator Head (010-0419-00); Swivel Probe Tip; Spring Ground Contact; Connector Test Point Jack; Instruction Manual (070-7129-01).

**Opt. A6 –** Japan, 100 V, 50 Hz ..... **NC**
**Power Supply with Amplifier -** Order 015-0106-00 ..... **$1,405**

**RECOMMENDED ACCESSORIES**
See page 464-465 for complete selection information.

# Differential Probes

## P6135A




### 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**

Differential probe pairs such as the P6135A are 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 TM 500 Series AM 502 Differential Amplifier, the P6135A provides 20,000:1 CMRR up to 1 MHz. An added benefit with the AM 502 is that the differential output can be connected to any oscilloscope for display.

### Characteristics

**CMRR –** On 11A33: 10,000:1 from DC to 1 kHz, derating to 100:1 at 20 MHz. On 7000-Series: 20,000 to 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.

**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
- Electric Ballast
- Intelligent Motion
- Single and Three Phase Adjustable Speed Drives

*Specifically designed to obtain the maximum in performance from a Tektronix differential measurement system.*

## ORDERING INFORMATION

**P6135A**

Pair of 10X, 150 MHz Differential Probes ..... TD **$750**

**Includes:** Adjustment Tool (003-1433-00); Two Retractable Hook Tips (013-107-06); Two Circuit Board Connectors; 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**

See pages 452-455 and 462-463 for complete selection information.

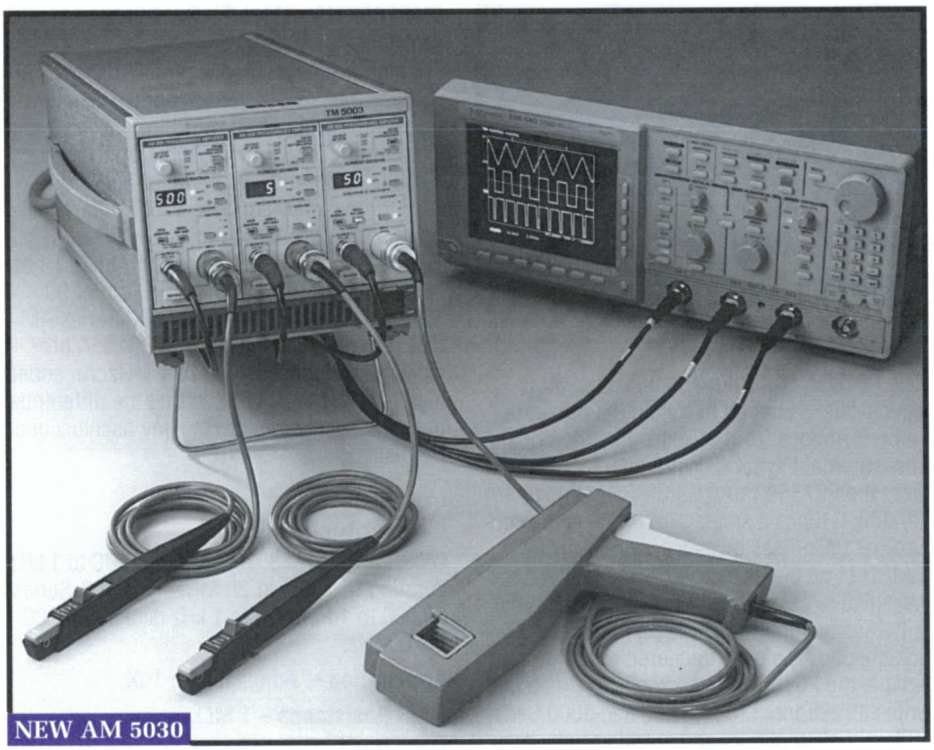
TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571).

# Power Measurements

*Tektronix has what you need to design and test power applications such as: Power Supplies, Motor Drives, Avionics, Electric Vehicles, Electronic Ballasts, Uninterruptible Power Supplies, DC to DC Converters, Inverters, Welders, Discharge Devices.*

**POWER MEASUREMENTS**

- Current
- Time Intervals
- High Voltage
- Isolation




*New 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 Volts. While providing valuable information about what is occurring in your device, it is clear that knowledge of currents, time intervals, voltages greater than 500V, differential voltages and temperatures 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, time, and floating isolated 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 floating isolated 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, time to voltage converters, high voltage probes, monolithic isolators, fiber optic isolation systems and temperature and RF probes.

In each section we describe product features and applications and provide information to enable you to select the right device which will allow you to safely and accurately make your measurement. We will also provide information about literature which provides valuable information on how to make measurements specific to your application.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Current Measurements

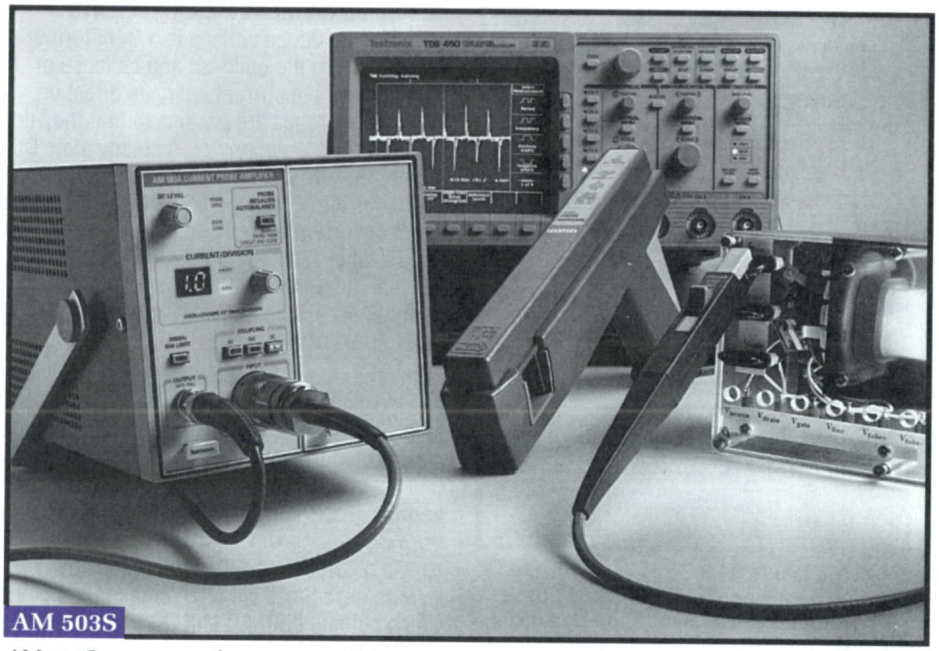


## Current Measurements

Tektronix offers the widest selection of high performance current probes available. Tek 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 strength 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 further divided into two mechanical configurations.



AM 503S

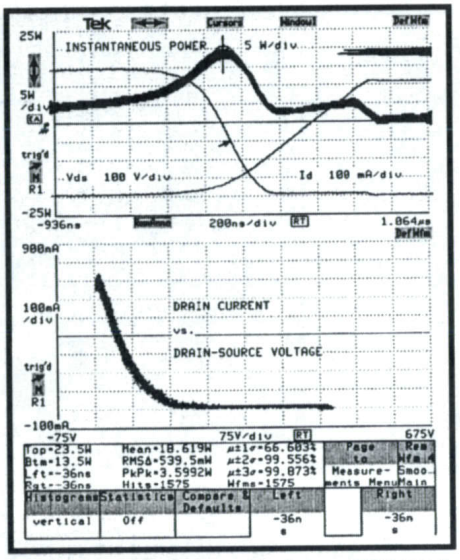
*AM 503S current probe system with both A6303 and A6302 current probes. The A6302 is measuring the fluorescent ballast line current which is displayed on a TDS 460 Digitizing Oscilloscope. For information about ballast testing request application note 51W-8614-0.*

### CURRENT PROBE SELECTION GUIDE

| Type | 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 | Current | Core Style | Max Barewire Voltage | Max Conductor Diameter |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **A6302/AM 503A or AM 5030** | DC to 50 | 50 A | 40 A | N/A | 20 kHz | 20 A | $100 \times 10^{-6}$ | 1 mA to 5 A*1 | 7 nS | AC/DC | split | 500 V | 0.15 in. |
| **with CT-4** | 0.5 to 20 | 20 kA | 3 kA | 50 Hz | 1.2 kHz | | 0.1 | 20 mA to to 5 kA*1 | 17.5 nS | AC | split | 3 kV | 1.50 in. |
| **A6303/AM 503A or AM 5030** | DC to 15 | 500 A | 200 A | N/A | 20 kHz | 100 A | $10{,}000 \times 10^{-6}$ | 5 mA to 50 A*1 | 23 nS | AC/DC | split | 700 V | 0.83 in. |
| **P6021 with Passive Termination** | 120 to 60 | 250 A | 15 A | 300 Hz | 5 MHz | 0.5 A | $500 \times 10^{-6}$ | 20 mA*1 or 100 mA*1 | 5.8 nS | AC | split | 600 V | 0.14 in. |
| **P6021 with CT-4** | 120 to 20 | 20 kA | 15 kA | 300 Hz | 1.2 kHz | 20 A | 0.5 | 400 mA or 100 A*1 | 17.5 nS | AC | split | 3 kV | 1.50 in. |
| **P6021 with 134** | 12 to 38 | 250 A | 15 A | 230 Hz | 5 MHz | 0.5 A | $500 \times 10^{-6}$ | 1 mA to 1 A*2 | 9.2 nS | AC | split | 600 V | 0.14 in. |
| **P6021 with 134 and CT-4** | 25 to 20 | 20 kA | 15 kA | 230 Hz | 1.2 kHz | 20 A | 0.5 | 20 mA to 5 kA*2 | 17.5 nS | AC | split | 3 kV | 1.50 in. |
| **P6022 with Passive Termination** | 935 to 120 | 100 A | 6 A | 3 kHz | 10 MHz | 0.2 A | $9 \times 10^{-6}$ | 10 mA or 100 mA*1 | 2.2 nS | AC | split | 600 V | 0.10 in. |
| **P6022 with 134** | 100 to 65 | 100 A | 6 A | 1.3 kHz | 10 MHz | 0.2 A | $9 \times 10^{-6}$ | 1 mA to 1 A*2 | 5.4 nS | AC | split | 600 V | 0.10 in. |
| **CT-1** | 25K to 1000 | 12 A | 1.4 A | | | 0.2 A | $1 \times 10^{-6}$ | 2 mA*1 (5 mV/mA) | 0.35 nS | AC | solid | 1000 V | 0.070 in. |
| **CT-2** | 1.2K to 200 | 36 A | 7 A | | | 0.2 A | $50 \times 10^{-6}$ | 10 mA*1 (1 mV/mA) | 0.5 nS | AC | solid | 1000 V | 0.052 in. |

*1 *Scope set at 10 mV/div.* *2 *Scope set at 50 mV/div.*

# Current Measurements




*A power measurement display on DSA602A. Current, voltage and instantaneous power in a power FET are shown in the upper display. The operating area of the turn-off transition is shown in the lower screen.*

## AC AND DC CURRENT MEASUREMENTS

AC currents induce voltage in a transformer resulting from the build-up 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. Additionally, signals which may look like AC, such as square wave switching on and off, but never fall below zero volts; actually have a significant DC component and can not 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.

## SPLIT VERSUS SOLID CORE

The two mechanical current probe configurations are split core and solid core. To accurately measure the flux field, we need to completely surround the conductor with the probe core. Tektronix offers two 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.

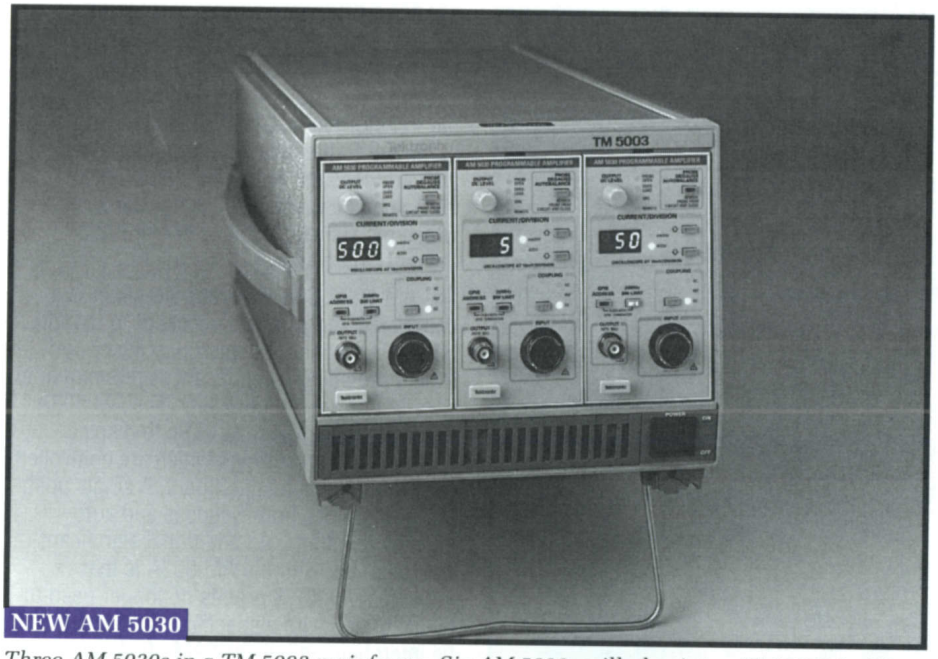
In this Current probe section we will describe the features and characteristics of each of the Tektronix Current probes, as well as mention some of the primary applications of each.

# AC/DC Current Probe Systems

**AM 503S**
**AM 503A**
**AM 5030**

**A6302**
**A6303**






NEW AM 5030

*Three AM 5030s in a TM 5003 mainframe. Six AM 5030s will plug into a TM 5006A. All current measurement parameters can be set using a GPIB controller.*

## AM 503 Current Measurement Family

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 newest member of this expanding family, 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.

### AM 5030 PROGRAMMABLE CURRENT PROBE AMPLIFIER

The new AM 5030 Programmable Current Probe Amplifier significantly extends the capabilities of the AM 503 Current Measurement family.

The AM 5030 is an enhanced performance version of the AM 503A Current Probe Amplifier with General Purpose Interface Bus (GPIB) programmability. 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 or 6-slot TM 5006A power module mainframe. The TM 5000 mainframes can be rackmounted. While the non-programmable AM 503A 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 or A6303 current probes and connects to any scope or analyzer via a BNC cable.

Like the AM 503A, 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 also provides several improvements over the AM 503A including a faster degauss/self-calibration cycle and more responsive, reliable front-panel controls.

*Continued on next page.*

### AM 503S

- AC/DC Measurements
- With A6302 Probe:
  - DC to 50 MHz
  - 20 A Continuous/50 A Peak
  - Split Core
  - Clips-on to conductors up to 0.15 in. diameter
- With A6303 Probe:
  - DC to 15 MHz
  - 100 A Continuous/500 A Peak
  - Split Core
  - Clips-on to conductors up to 0.83 in. diameter

### NEW AM 5030

- GPIB Programmable Current Probe Amplifier
- Plugs into TM 5000 Power Modules
- Operated with external controller or manually from front panel

### AM 503A

- Manual Current Probe Amplifier
- Push Button Auto Balance/De gauss
- Bright LED Current/Division Display
- Microprocessor Controlled
- Eliminates Need to Calibrate Amplifier with Specific Probes
- Plugs into TM500 or TM5000 Power Modules

*Simultaneous AC/DC current measurements. Ideal for measuring currents in switching power supplies, motor controllers, disk drives.*

*AM 5030 automates evaluation, characterization or test system measurements. Ideal for multiple input, repetitive measurements.*

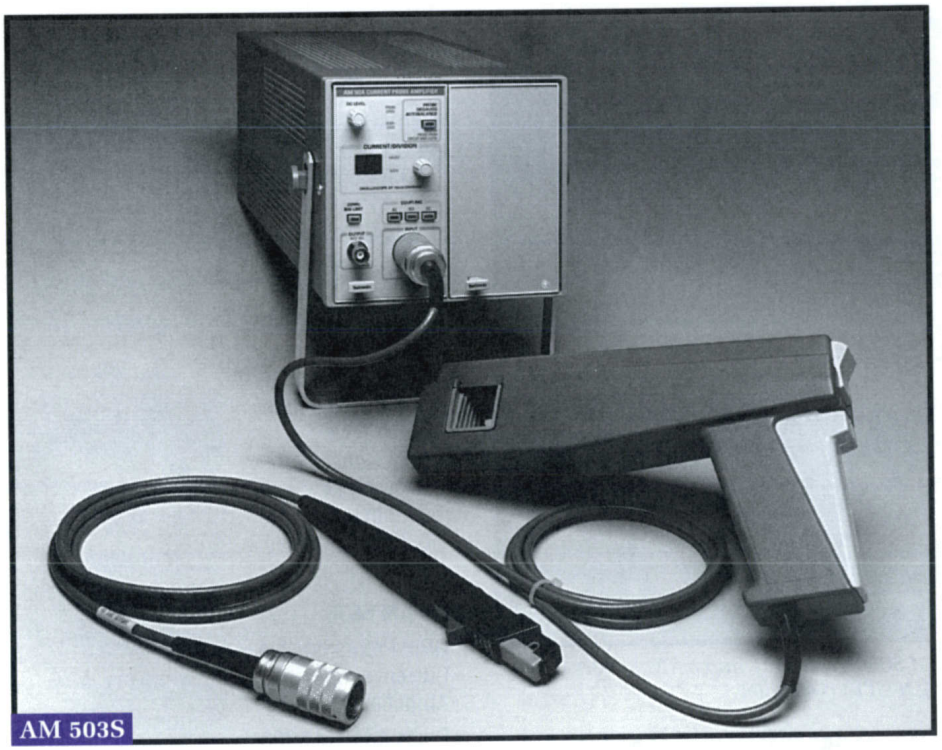
TD

AM 503S, AM 503A, A6302, A6303 available through an Authorized Tektronix Distributor (listed on pages 570-571) and AM 503S also available through TekDirect. Call 1-800-426-2200

AM 5030 available through your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Current Probe Systems

**AM 503S** **AM 503A** **AM 5030** **A6302** **A6303**




*AM 503S with A6302 and A6303 probes.*

**AM 5030** *(continued)*
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 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 100 Amps can be measured by clipping the split-core probes around the conductor. The AM 503S is truly a system, consisting of an AM 503A Current Probe Amplifier, a TM 502A two-wide Power Module, an A6302 Current Probe and a handy plug-in tool-box. Options enable you to add or substitute an A6303 Current probe.

Order AM 503S current probe system data sheet 51W-7955-1 for more information.

**AM 503A CURRENT PROBE AMPLIFIER**
The AM 503A Current Probe Amplifier is the heart of the AM 503S System. The AM 503A 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 A6302/3 Current Probe core.

The AM 503A Current Probe Amplifier is a completely redesigned successor to the AM 503. All functions are microprocessor controlled providing a significant improvement in ease of use and functionality. The AM 503A uses bright easy to read LEDs to display current/Division settings which are controlled with a single knob adjustment. A single push-button provides both Degauss and auto-balance functions. An additional significant improvement with the AM 503A is that individual A6302/3 probes no longer need to be calibrated with a specific amplifier but can be interchanged between AM 503As and AM 5030s.

The AM 503A operates in any TM 500/ TM 5000 Power module. The 50 Ω output of the AM 503A can be displayed on any oscilloscope or measurement instrument that has a sensitivity setting of 10 mV/Division. A 50 Ω output cable and termination is included with the AM 503A. The scope or measurement instrument requires at least a 200 MHz bandwidth to display the full bandwidth of the A6302 and 60 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.

# Current Probe Systems

**AM 503S** **A6302**
**AM 503A** **A6303**
**AM 5030**






*AM 503A Current Probe Amplifier*

## A6302 and A6303 Current Probes

The A6302 and A6303 current probes convert the DC and AC flux field of a conductor to a voltage signal which is sent to the AM 503A Current Probe Amplifier. The A6302/3 probes incorporate both a Hall Effect device which senses DC current and a transformer which senses the AC current. Both probes utilize a bucking current from the AM 503A to completely eliminate core saturation for up to 20A for the A6302 and 100A for the A6303. With the convenient split-core design they are easy to clip on and off of the conductor.

The A6302 and A6303 offer a wide range of current measurement capability. The A6302 covers frequencies from DC to 50 MHz. It clips onto conductors up to 3.81mm(0.15 in) and measures continuous currents up to 20 amps and peak currents up to 50A as long as they do not exceed the Amp*second product of 100A* µS. The larger A6303 is for measuring higher amplitude, lower frequency currents. It clips onto conductors up to 21.1mm (0.83 in). Its frequency range is from DC to 15 MHz and it will measure continuous currents up to 100 amps and peak currents up to 500A as long as they do not exceed the Amp*second product of 10,000A* µS.

The A6302 and A6303 are also compatible with the AM 5030 Programmable Current Probe Amplifier as well as the two channel 11A16 Current Probe Amplifier for 11000 and DSA Series oscilloscopes. With the 11A16, the A6302 is rated for 10.5A and 52.5A for the A6303. The peak AC current ratings for the A6302 can be extended up to 20,000A by using a CT-4 Current Transformer.

### 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. There is a limit to the bucking current of 20A in the A6302 and 100A in the A6303. Up to these amplitudes you need not be concerned about the amp*second product.

## ORDERING INFORMATION

**AM 5030**
Programmable Current Probe Amplifier ..... **$1,995**
**Includes:** 50 Ω BNC cable(012-0057-01); 50 Ω BNC termination (011-0049-01); Instruction Manual(070-8766-00): Reference Card (070-8770-00). The AM 5030 requires an A6302 or A6303 Current Probe and a TM 5003 or TM 5006A power module mainframe. See page 383.

**AM 503S**
Current Probe System ..... TD **$2,745**
**Includes:** AM 503A Current Probe Amplifier; TM 502A Power Module; A6302 Current Probe; Plug-in tool box(016-0362-02); Operator's Manual(070-8170-00).
**Opt. 01** – Adds A6303 Current Probe..... TD **+$1,395**
**Opt. 03** – Substitutes A6303 Current Probe ..... TD **+$650**
**AM 503S Service Manual** – Order 070-8174-00..... **$145**

**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1** – Universal Euro 220 V, 50 Hz. ..... **NC**
**Opt. A2** – UK 240 V, 50 Hz..... **NC**
**Opt. A3** – Australian 240 V, 50 Hz..... **NC**
**Opt. A4** – North American 240 V, 60 Hz..... **NC**
**Opt. A5** – Switzerland 220 V, 50 Hz. ..... **NC**

**AM 503A**
Current Probe Amplifier..... TD **$1,650**
Includes: 50 Ω BNC cable(012-0057-01); 50 Ω BNC termination (011-0049-01); Operator's Manual(070-8170-00). The AM 503A requires one of the TM 500/5000 Series Power modules. See page 383 and 384.

**A6302**
2 m 20A Current probe ..... TD **$795**
**Includes:** 5 inch (130 mm) Ground lead (175-0124-01); 3 inch (75 mm) Ground lead (175-0263-01); 2 miniature alligator clips (344-0046-00).

**A6303**
2 m 100A Current probe..... TD **$1,435**
**Includes:** Carrying case (016-0622-02)

Information for the use of the A6302 and A6303 Current Probes is included in the AM 503S Operator's Manual(070-8170-00). Service information is in the AM 503S Service Manual - (070-8174-00). A6302/3 probes must be used with an AM 503A or AM 5030 Current Probe Amplifier.

TD
AM 503S, AM 503A, A6302, A6303 available through an Authorized Tektronix Distributor (listed on pages 570-571) and AM 503S also available through TekDirect. Call 1-800-426-2200

AM 5030 available through your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# AC Current Probes



*CT-1 and CT-2 Solid Core AC Current Transformers for fast, low amplitude current measurement. The CT-4 enables 20,000 A AC current measurements for automotive, avionics and industrial power applications.*

**CT-1**

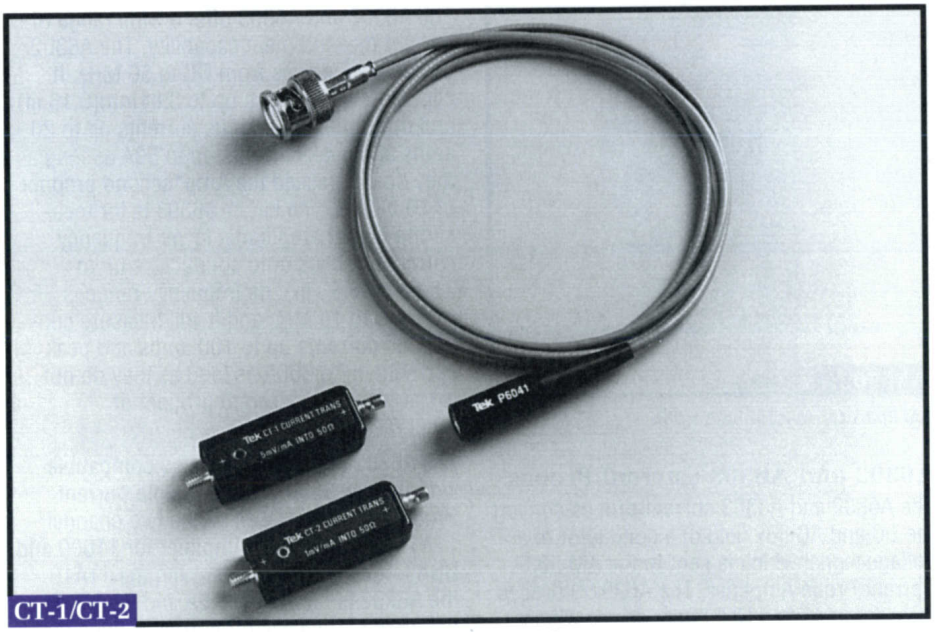
- 25 kHz to 1 GHz
- 12 A Max Pulse Current
- 450 mA Max CW Current
- For 50 Ω Input
- AC Only
- Solid Core
- ESD Testing

**CT-2**

- 1.2 kHz to 200 MHz
- 36 A Max Pulse Current
- 2.5 A Max 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 3000 A RMS
- Accepts 1.5 Inch Diameter Conductors
- Measurements on Bare Conductors to 3000 V
- Nullifies DC Effects to 300 A with DC Bucking Coil
- AC
- Split Core
- Use with A6302 or P6021

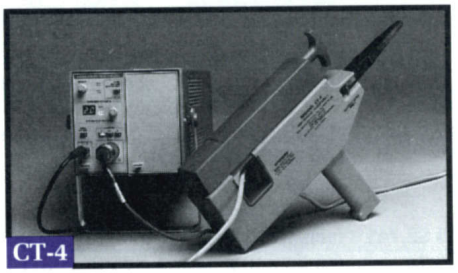



*CT-1/CT-2 Current Probes with P6041 BNC Probe Cable.*

## 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 a high impedance (1 MΩ) oscilloscope input. One probe cable can be used to monitor several current transformers




*AM 503S with CT-4 Current Transformer.*

## 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 clip-on current probes. Maximum low frequency performance down to 0.5 Hz is obtained using the AM 503S. Current amplitudes to 20,000 amps may be measured using the A6302 or P6021 (with passive termination) provided the amp-second ratings are not exceeded.

The CT-4 may be used with the P6021 and 134 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. A DC bucking coil assembly allows up to 300 A of steady state DC to be nullified (derates to 1 MHz B/W). This is very useful for measuring AC signals on top of a constant DC voltage level.

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571).

## ORDERING INFORMATION

**CT-1**
Current Probe, Current Transformer and Probe Cable (42 in.)..... TD **$295**
**Includes:** Instruction Manual (070-0375-01).
**Opt. 09** – Current Transformer only. .....**–$90**

**CT-2**
Current Probe, Current Transformer and Probe Cable ..... TD **$255**
**Includes:** Instruction Manual (070-0406-01).

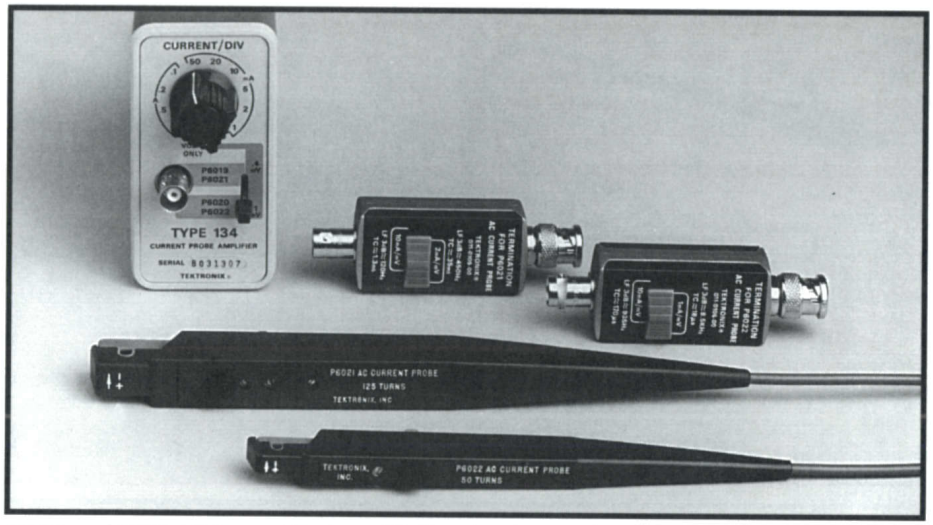
**Opt. 09** – Current Transformer only .....**–$90**
**P6041** – Probe Cable (42 in.) only.....**$95**

**CT-4**
Current Probe with DC Bucking Coil..... TD **$1,625**
**Includes:** Carrying Case (016-0191-03); 12-in. wide, 4 ft. long High Voltage Bushing (015-0194-00); DC Bucking Coil (015-0190-00); Instruction Manual (070-6478-00).

# AC Current Probes








*P6021 and 6022 AC Current Probes with Terminations and 134 Current Probe Amplifier.*

*Versatile Clip-on probes for general purpose AC current measurements.*

**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

**134**
- Amplifier for P6021 and P6022
- P6021: 12 Hz to 38 MHz
- P6022: 100 Hz to 65 MHz

## P6021 Current Probe

The P6021 and P6022 Current Probes with the 134 Current Probe Amplifier provide a versatile AC current measurement system. 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.

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) 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.

## 134 Current Probe Amplifier

The 134 is used to extend the low frequency measurement capabilities and sensitivity of the P6021 or P6022 Current Probes. Using the 134 Amplifier extends the initial P6021 measurement capability of 120 Hz down to 12 Hz. The P6022/134 combination goes to 100 Hz from 935 Hz. The Current/Div switch provides calibrated current steps from 1 mA/div to 1 A/div (with the oscilloscope or plug-in unit adjusted for a deflection factor of 50 mV/div). When using a 134 with a P6021 or P6022, the passive termination is not required.

The 134 can also be used as an auxiliary voltage amplifier by placing the Current/ Div switch in the Volts position.

## ORDERING INFORMATION

**P6021**
5 ft Current Probe with Termination ..... TD **$550**
**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 (070-0947-01).

**P6022**
5 ft. Current Probe with Termination ..... TD **$595**
**Includes:** Same as the P6021; Instruction Manual (070-0948-00).
**Opt. 03 –** 9 ft. with termination, P6021 and P6022 ..... **+$45**

**134**
Current Probe Amplifier ..... TD **$860**
**Includes:** Hanger assembly (014-0029-00); Cable Assembly (012-0104-00); Power Supply (015-0058-02); Instruction Manual (070-0990-01).

**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1 –** Universal Euro 220 V, 50 Hz. ..... **NC**
**Opt. A2 –** UK 240 V, 50 Hz. ..... **NC**
**Opt. A3 –** Australian 240 V, 50 Hz. ..... **NC**
**Opt. A4 –** North American 240 V, 60 Hz. ..... **NC**
**Opt. A5 –** Switzerland 220 V, 50 Hz. ..... **NC**

**ADDITIONAL ACCESSORIES**
**Carrying Case –** For P6021 or P6022, and a 134 Amplifier. Order 016-0087-02 ..... **$80**
**Passive Termination –**
(P6021) – Order 011-0105-00 ..... **$180**
(P6022) – Order 011-0106-00 ..... **$225**
**134 Power Supply –** (110 VAC) Order 015-0058-02 ..... **$290**
**134 Power Supply –** (230 VAC) Order 015-0059-02 ..... **$385**

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.

# High Voltage Probes

**P6015A**
**P6007**
**P6009**

**P400**
**P850**

*P6015A*

*High voltage measurements for auto ignition, transformers, circuit breakers, surge protectors, lightning strike evaluation, avionics: radar, magnetrons, traveling wave tubes, electric ground transportation vehicles, semiconductor production equipment.*

*P6007/P6009*

*Safe measurement of high voltage power supplies, industrial motors.*

*P400/P850*

*Safe floating power measurements for industrial service with 22X Handheld Oscilloscopes.*

TD
Product available through an Authorized Tektronix Distributor (listed on pages 570-571) P6015A, P6007, P6009 also available through TekDirect. Call 1-800-426-2200.

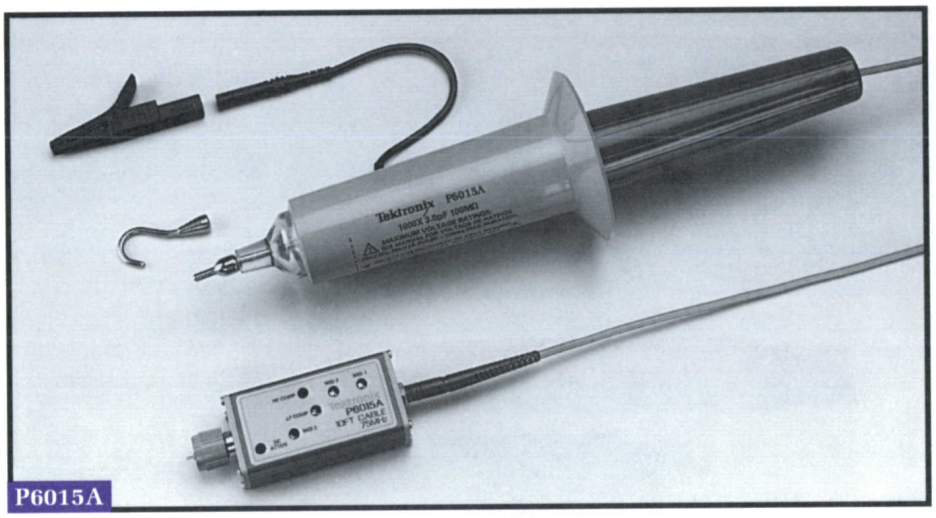
**P6015A**
- High Voltage – 20 kV DC/40 kV Peak (100 ms pulse width)
- High Bandwidth – 75 MHz
- Silicone Dielectric
- Optional 1,000X Coding
- Wide Compensation Range (7-49 pF)
- Heavy Duty Versatile Ground Lead and Clip

**P6007**
- DC to 25 MHz
- 100X
- 1500 VDC + Peak AC
- Low Capacitance – 2.0 pF

**P6009**
- DC to 120 MHz
- 100X with Readout
- 1500 VDC + Peak AC
- Low Capacitance – 2.5 pF

**P850**
- 10X
- DC to 60 MHz
- UL Listed 1244

**P400**
- 1X
- DC to 20 MHz
- UL Listed 1244



P6015A

## P6015A High Voltage Probe

For heavy duty high performance measurements of voltages over 1.5 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.

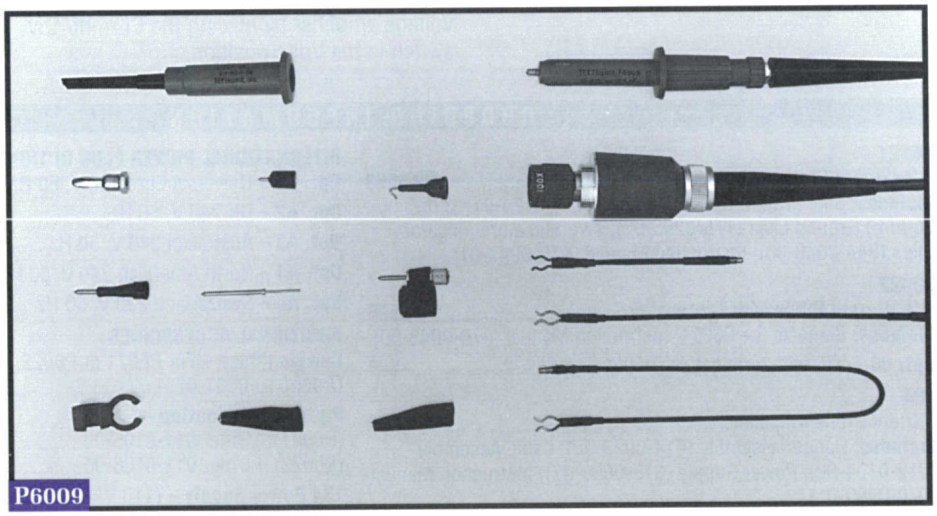
The P6015A uses an environmentally safe silicone compound for a dielectric and never needs refilling. Other features include: a 7-49 pF compensation range, small compensation boxes which fit on adjacent amplifier inputs, and a readout option for use with Tektronix digital scopes. With the readout option, 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.

## P6009 High Voltage Probe

The P6009 is a low input capacitance, high-voltage (1.5 kV) probe designed for higher performance measurements. The probe can be compensated to match plug-ins and oscilloscopes with nominal input capacitances of 8 to 49 pF and input resistance of 1 MΩ.

The P6009 is equipped with a BNC connector that provides CRT Readout information when used with plug-in units and oscilloscopes that have these features.

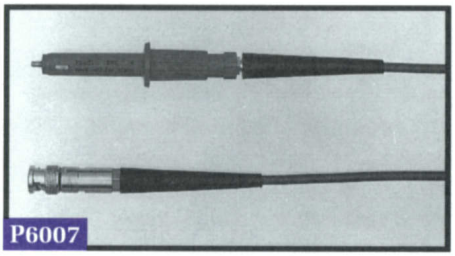

P6009

# High Voltage Probes

**P6015A**
**P6007**
**P6009**

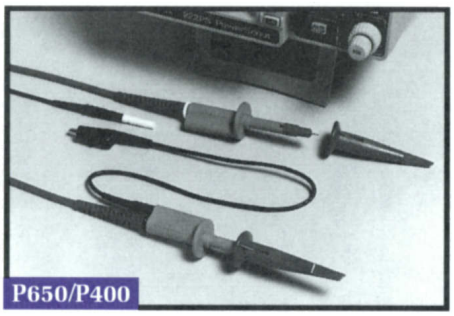
**P400**
**P850**






## P6007 High Voltage Probe

The P6007 is a low input capacitance, high-voltage (1.5 kV) probe. It can be compensated to match all plug-ins and oscilloscopes with nominal input capacitances of 8 to 55 pF and input resistance of 1 MΩ.




*P850 and P400 with 222PS.*

## P400 and P850 Voltage Probes

The P400 and P850 are used with the 222A, 222PS, and 224 handheld oscilloscopes. These oscilloscopes feature two completely isolated floating input channels. The P400 and P850 are UL listed and were specifically designed for making safe power measurements. The P400 is 1X attenuation and the P850 is 10X attenuation. These probes directly plug into the 22X oscilloscopes and are only usable with them. Since the performance of the probes depend on which of the 22X oscilloscopes they are being used with, refer to the characteristics table for specific scope/probe specifications.

## CHARACTERISTICS

**P6015A/P6007/P6009**

| Probe | Nominal Length | Attenuation | Bandwidth | Rise Time | Loading | Max Input V | 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 | 7-49 | No |
| P6015A Opt. 2R | 25 ft. | 1000X | 25 MHz | 14 ns | 100 MΩ/4 pF | 20 kV | 7-49 | Yes |
| P6007 Opt. 01 | 3.5 ft. | 100X | 25 MHz | 14 ns | 10 MΩ/2 pF | 1.5 kV | 8 to 55 | No |
| P6007 | 6 ft. | 100X | 25 MHz | 14 ns | 10 MΩ/2.2 pF | 1.5 kV | 8 to 55 | No |
| P6007 Opt. 03 | 9 ft. | 100X | 25 MHz | 14 ns | 10 MΩ/2.4 pF | 1.5 kV | 8 to 55 | No |
| P6007 Opt. 04 | 12 ft. | 100X | 25 MHz | 14 ns | 10 MΩ/2.6 pF | 1.5 kV | 8 to 55 | No |
| P6009 | 9 ft. | 100X | 120 MHz | 2.9 ns | 10 MΩ/2.5 pF | 1.5 kV | 8 to 47 | Yes |

**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* | 3.5 ft. | 10X | 10 MΩ/4.5 pF | 10 MHz | 10 MHz | 60 MHz | 400 V | 850 V | 850 V |

** 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

**P6015A**
1,000X, 10 ft. High Voltage Probe ..... TD **$950**
**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. ..... **+$55**
**Opt. 25** – 25 ft. without readout. ..... **+$125**
**Opt. 2R** – 25 ft. with readout. ..... **+$170**

**P6007**
100X, 5 ft. High Voltage Probe ..... TD **$165**
**Includes:** Retractable Hook Tip (013-0071-00); Banana Tip (134-0013-00); 5 in. Ground Lead (175-0124-01); 12 in. Ground Lead (175-0125-01); .005 in. Diameter Straight Tip (206-0015-00); .080 in. Diameter Spring Tip (206-0060-00); Hook Tip (206-0105-00); 2 Miniature Alligator Clips (344-0046-00); Probe Holder (352-0090-00); Instruction Manual (070-0388-01).
**Opt. 01** – 3.5 ft. Cable ..... **+$25**
**Opt. 03** – 9 ft. Cable ..... **+$30**
**Opt. 04** – 12 ft. cable ..... **+$35**

**P6009**
100X, 9 ft. High Voltage Probe with Readout ..... TD **$270**
**Includes:** Same as the P6007 plus Bayonet Ground Assembly (013-0052-00); 3 in. Ground Lead (175-0263-01); Instruction Manual (070-0401-01).

**P850**
10X, 3.5 ft. Voltage Probe ..... TD **$100**
**Includes:** Ground Lead (196-3337-00); Accessory Kit (020-1908-00); Data sheet (063-0634-00).

**P400**
1X, 3.5 ft. Voltage Probe ..... TD **$100**
**Includes:** Ground Lead (196-3337-00); Accessory Kit (020-1908-00); Data sheet (063-0634-00).

**RECOMMENDED ACCESSORIES**
See page 466-467 for complete selection information.

TD
Product available through an Authorized Tektronix Distributor (listed on pages 570-571)
P6015A, P6007, P6009 also available through TekDirect. Call 1-800-426-2200.

# A6906S A6905S A6902B A6901 Voltage Isolators

*Safe and Accurate Measurement Solutions for Floating Voltages: Isolation Amplifiers, Indirect Grounding, Differential Measurement Systems, and Isolated Input Oscilloscopes*

**A6906S**
- For Floating Signals to ±850V
- 100 MHz
- Fiber Optic Separation up to 200 meters
- GPIB

**A6905S**
- For Floating Signals to ±850V
- 15 MHz
- Fiber Optic Separation up to 100 meters

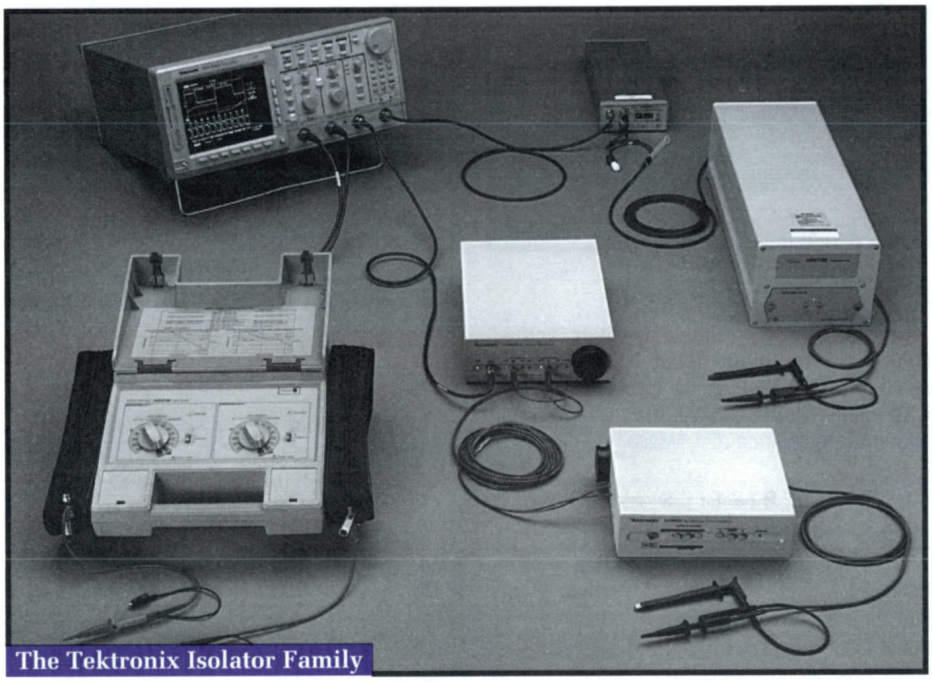
**A6902B**
- For Floating Signals to ±3000V
- 20 MHz
- Dual Channel
- Monolithic

**A6901**
- For Elevation of Test Instrument Chassis to ±40V
- Indirect Grounding

TD

A6902B, A6901 also available through an Authorized Tektronix Distributor (listed on pages 570-571) A6902B, A6905S also available through TekDirect. Call 1-800-426-2200.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.




*The Tektronix Isolator Family; A6902B (left), A6905S and A6906S.*

## Floating Measurements

Isolators enable safe oscilloscope measurements of floating voltages or signals that are not referenced to ground. Isolation amplifiers 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 measurements 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 measurements 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. Common ways of defeating the scope ground are; non monitored isolation transformers, double insulated mains, isolating circuits and the traditional cutting off the ground prong or using a 3-to-2 wire adapter. All of these are dangerous!

Fortunately, there are several solutions available which are not only safe but much more accurate than the dangerous procedures. These fall into four general categories: Isolation Amplifiers, Indirect grounding, Differential measurement systems and Isolated input oscilloscopes.

### 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 Systems provide both isolation and physical separation for signals up to 850 volts 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 dual-channel A6902B uses electro-optical/transformer isolation and is rated for up to 3,000 volts.

### INDIRECT GROUNDING

An indirect grounding device is connected between the scope and the power mains. The A6901 Ground Isolation Monitor allows a scope to float up to a safe level of 40 volts and immediately reconnects to ground when the voltage exceeds this level.

### DIFFERENTIAL MEASUREMENT SYSTEMS

Differential voltage measurements can be made with high accuracy with the P6046 up to 250 volts, and up to 500V with a P6135A Differential Probe Pair and a differential amplifier such as the 11A33. (See page 470).

# Voltage Isolators



### ISOLATED INPUT OSCILLOSCOPES

The 222PS/224 hand held oscilloscopes feature dual input channels, individually isolated from the scope's chassis as well as from each other. With the 850 volt rated P400 and P850 probes floating measurements can be made safely and accurately.

For more information, request Floating Oscilloscope Measurements... And Operator Protection, 60W-8535-0.

### VOLTAGE ISOLATORS

Tektronix offers the most complete line of isolation products to satisfy your floating measurement requirements. The isolation product line presently 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 three different methods for making floating measurements - one of which will be the most appropriate to your specific situation. All four isolators are third party safety certified.

### GROUND ISOLATION

If you are measuring logic levels, concerned with low frequency ground loops or measuring other voltages referenced within 40 volts of above ground, the A6901 Ground Isolation Monitor may be the appropriate solution for your requirements. Connected between a grounded power source and the measurement instrument, it allows your instrument ground to float up to 40 volts. If the voltage potential exceeds 40 volts it immediately reconnects to ground thus preventing exposure to dangerous voltages or voltage stress to the instrument. Since the A6901 is not in the signal path, you can use your preferred probing solution, including active probes.

### 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 two channel voltage isolator, the A6902B, is an economical solution for isolation of power devices with slower switching speeds consistent with its limited dv/dt and slew rate characteristics.

### FIBER OPTIC ISOLATION SYSTEMS

New to our product line, 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.

### 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 amplified 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 5V will result in an output of 0.5 mV. (5V / 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 50V, 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 >.5 V.

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.

### CHARACTERISTICS

| | A6901 | A6902B | A6905S | A6906S |
|---|---|---|---|---|
| Bandwidth(-3 dB) | Instrument Spec | 20 MHz | 15 MHz | 100 MHz |
| Max Voltage | GND ±40 V | 500 V/3,000V*1 | 850V | 850V |
| Common to Gnd Slew Rate | N/A | 500V/µs | 10,000V/µs | 100,000V/µs |
| Separation distance | N/A | 1.8M | 3m, 15m, 50m, 100m | 3m, 10m, 20m, 100m, 200m |
| CMRR @ 60 Hz | N/A | 108 dB*2 | 100 dB*3 | 120 dB*3 |
| @ 1 MHz | N/A | 38 dB*2 | 50 dB*3 | 60 dB*3 |
| @ 10 MHz | N/A | 10 dB*2 | 30 dB*3 | 40 dB*3 |
| Channels | Instrument Spec | 2 | 1 | 1 |
| Isolation Method | Transformer | Optical/transformer | Fiber Optic | Fiber Optic |
| GPIB | N/A | N/A | N/A | IEEE 488.1 |
| Recommended Environment | Ambient | Controlled | Controlled | Ambient |
| Battery operating time | N/A | N/A | 10 Hours | 12 Hours |

*1 *With optional 3,000 V probe*
*2 *With 10X probe*
*3 *With 100X probe*

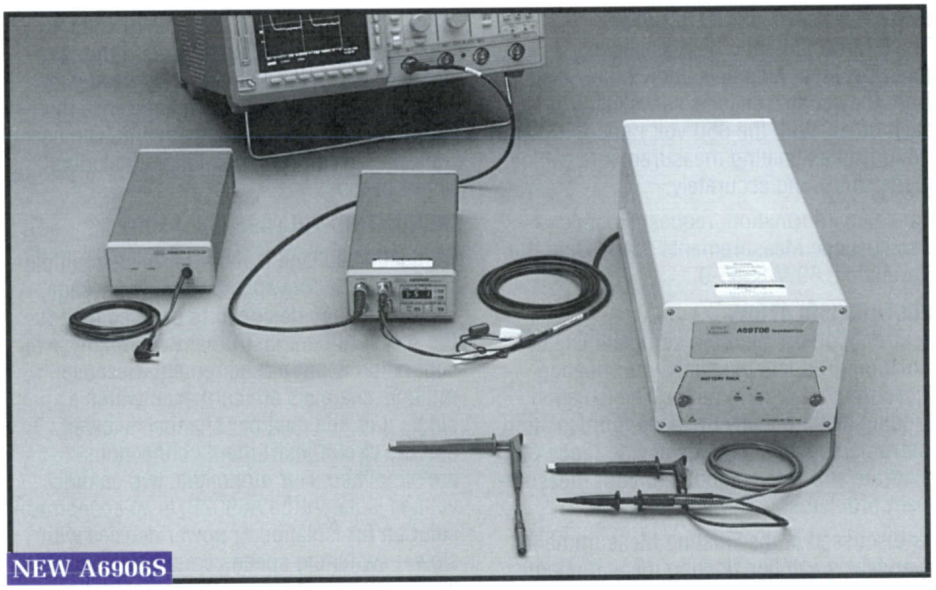
# Isolation Systems



*Provides safe floating measurements for the highest performance switch-mode power electronic circuits.*

**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




## 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.

## 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** –
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.

## ORDERING INFORMATION

**A6906S**
100 MHz Fiber Optic Isolation System (850 V Max) ..... **$6,750**
**Includes:** One 850 V Floating Probe (010-0568-00) includes Industrial Lead Set (012-1392-00); 50 Ω terminator (011-0049-01); 43" 50 Ω cable (012-0057-01); 1 Rechargeable Battery Pack (650-3022-00); A6906S Instruction Manual (070-8900-00).

**Opt. 01** – Substitute 20 meter fiber optic cable ..... **+$200**
**Opt. 02** – Substitute 100 meter fiber optic cable ..... **+$1,200**
**Opt. 03** – Substitute 200 meter fiber optic cable ..... **+$2,500**
**Opt. 04** – Substitute 10 meter fiber optic cable ..... **+$85**

**GPIB Cable** – Order 012-0991-00 ..... **$195**
**75 Ω BNC Cable** – Order 012-0074-00 ..... **$33**
**75 Ω Termination** – Order 011-0055-01 ..... **$50**

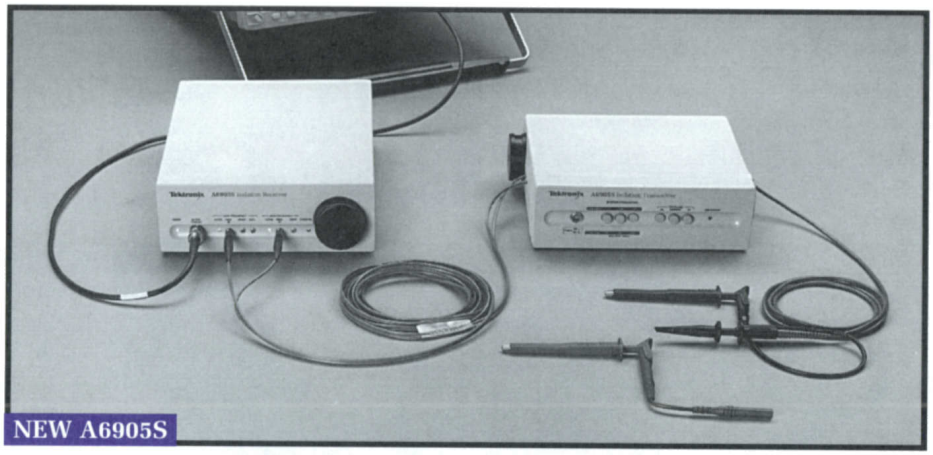
**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1** – Universal Euro 220V, 50 Hz ..... **NC**
**Opt. A2** – UK 240 V, 50 Hz ..... **NC**
**Opt. A3** – Australian 240 V, 50 Hz ..... **NC**
**Opt. A4** – North American 240 V, 60 Hz ..... **NC**
**Opt. A5** – Switzerland 220V, 50 Hz ..... **NC**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# Isolation Systems








**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

*Provides safe floating measurements for most line-operated power electronics devices including switch mode circuits where common-mode slew rates exceed 500 V/µsec.*

## A6905S

The A6905S is the mid line power measurements work horse. 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 volts of isolation capability, with a 15 MHz bandwidth and 10X, 100X and 1,000X attenuation settings. The three meter fiber optic cable is standard. 15m, 50m and 100m 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 offers a significant increase in performance over the A6902B in its ability to reject common mode signals with faster dV/dt transition times.

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.

Order A6905S Fiberoptic Isolation System data sheet 51W-8987-0 for more information.

## 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 1MΩ 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 |
| 10kHz to 100 kHz: | > 90 dB |
| 100 kHz to 1 MHz: | > 50 dB |

**POWER REQUIREMENTS**

**Line Voltage Ranges –** 100 - 132 V, 200 - 242 V.

**Line Frequency Range –** 45 - 65 Hz.

**Maximum Power Consumption –** 15W.

## ORDERING INFORMATION

**A6905S**

15 MHz Fiber Optic Isolation System (850 V Max) ..... TD **$2,695**

**Includes:** One 850 V Floating Probe (010-0565-00), Industrial Lead Set (012-1392-00); 50 Ω terminator (011-0049-01); 43" 50 Ω cable (012-0057-01); 2 Rechargeable Battery Packs (118-9020-00); A6905S Instruction Manual (070-8773-00).

**Opt. 01 –** Substitute 15 M Fiber Optic Cable..... **+$185**

**Opt. 02 –** Substitute 100 M Fiber Optic Cable..... **+$655**

**50 M Fiber Optic Cable –** Order 174-3096-00 ..... **$680**

**INTERNATIONAL POWER PLUG OPTIONS**

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

**Opt. A2 –** UK 240 V, 50 Hz..... **NC**

TD Product available within 24 hours through TekDirect Call 1-800-426-2200.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# A6902B
# A6901

# Voltage Isolators

*A6902B provides safe floating power measurements when the common mode signal is DC, line voltage, or has a slew rate of less than 500 V/µsec.*

*A6901*

*Provides a convenient and safe way to float your measurement instrument up to ±40 Volts from ground. Protects from electric shock. Enables accurate logic level measurements and eliminates ground loop noise.*

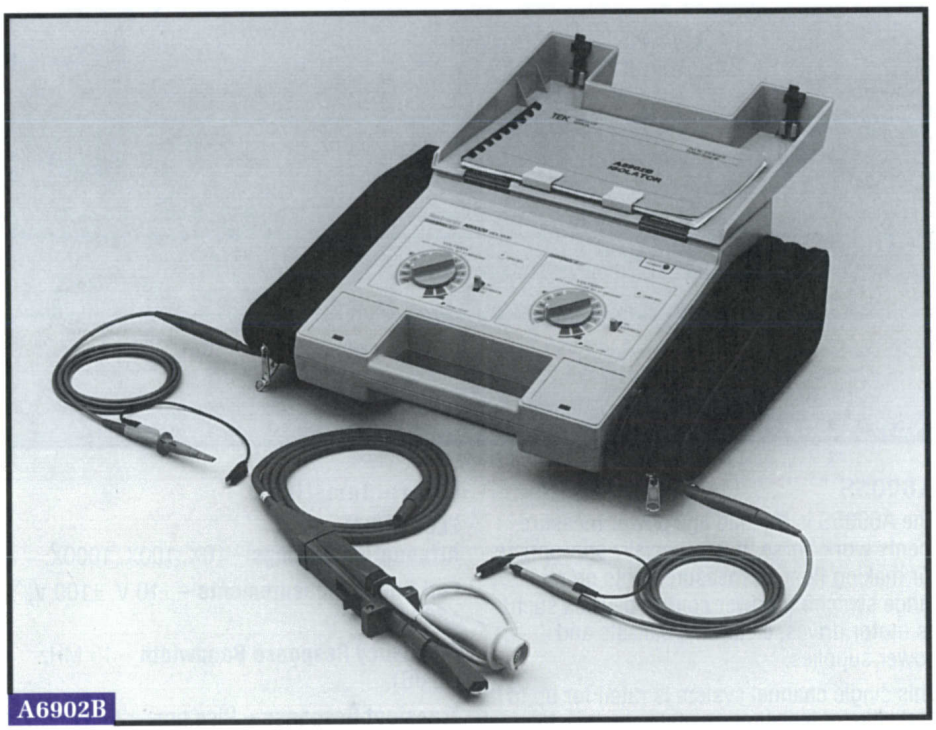
**A6902B**

- Monolithic
- For 50 Ω or 1 MΩ Inputs
- Two Independently Isolated Channels
- High Voltage
- UL Listed to 3000 V/Channel (6000 V Maximum Channel Differential)*1
- DC to 20 MHz Bandwidth

*1 When ordered with Opt. 02 or 09.

**A6901**

- Permits Elevation of Test Instrument Chassis to ±40 V Peak (28 V RMS) from Earth Ground
- UL and VDE Safety Certification
- Connects Between Your Measurement Instrument and Power Outlet Enabling Use of Optimum Low Voltage Probing Solution.




*A6902B with 500 V and 3,000 V probes*

## A6902B Voltage Isolator

The A6902B monolithic isolator offers dual isolated channels for an economical cost per channel, 500 V or 3,000 V probes (provide up to 6,000 V difference between channels), 20 MHz bandwidth and a very convenient means of setting the volts/division output to the measurement instrument. All of this in a convenient, easy to handle portable package. For signals characterized by common to ground slew rates of ≤ 500 V/µs and maximum transition time ≤ 100 V/ns this is a very reasonable solution. The A6902B is very good where the common mode signals are DC or up to 500 Hz, i.e. working with a 60 Hz ground loop problem. The A6902B's non-conductive, durable plastic case is connected to your measurement instrument by a 1.8m (6 ft.) 50 Ω cable.

## A6902B Characteristics

**ELECTRICAL**

**Deflection Factor –** Probe Tip Sensitivity: 20 mV/div to 500 V/div in 1-2-5 sequence with oscilloscope set to 100 mV/div.
**Accuracy:** ≤5% of indicated V/div switch setting.

**Frequency Response Bandwidth –** DC coupled (to –3 dB point) is ≥20 MHz. AC coupled (to lower –3 dB point) is ≤5 Hz to ≥20 MHz (50 to 500 V/div not specified).

**Transient Response –** Rise time ≤17.5 ns.

**Maximum Working Voltage:**
**Small Probe (500 V) –** Probe Center Tip to Earth Ground: 500 V (DC + peak AC). Probe Center Tip to Probe Common: 500 V (DC + peak AC) to 3 MHz. Maximum voltage derates above 3 MHz. Probe Common to Earth Ground: 500 V (DC + peak AC) to 6 MHz. Maximum voltage derates above 6 MHz.

*Continued on next page.*

TD
Product available through an Authorized Tektronix Distributor (listed on pages 570-571). A6902B also available through TekDirect. Call 1-800-426-2200.

# Voltage Isolators





## A6902B Characteristics *(continued)*

**Large Probe (AC Coupled) –** Probe Center Tip to Earth Ground: 500 V (DC + peak AC).

**Large Probe (DC Coupled) –** Probe Center Tip to Earth Ground: UL 3000 V. Probe Center Tip to Probe Common: UL 3000 V (DC + peak AC) to 450 kHz. Maximum voltage derates above 450 kHz. Probe Common to Earth Ground: UL 3000 V (DC + peak AC) to 250 kHz. Maximum voltage derates above 250 kHz.

**Maximum Input dV/dt –** 100 V/ns.

**Input Impedance –** Resistance: 10 MΩ ±3%.

**Capacitance –** ≈ 19 pF with either probe.

**Output Impedance –** 50 Ω ±5%.

**Output Drive –** 4 V p-p into 1 MΩ.

**Common-Mode Capacitance –** 100 pF from probe common to earth ground.

**Max Common to Ground Slew Rate –** 500 V/µs.

**Tangential Noise –** ≤20 mV.

**DC Drift with Temperature –** ≤10 mV/°C or 0.1 div/°C at output.

**Range of Output DC Level –** At least +5 div from center screen.

**Channel Isolation –** Maximum Voltage: Using two 3,000 V UL probes is 6000 V (DC + peak AC) UL. Using two 500 V probes is 1000 V (DC + peak AC).

**Delay –** 51 ns ±3 ns (large probe), 52 ns ±3 ns (small probe), from probe input to instrument input. CH 1, CH 2 delay difference is ≤4 ns.

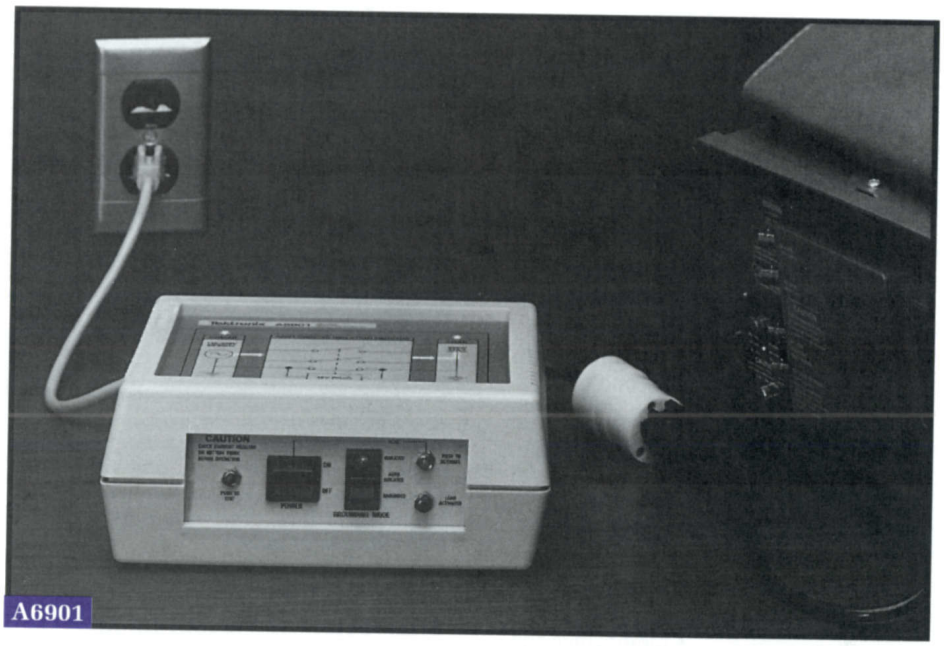
**Common Lead Signal Feedthrough –** –106 dB from probe input to output BNC to 500 Hz. Derated above 500 Hz.

**POWER REQUIREMENTS**

**Line Voltage Ranges –** Low: 90 to 132 V. High: 180 to 250 V.

**Line Frequency Range –** 48 to 440 Hz.

**Maximum Power Consumption –** 24 W at 115 V, 60 Hz.



A6901

## A6901 Ground Isolation Monitor

Placed between a measurement instrument and its power source, the A6901 Ground Isolation Monitor acts as an indirect grounding device, allowing floating measurements to be made with operator protection.

The A6901 monitors the voltage on the isolated system. When the voltage exceeds 40 V peak (28 V RMS) the power source to the instrument is interrupted, the isolated grounding system is connected to the power source grounding system, and an audible alarm is sounded. Before power is supplied to the measurement instrument, the A6901 tests the power source for a functional ground*[1]. If a functional ground is not established, the ground isolation monitor will not go into isolated mode.

## A6901 Characteristics

**ELECTRICAL**

**Trip Voltage (DC) –** 40 V peak (28 V RMS) or ±40 V (within 5%).

**Trip Current –** 0.5 mA, 3.5 to 5 mA selectable.

**Neutral-to-Ground Continuity –** Between 3 and 10 V RMS (8.5 and 28.3 V p-p), 50 Hz.

**DC Voltage Trip Delay –** < 20 ms.

**Line Voltage Ranges –** 90 to 128 V RMS, 180 to 250 V RMS.

**Line Frequency Range –** 48 to 66 Hz.

**Maximum Power Consumption (No External Load) –** 12 W at 115 V, 60 Hz.

**Load Power –** 500 W maximum.

*[1] *If the A6901 is used in conjunction with a GFI (Ground Fault Indicator), consult the GFI manual for compatibility information.*

## ORDERING INFORMATION

**A6902B**

Voltage Isolator ..... TD **$2,300**

**Includes:** Two 500 V Isolation Probes (010-0411-15); Right Angle Power Cord (161-0104-00); Two 72 in (183 cm), 50 Ω Output Cables (012-0204-00); Operator Manual (070-5614-01).

**Opt. 02 –** Add two 3,000V Large Probes (010-0409-01) ..... **+$660**

**Opt. 09 –** Add two 3,000V Large Probes plus two 4 mm Banana Adapters ..... **+$760**

**Service Manual –** Order 070-5615-03 ..... **$24**

**INTERNATIONAL POWER PLUG OPTIONS**

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

**Opt. A2 –** UK 240 V, 50 Hz. ..... **NC**

**Opt. A3 –** Australian 240 V, 50 Hz ..... **NC**

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

**Opt. A5 –** Switzerland 220 V, 50 Hz ..... **NC**

**A6901**

Ground Isolation Monitor ..... TD **$1,800**

**Includes:** Operator Manual (070-3618-00).

**INTERNATIONAL POWER PLUG OPTIONS**

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

**Opt. A2 –** UK 240 V, 50 Hz. ..... **NC**

**Opt. A3 –** Australian 240 V, 50 Hz ..... **NC**

**Opt. A5 –** Switzerland 220 V, 50 Hz ..... **NC**

*Opt. A4, North American 240 V not available due to lack of a grounded neutral connection in the 240 V North American system.*

TD
Product available through an Authorized Tektronix Distributor (listed on pages 570-571) A6902B also available through TekDirect. Call 1-800-426-2200.

# Instantaneous Time-Interval to Voltage Converter



*A clear view into digital and PWM control.*

*Compatible with analog scopes, digital scopes, and waveform analyzers.*

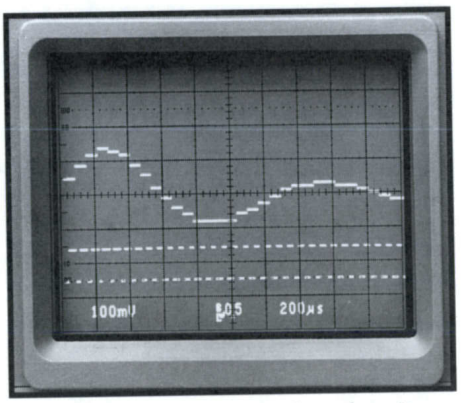
**TVC 501**

- Real time Scope Display of Time-Interval Variations vs. Time
- Time Delay, Pulse Width, and Period Measurements
- >2 Million Uninterrupted Event-by-Event Measurements/ Second

**APPLICATIONS**

- Switch Mode Power Supply PWM
- UPS Sinewave Synthesis
- Motor Drive and ASD Control
- Optical Encoder and Digital Servo Timing
- Engine Control Module PWM
- Processor Throughput Performance
- Digital Glitch Detection
- Telecom Signalling
- Oscillator Start-Up and PLL Acquisition Timing
- Switch and Relay Bounce Dynamics

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571).




*The TVC 501 instantaneously and continuously converts consecutive timing measurements to a time-interval vs. time waveform. The top trace (TVC output) shows the pulse-to-pulse width vs. time variations of the lower stream of pulses.*




## The Need for Time-Interval Measurements

Measuring parameters is no longer as simple as recording voltage vs. time. In digital or switching systems, signals are sampled, pulse-coded, or pulse-width modulated. Relevant information is in the varying time intervals between the signal transitions. It is in these time intervals that failures often occur. For example, control pulse widths in a switching power supply can be too long or short which can overdrive output transistors. Or an embedded controller's interrupt latency can be too long which can cause a system crash.

Timing variations typically appear as left-to-right motion or jitter on a scope. Timebase or trigger holdoff adjustments may improve display stability but do not show timing dynamics. The TVC 501 untangles the often confusing waveforms in digital systems and delivers a coherent and real-time view.

### SAME SCOPE, MORE POWER

The TVC 501 adds three measurement functions to your scope's voltage vs. time capability: time-delay vs. time, pulse-width vs. time, and period vs. time.

The TVC continuously measures the timing parameter and instantaneously generates a voltage proportional to the measurement. Timing measurements are made with crystal controlled accuracy using digital counters. Conversions are performed pulse-to-pulse without averaging. The TVC output goes to any scope. The TVC 501 provides seven vertical scales from 1 µsec to 1 sec per division. Up to 30,000 divisions of offset permit small timing variations to be viewed on events with large average values.

### REAL TIME

There is no resetting or rearming. The continuous TVC output becomes another trace on your scope that can be correlated, measured, and analyzed with waveforms on other channels. Since the TVC generates voltages proportional to time-intervals, you can set your scope to trigger on timing violations such as a time-delay that exceeds a threshold or an incorrectly narrow pulse or glitch.

### QUICK RESULTS

The TVC output is calibrated to drive any scope channel set to 100 mV per division. One key press can automatically set the trigger level or the measurement range. You can use the monitor output signal to verify that the TVC is measuring what you actually want it to measure. The TVC can also generate demonstration signals to quickly familiarize you with its operation.

### FLEXIBLE CONFIGURATION

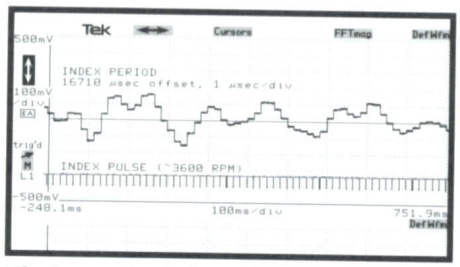
The TVC 501 can be used with other TM 500/5000 modular instruments in a suitable power module mainframe. See page 351.

### APPLICATION INFORMATION

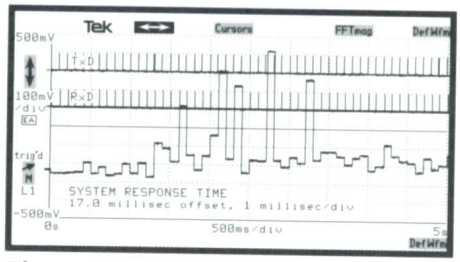
The TVC 501 Applications Brochure (60W-7869-00) includes a concept introduction and over 100 pages of application ideas that can help you apply the TVC. Several applications of the TVC 501 are illustrated in the following figures.

# Instantaneous Time-Interval to Voltage Converter

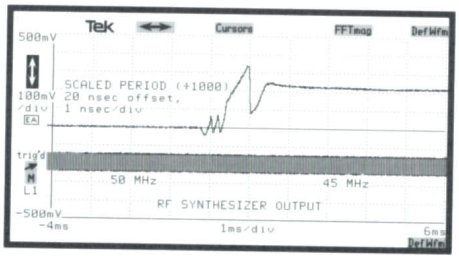




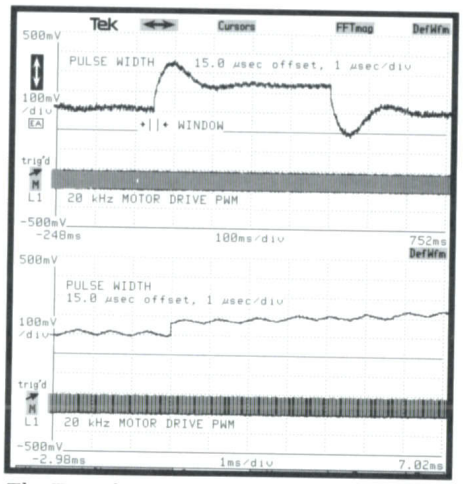

*The lower signal shows the once per revolution disk drive index pulse. The TVC measures the pulse-to-pulse period variations and generates the upper waveform. The timing offset was set to 16710 µsec to show the ±2 µsec period variations.*



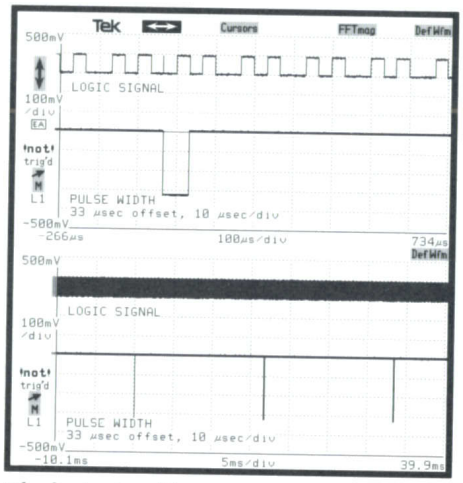

*The upper two traces show the TxD and RxD signals on a terminal-mainframe RS-232 link. The TVC measures each delay between a character sent to the mainframe and the subsequent response. With an offset of 17 msec, the response time range was about 14-21 msec.*




*Using the built in prescaler, the TVC uncovers the ~3 msec settling interval of an RF synthesizer switching from 50 MHz to 45 MHz. The period shifts from 20.0 to 22.2 nsec.*




*The TVC shows the pulse width variations of a motor drive signal as the controller jogs the speed (upper screen). The 20 kHz PWM signal itself is a blur. On the lower screen the two signals are windowed around the transition. The TVC unveils an instantaneous step in pulse width as well as a pulse width oscillation.*




*The logic signal has a constant 33 µsec pulse width, but there is an occasional glitch. In the width mode, the TVC instantly responds to the glitch and recovers after the next pulse. Over a longer measurement interval (lower screen), the logic signal appears as a blur; the TVC shows that the glitch is periodic.*

## Characteristics

**A AND B CHANNEL INPUTS (BNC)**

**Impedance –** 1 MΩ, ≤50 pF.

**Coupling –** AC or DC selectable.

**Trigger Slope –** Rising or falling edge selectable.

**Trigger Level –** Adjustable in 10 mV steps in ±1.25 V window, 100 mV steps in ±12.5 V window when using 10X probes. Digital trigger level readout decodes Tektronix readout probes.

**Sensitivity –** ~10 nsec pulses at 250 mV.

**TIMING MEASUREMENTS**

**Functions –** A-Period, A-Width, A-to-B Delay.

**Scope Viewing Range –** ±4 divisions around Conversion Offset, out-of-range LED flags conversions outside of viewing range.

**Conversion Offset –** Adjustable to 30,000 divs in 0.1 div increments.

**Conversion Scale –** 1 µsec/div to 1 sec/div in 7 decade steps.

**Best Timing Resolution –** 33 nsec at 1 µsec scale (1/30th of a division).

**Uninterrupted Rate –** Up to 2.5 MHz (400 nsec between events), random sampling LED flags missed measurements.

**MEASUREMENT OUTPUT (BNC)**

**Voltage Range –** ±400 mV into 1 MΩ. Corresponds to ±4 vertical scope divisions when scope set to 100 mV/div. Automatically clips outside of ±4 division range.

**Response Time –** voltage settles <500 nsec after end of event.

**A AND B MONITOR OUTPUTS (SMB)**

**Voltage Range –** ~0-500 mV into 1 MΩ. Goes high when input meets trigger slope and level criteria.

**B Monitor Prescaler –** Can generate one pulse every 100 or every 1000 triggers to measure high frequency oscillators (>100 MHz).

**B Monitor Demonstration –** Can generate 5 different digital demonstration signals.

## ORDERING INFORMATION

**TVC 501**
Instrument Module..... TD **$2,495**
**Includes:** 2 Monitor Cables; 1 Output Cable; 1 P6109B 10X Readout Probe; Operator's Manual (070-7991-00); Service Manual (070-7992-00). Requires a TM 500/5000 Power Module. See pages 383 and 384.

**ADDITIONAL ACCESSORIES**

**Monitor cable –** 42 in SMB-BNC Order 012-0532-00 ..... **$75**

**Output cable –** 42 in BNC-BNC Order 012-0057-01 ..... **$30**

**50 Ω BNC Feed Through Termination –** Order 011-0049-01 ... **$37**

**P6408 16-Bit Word Recognizer –** Use the P6408 when time-intervals are defined by a bus address ..... TD **$500**

**P6420 RF Probe –** 10 kHz-1 GHz. Demodulates RF bursts for pulsed RF timing measurements. ..... TD **$200**

**P6009 100X Readout Probe –** Extends trigger voltage range to ±125V for high voltage pulses. ..... TD **$270**
See probes section for other readout probes and input terminations.

**BNC Adapter –** Converts P6109 Probe Tip to BNC male. Order 013-0084-01 ..... **$15**

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571).

# P6602
# P6008
# P6420

# Specialty Probes

*The P6008 provides voltage measurements in extreme environments.*

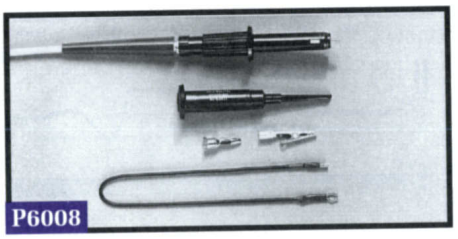
*The P6420 is ideal for transmitter or receiver design, RF power measurement and RF demodulation testing.*

*The P6602 provides circuit board thermal analysis, heat sink evaluation, and hot spot detection.*

**P6008**
- –50°C to +150°C Temperature Range
- 100 MHz, Environmental

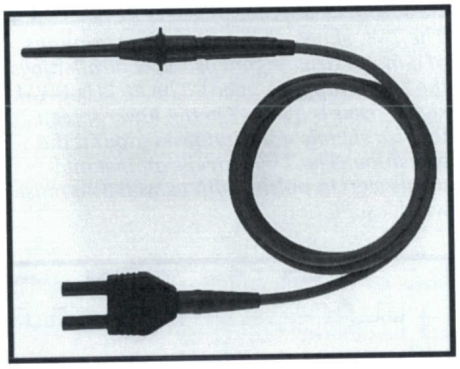
**P6420**
- RF Probe
- 10 kHz to 1 GHz Bandwidth
- Voltage Range 0.5 to 25 V RMS (70.7 V p-p)
- For DMM or Oscilloscope
- UL Listed 1244

**P6602**
- Temperature measurements from –62°C to 240°C
- Use with TM500/5000 and Tektronix Oscilloscope DMMs
- UL Listed 1244




## P6008 Environmental Probe

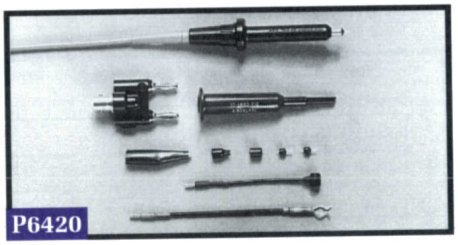
The P6008 Environmental Probe operates over –50°C to +150°C for the probe body and cable; the compensation box operates from –15°C to +55°C. The P6008 is compatible with the #6-32 screw-tip accessories.



## For DMM Input

The P6602 is a temperature-measuring device designed to operate with the DM504A, DM5110 and DM511 Digital Multimeters, or with the 2236A oscilloscope and the 2445B, 2455B, and 2465B with DMM. The temperature-sensing element consists of a thin-film platinum resistor on the tip of the probe. Measurements are made by touching the probe tip to the test surface. The thermal signal is transmitted to the associated digital multimeter through a two-conductor cable.

The probes are totally immersible except in liquids that are incompatible with Polyetherether-ketone (PEEK) compounds. The sensor, tip, and cable are limited to a maximum of 240°C.




## P6420

The P6420 radio frequency (RF) probe measures high frequency AC voltage from 10 kHz to 1 GHz. It provides a DC output voltage proportional to the RMS value of a sine-wave input. It can be used with a DMM; or with an oscilloscope for RF envelope analysis.

### CHARACTERISTICS

| Probe Type | Nominal Length | Attenuation | Bandwidth | Rise Time | Loading Input R/C | Max V (DC + pk AC) | Instrument Input R/C |
|---|---|---|---|---|---|---|---|
| **P6008** | 6 ft | 10X | 100 MHz | 3.5 ns | 10 MΩ/7.5 pF | 600 V | 1 MΩ/12-47 pF |
| **P6420** | 2 m | N/A | 10 kHz to 1 GHz | N/A | 10 MΩ/3.7 pF | 42.2 V | 10 MΩ DMM |

### ORDERING INFORMATION

**P6008**
100 MHz Environmental Probe ..... TD **$395**
**Includes:** Retractable Hook Tip (013-0071-01); Banana Tip (134-0013-00); 12 in. Ground Lead (175-0125-01); Alligator Clip (344-0045-00); Probe Holder (352-0090-00); Instruction Sheet.

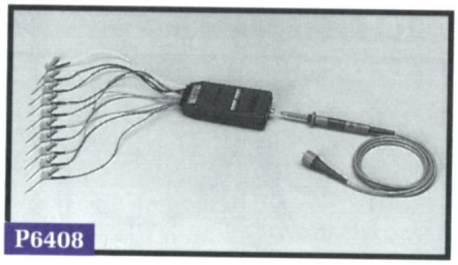
**P6602**
1.5 m Temperature Probe ..... TD **$335**
**Includes:** Instruction Manual (070-4038-00).

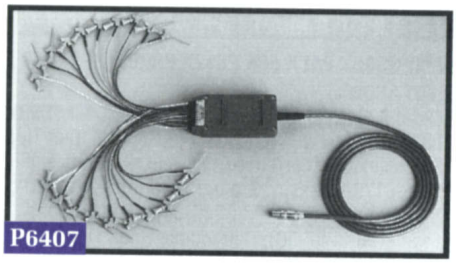
**P6420**
2 m RF DMM Probe ..... TD **$200**
**Includes:** Retractable Probe Tip (013-0097-01); Two Alligator Clips (344-0046-00); Two Replaceable Probe Tips; Insulating Ground Cover (166-0404-01); 3 in. Ground Lead (175-0849-00); 6 in. Ground Lead (175-1017-00); Probe Holder (352-0351-00); BNC Female to Dual Banana Adapter (103-0090-00); Data Sheet.

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571).

# Word Recognizer Trigger Probes






### P6407/P6408

The P6407 and P6408 are 16-Bit word recognizer trigger probes for use with analog and digital storage oscilloscopes. They allow 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 P6407 is available as an option to 2400-Series oscilloscopes and may be field-added to 2400-Series digital storage oscilloscopes. The trigger word is programmed from the oscilloscope's front panel.

The P6408 may also be used with 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.

The P6408 can be used with the TVC 501 to detect interrupt response faults, monitor subroutine timing, or verify PWM digital generation in embedded processor applications. Refer to the TVC 501 Applications Brochure (60W-7869) for further information.

### P6407/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
- P6407 – Use with 2400-Series Oscilloscopes
- P6408 – Use with any Oscilloscope

*Oscilloscope triggering on user-defined logic states.*

## CHARACTERISTICS

| | P6407 | P6408 |
|---|---|---|
| Input Channels – Data (Clock/Qualifier)/Power (Ground) | 16 ( 2 )/1 ( 2 ) | 16 ( 1 )/1 ( 2 ) |
| Input Logic Level – HI (ONE)/LO (ZERO) | ≥ 2.0 V / ≤ 0.6 V | ≥ 2.0 V / ≤ 0.7 V |
| Input Loading Current – HI (ONE)<br>– LO (Zero) | 20 mA max @ 2.5 V<br>–600 mA max @ 0.5 V | 20 mA max @ 2.7 V<br>–600 mA max @ 0.5 V |
| Maximum Input Voltage Swing | –0.5 V to ≤ 5.5 V | 0 V to ≤ V cc |
| Max Non-destructive Input Voltage | –0.7 V to 5.5 V | –1 V (LO) to +15 V (HI) |
| Word Recognizer Output Level – HI (ONE)/LO (ZERO) | ≥ 2.0 V/≤ 0.5 V | ≥ 200 mV/≤ 70 mV |
| **Asynchronous Mode** | | |
| Maximum Trigger Frequency | 10 MHz | 20 MHz |
| Minimum Coincidence Between Data Inputs Resulting in a Trigger | 85 ns | 40 ns |
| Max Coincidence Between any Two Data Inputs Without Producing a Trigger | 20 ns | 40 ns |
| Delay of Input Word Coincidence to Word Out | ≤140 ns | 20 ns |
| **Synchronous Mode** | | |
| Data Setup Time | 25 ns | |
| Data Hold Time | 0 ns | |
| Minimum Clock Pulse Width High / Low | 20 ns / 20 ns | |
| Minimum Clock Period | 50 ns | |
| Delay of Selected Clock Edge to Word Out | ≤ 55 ns | |
| Power Requirements | Provided by Host 2400 Series Instrument | +5 V ±0.25 V 100 mA max. |
| Recommended Instrument | 2400 Series with Word Recognizer Option | Any instrumentation with 8 to 35 pF inputs. |

## ORDERING INFORMATION

**P6407**
Word Recognizer/Trigger Probe ..... TD **$750**
**Includes:** Two (10 wide) Lead Headers (012-0747-01); Pkg. of 20 SMT KlipChip™ Adapters (SMG50); Instruction Sheet (070-5582-00).

**P6408**
Word Recognizer/Trigger Probe ..... TD **$500**
**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 ..... **$60**
Used with 1101A Power Supply.

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571) P6408 also available through TekDirect. Call 1-800-426-2200.

# Probe Accessories Packs Test Leads, Cables

## ORDERING INFORMATION – SELECTION GUIDE




**ACCESSORY PACK/MINIATURE PROBE TIPS**
Order 020-1724-00 ..... TD **$41.00**
**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 (214-4125-01).

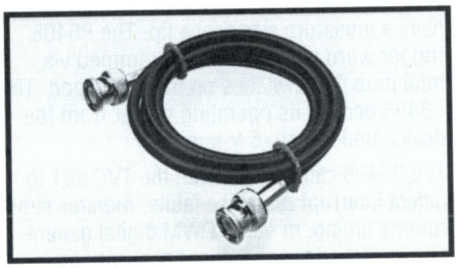



**ACCESSORY PACK/P613X**
**COMPACT AND SUBMINIATURE**
Order 020-1835-00 ..... TD **$90.00**
**Includes:** Screwdriver (003-1433-00); Retractable Hook Tip (013-0107-07); Retractable Hook Tip (013-0208-02); 2 in. Ground Lead (195-4240-00); 3 in. Ground Lead (196-3113-03); 6 in. Ground Lead (196-3113-02); 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 #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).

TD
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

**ACCESSORY PACK FOR P612X PROBE TIPS (NOT SHOWN)**
Order 020-1836-00 ..... TD **$55.00**
**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 #6-32 Connector (344-0046-00); SMT KlipChip™ (206-0364-00); Spring Ground (214-4125-00).



## Test Leads

**ALM01**
UL listed red and black test lead set with miniature size probe tips. Incorporates shrouded banana plugs and includes two retractable hook tips ..... **$25.00**

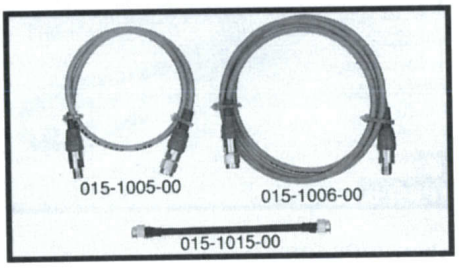
## Cables

**COAXIAL BNC CABLES**
**50 Ω**

| | | |
|---|---|---|
| 012-0057-01 | 42 in., male to male | **$30.00** |
| 012-0076-00 | 18 in., male to male | **$33.00** |
| 012-0104-00 | 18 in., male to female | **$32.00** |
| 012-0127-00 | 18 in., BNC male to BSM female | **$48.00** |
| 012-0208-00 | 10 in., male to male | **$28.00** |
| 012-0482-00 | 36 in., precision (1%) male to male | **$35.00** |
| 012-1341-00 | 36 in., male to male | **$55.00** |
| 012-1342-00 | 24 in., male to male TD | **$60.00** |

**75 Ω**

| | | |
|---|---|---|
| 012-0074-00 | 42 in., male to male | **$33.00** |
| 012-1337-00 | 60 in., male to male TD | **$55.00** |
| 012-1338-00 | 36 in., male to male | **$55.00** |
| 012-1339-00 | 24 in., male to male | **$55.00** |




**COAXIAL SMA (3MM) 50 Ω CABLES**
**General Purpose Flexible Cables**

| | | |
|---|---|---|
| 174-1364-00 | 12 in., male to male TD | **$40.00** |
| 174-1427-00 | 20 in., male to male TD | **$65.00** |
| 174-1428-00 | 60 in., male to male | **$80.00** |

**Precision, Flexible Delay Cables**

| | | |
|---|---|---|
| 015-0560-00 | 2 ns, male to male | **$565** |
| 015-0561-00 | 5 ns, male to male | **$675** |
| 015-0562-00 | 1 ns, male to male | **$515** |
| 015-1005-00 | 2 ns, male to female | **$345** |
| 015-1006-00 | 5 ns, male to female | **$315** |
| 015-1019-00 | 1 ns, male to female | **$335** |

**Semirigid Delay Cables**

| | | |
|---|---|---|
| 015-1015-00 | 500 ps, 4.5, male to male | **$37.00** |
| 015-1017-00 | 750 ps, male to male | **$60.00** |

**PATCH CORDS (Not Shown)**
**BNC to BNC, 18 in.**

| | | |
|---|---|---|
| 012-0086-00 | Black | **$12.00** |
| 012-0087-00 | Red | **$19.50** |

**BNC to Banana Plug-Jack, 18 in.**

| | | |
|---|---|---|
| 012-0090-00 | Black | **$11.25** |
| 012-0091-00 | Red | **$10.75** |

**Banana Plug-Jack to Banana Plug-Jack, 18 in.**

| | | |
|---|---|---|
| 012-0031-00 | Red | **$13.75** |
| 012-0039-00 | Black TD | **$13.75** |

**Pin-Jack to Pin-Jack, 0.08 in. dia-pin**

| | | |
|---|---|---|
| 012-0179-00 | Red, 8 in. | **$6.00** |
| 012-0180-00 | Red, 18 in. | **$5.50** |
| 012-0181-00 | Black, 8 in. | **$6.00** |
| 012-0182-00 | Black, 18 in. | **$7.50** |

**INTERFACE CABLES (Not Shown)**
**GPIB**

| | | |
|---|---|---|
| 012-0991-00 | 2m, double-shielded TD | **$195** |
| 012-0991-01 | 1m, double-shielded TD | **$195** |
| 012-0991-02 | 4m, double-shielded | **$315** |

**Centronics**

| | | |
|---|---|---|
| 012-1233-00 | 3 m, 4693 to Terminal | **$180** |
| 012-1250-00 | 8 ft. Male Centronics to PC 25-Pin D TD | **$55.00** |
| 012-1284-00 | 9 ft. Male to Male | **$35.00** |

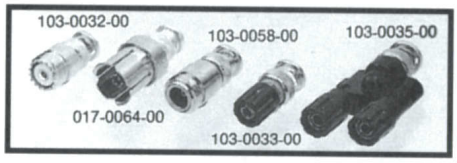
**RS-232C**

| | | |
|---|---|---|
| 012-0911-00 | 10 ft. DB25 male – DB25 female, straight through | **$100** |
| 012-1285-00 | 9 ft. DB25 male – DB25 female, null modem | **$50.00** |
| 012-1298-00 | 9 ft. DB25 male – DB9 female, null modem TD | **$45.00** |
| 131-4923-00 | DB25 male – DB25 male gender changer | **$18.00** |

# Adapters, Connectors and Adapter Kits

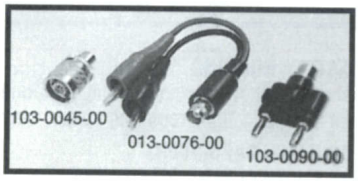


## ORDERING INFORMATION – SELECTION GUIDE

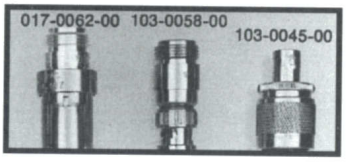



### BNC ADAPTERS

| | | |
|---|---|---|
| 103-0032-00 | BNC male to UHF female | $10.25 |
| 017-0064-00 | BNC male to GR | $150 |
| 103-0058-00 | BNC male to N female ... TD | $18.75 |
| 103-0033-00 | BNC male to binding post ... TD | $7.50 |
| 103-0035-00 | BNC male to dual binding post ... TD | $21.00 |




| | | |
|---|---|---|
| 103-0045-00 | BNC female to N male ... TD | $21.00 |
| 013-0076-00 | BNC female to Clip Leads ... TD | $55.00 |
| 013-0076-01 | BNC female to EZ ball .... TD (not shown) | $32.00 |
| 103-0090-00 | BNC female to dual banana ... TD | $15.50 |




### N STYLE ADAPTERS

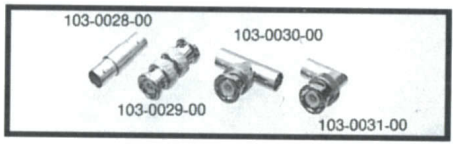
| | | |
|---|---|---|
| 017-0062-00 | N female to GR | $145 |
| 103-0058-00 | N female to BNC male ... TD | $18.75 |
| 103-0045-00 | N male to BNC female ... TD | $21.00 |

### 3.5 MM ADAPTERS (NOT SHOWN)

| | | |
|---|---|---|
| 015-0551-00 | Male to male | $400 |
| 015-0550-00 | Female to female | $355 |
| 015-0552-00 | Male to female connector saver | $280 |

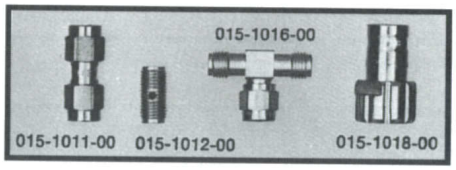
### SMA ADAPTERS (NOT SHOWN)

| | | |
|---|---|---|
| 015-0572-00 | SMA female to BNC male | $28.00 |
| 015-0554-00 | SMA male to BNC female | $47.00 |
| 015-1009-00 | SMA male to N-female | $70.00 |
| 015-0553-00 | Threaded female to male slip on connector | $46.00 |
| 015-0549-00 | Male to female connector saver *1 | $185 |




### BNC CONNECTORS

| | | |
|---|---|---|
| 103-0028-00 | BNC female to BNC female ... TD | $12.75 |
| 103-0029-00 | BNC male to BNC male | $14.25 |
| 103-0030-00 | BNC T ... TD | $14.75 |
| 103-0031-00 | BNC elbow male to female | $13.50 |

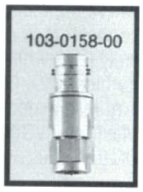



### SMA CONNECTORS

| | | |
|---|---|---|
| 015-1011-00 | SMA male to male | $30.00 |
| 015-1012-00 | SMA female to female | $12.00 |
| 015-1016-00 | SMA T | $50.00 |
| 015-1018-00 | SMA male to BNC female | $14.00 |

**1 Used permanently installed on instrument to prolong life of instrument connector.*




### MISC. CONNECTORS

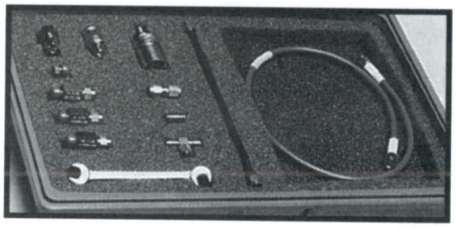
| | | |
|---|---|---|
| 013-0126-00 | "F" Female to BNC male | $24.00 |
| 103-0158-00 | "F" Male to BNC female | $15.50 |



### BNC ADAPTER KIT

AK01 BNC Adapter Kit ... **$440**

**Includes:** 50 Ω Feed-through termination 011-0049-01; 50 Ω 10X Attenuator 011-0059-02; 50 Ω, 5X Attenuator 011-0060-02; 50 Ω, 6 dB Attenuator 011-0069-02; 50 Ω, Coax Cable, 42 in. (2 each), 012-0057-01; GR to BNC Female Adapter 017-0063-00; BNC Female to BNC Female Adapter 103-0028-00; BNC "T" 103-0030-00; BNC elbow male to female 103-0031-00; BNC female to dual banana 103-0090-00; BNC male to BNC male 103-0029-00.



### SMA ADAPTER KIT

AK02 SMA Adapter Kit ... **$1,080**

**Includes:** 4.5 in. Semi-Rigid Cable w/Male Connectors (015-0015-00); 1 m, Flexible, 50 Ω Cable w/Male Connectors (174-1341-00); 2X attenuator (015-1001-00); 5X Attenuator (015-1002-00); 10X Attenuator (015-1003-00); GR to SMA Female Adapter (015-1008-00); SMA Male to SMA Male Adapter (015-1011-00); SMA Female to SMA Female Adapter (015-1012-00); SMA "T" (015-1016-00); SMA Male to BNC Female (015-1018-00); 50 Ω Termination (015-1022-00); SMA Female to BNC Male Adapter (015-0572-00).

**1 Contact your Tektronix representative for price information.*

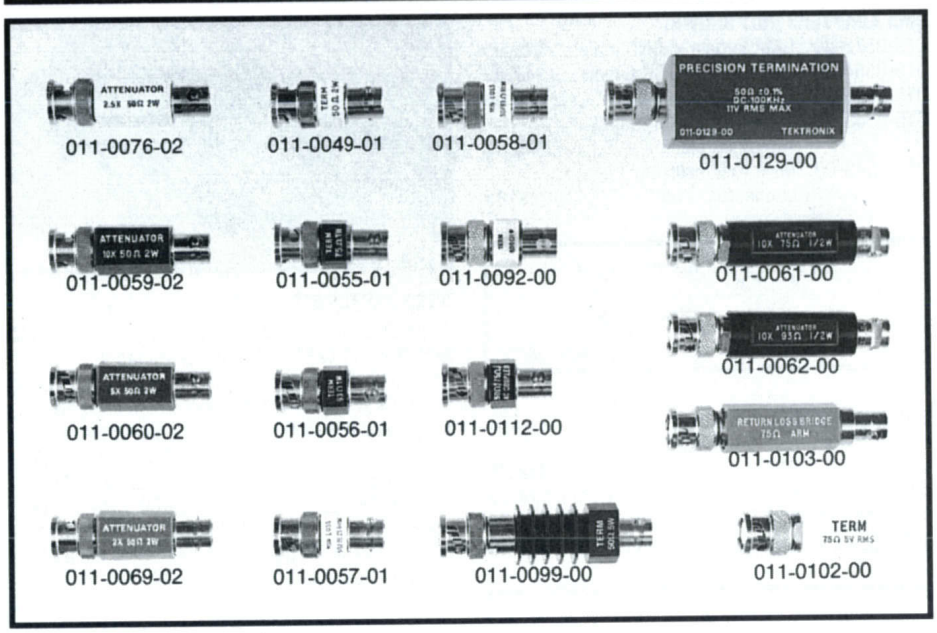
TD

Product also available within 24 hours through TekDirect. Call 1-800-426-2200

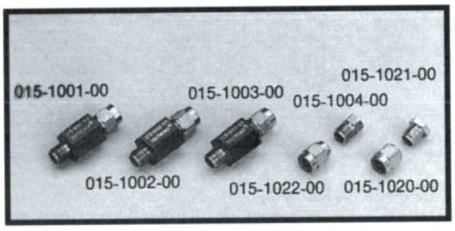
To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Attenuators

## ORDERING INFORMATION – SELECTION GUIDE




*BNC (See table next page)*




*SMA (See table next page)*



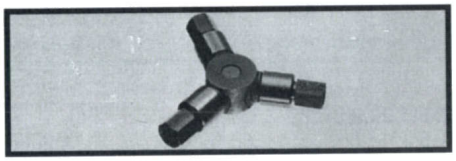
**ACCESSORY HOUSING** 011-0081-00 .....**$105**
Accessory housing without electrical components is useful for applications requiring special circuitry.

**50 Ω COUPLING CAPACITORS**
Coupling Capacitor SMA 015-1013-00 .....**$380**

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).

**3.5 MM TERMINATIONS (NOT SHOWN)**

| | | |
|---|---|---|
| 011-0149-00 | Female 50 Ω | **$1,935** |
| 011-0150-00 | Female short-circuit | **$385** |
| 011-0148-00 | Male 50 Ω | **$1,935** |
| 011-0151-00 | Male short-circuit | **$330** |



**50 Ω POWER DIVIDER**

| | | |
|---|---|---|
| 015-0565-00 | SMA female connector | **$445** |
| 015-1014-00 | SMA male connector | **$315** |
| 017-0082-00 | GR connectors | **$1,300** |

Designed for use in broad-band 50 Ω systems where the mismatch introduced by ordinary "Tee" connectors is undesirable. Load isolation is nominally 6 dB while the voltage attenuation ratio is nominally 2X (input to either load arm, other load arm terminated in a standard 50 Ω termination). Maximum VSWR on the 015-1014-00 is 1.50 from DC to 12.00 GHz and 1.90 from 12.01 to 18.00 GHz.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Attenuators/Terminations



## ATTENUATORS/TERMINATIONS SELECTION GUIDE

**BNC 50, 75, and 93 Ω** (See photo next page)

| | Type | Impedance (Ohms) | Z-Tol. (Ohms) | Atten. | Atten. (db) | Tol. (db) | Freq. (dc to) (Watts) | Avg. Power (Watts) | Peak Power | Max. VSWR | Price |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 011-0049-01 | Feed-through termination | 50 | ±1 | NA | NA | NA | 1 GHz | 2 | 300 | 1.2-DC to 1 GHz | TD $37.00 |
| 011-0059-02 | Attenuator | 50 | ±1 | 10X | 20 | ±0.4 to1 GHz<br>±0.6 1-2 GHz | 2 GHz | 2 | 500 | 1.1-DC to 1 GHz<br>1.2-1 to 2 GHz | $75.00 |
| 011-0060-02 | Attenuator | 50 | ±1 | 5X | 14 | ±0.4 to1 GHz<br>±0.6 1-2 GHz | 2 GHz | 2 | 500 | 1.1-DC to 1 GHz<br>1.2-1 to 2 GHz | $55.00 |
| 011-0069-02 | Attenuator | 50 | ±1 | 2X | 6 | ±0.3 to1 GHz<br>±0.5 1-2 GHz | 2 GHz | 2 | 500 | 1.1-DC to 1 GHz<br>1.2-1 to 2 GHz | TD $75.00 |
| 011-0076-02 | Attenuator | 50 | ±1 | 2.5X | 8 | ±0.3 to1 GHz<br>±0.5 1-2 GHz | 2 GHz | 2 | 500 | 1.1-DC to 1 GHz<br>1.2-1 to 2 GHz | $60.00 |
| 011-0099-00 | Feed through termination | 50 | ±0.5 | NA | NA | NA | 200 MHz | 5 | | 1.1-DC to 100 MHz<br>1.2-100 to 200 MHz | $70.00 |
| 011-0055-01 | Feed through termination | 75 | ±1 | NA | NA | NA | 100 MHz | 1 | 300 | 1.1-DC to 100 MHz | TD $50.00 |
| 011-0056-01 | Feed through termination | 93 | ±1 | NA | NA | NA | 100 MHz | 1 | 300 | 1.1-DC to 100 MHz | $48.00 |
| 011-0057-01 | Min. loss attenuator | 50-75 | | 2.3X | 7.2 | ±0.5 | 100 MHz | 0.5 | | 1.1-DC to 100 MHz | $55.00 |
| 011-0058-01 | Min. loss attenuator | 50-93 | | 2.3X | 7.2 | ±0.5 | 100 MHz | 1.2 | | 1.1-DC to 100 MHz | $47.00 |
| 011-0061-00 | Attenuator | 75 | | 10X | 20 | | | 0.5 | | | $55.00 |
| 011-0062-00 | Attenuator | 93 | | 10X | 20 | | | 0.5 | | | $40.00 |
| 011-0092-00 | Feed through termination | 600 | ±6 | NA | NA | NA | 1 MHz | 1 | | | $42.00 |
| 011-0112-00 | Min loss attenuator | 75-50 | | | | | | 2 | | (AC coupled) | $105 |
| 011-0129-00 | Feed through termination | 50 | ±0.05 | NA | NA | NA | 100 kHz | | | | $195 |
| 011-0102-00 | Coax termination | 75 | ±0.5 | NA | NA | NA | | 0.5 | | | $33.00 |
| 011-0103-00*1 | Return loss bridge | 75 | ±0.5 | NA | NA | NA | | | | | $32.00 |

**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 next page)

| | Type | Impedance (Ohms) | Z-Tol. (Ohms) | Atten. | Atten. (db) | Tol. (db) | Freq. (dc to) (Watts) | Avg. Power (Watts) | Peak Power | Max. VSWR | Price |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 015-1001-00 | Attenuator | 50 | ±1.0 | 2X | 6 | ±0.3 | 18 GHz | 1 | 500 | 1.15-DC to 4 GHz<br>1.25-4 to 12.4 GHz<br>1.35-12.4 to 18 GHz | $225 |
| 015-1002-00 | Attenuator | 50 | ±10 | 5X | 14 | ±0.5 | 18 GHz | 1 | 500 | 1.15-DC to 4 GHz<br>1.20-4 to 8 GHz<br>1.25-8 to 12.4 GHz<br>1.35-12.4 to 18 GHz | $210 |
| 015-1003-00 | Attenuator | 50 | ±1.0 | 10X | 20 | ±0.5 | 18 GHz | 2 | 500 | 1.15-DC to 4 GHz<br>1.20-4 to 8 GHz<br>1.25-8 to 12.4 GHz<br>1.35-12.4 to 18 GHz | $235 |
| 015-1004-00 | Termination (female) | 50 | ±0.5 | NA | NA | NA | 18 GHz | 0.5 | 200 | 1.05-DC to 4 GHz<br>1.10-4 to 12.4 GHz<br>1.15-12.4 to 18 GHz | $80.00 |
| 015-1020-00 | Short-circuit termination (male) | 0 | | NA | NA | NA | 18 GHz | NA | NA | | $31.00 |
| 015-1021-00 | Short-circuit termination (female) | 0 | | NA | NA | NA | 18 GHz | NA | NA | | $33.00 |
| 015-1022-00 | termination (male) | 50 | ±0.5 | NA | NA | NA | 18 GHz | 0.5 | 100 | | $50.00 |

TD
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# HC100
# HC220

# Four Color Plotter/ Low Cost Bubble Jet Printer

*Color or laser quality hard copy at the touch of a button!*

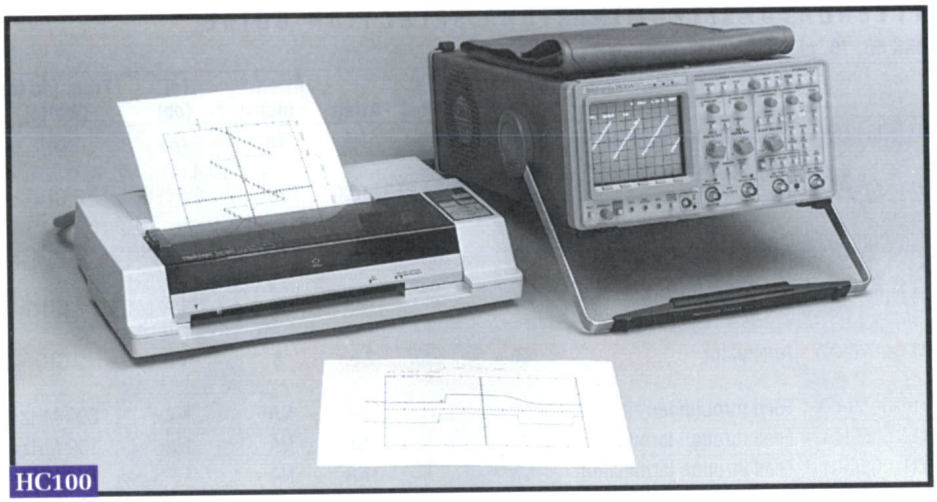
**APPLICATIONS**
- Business Reports
- Presentations

**PRODUCT COMPATIBILITY**
- TDS Series
- 11000 Series
- Most PC Systems

**HC100**
- Direct Plots from Most Tek Digitally-Based Instruments Without Using a Controller
- Standard Interfaces:
  - Centronics Parallel
  - GPIB
- Optional Interface:
  - RS-232C Serial
- A4 and US Letter Sizes
- Four Plotting Modes, Including HPGL

**HC 220**
- Direct Plots in About 90 Seconds
- Compact Size
- Inexpensive
- Accurate and Fast
- Laser Quality Printouts

TD
Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.


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 (HP-GL, Epson HI 80, Graphtec commands sets), printer (Epson RX-80 compatible), self tests (HP-GL and standard plotter). The HC100 is shipped in the HP-GL mode.

Plotter operation is supported by HP-GL (Hewlett-Packard Graphics Language). Tek codes and formats are also supported on the GPIB interface.

Other modes in the HC100 include Graphtec emulation and Epson RX80 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.

Both graphics and text can be plotted in color. There are three types of pens used: fiber-tip pens with water-based ink for paper, fiber-tip pens with oil-based ink for overhead projection film, and ball-point pens with water-based ink for paper. Ball point pens produce a finer line than a fiber pen. Additional or replacement pens are available through Tektronix.

The HC100 pen cartridge holds four pens. The pens can be different colors, ink types, or point styles. The pen cartridge is easily changed allowing you to quickly change colors or pen types.

The HC100 cannot be used in a multi-controller environment, such as with a GPIB instrument and GPIB controller, unless attached to the controller (IBM PC or equivalent). Multiple GPIB controllers on one bus does not conform to IEEE-488 standards.

## 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.

**RS-232C BOARD SPECS**

**Asynchronous –** Bit Rate: 75 BPS to 19,200 BPS. Note: HC100 Opt. 03 is set at 9,600 baud. Buffer: 32K.

**POWER REQUIREMENTS**

**Line Voltage –** Standard: 117 VAC ±10%; Options A1-A5: 220 V/240 VAC ±10%.

**Line Frequency –** 49.5 Hz to 60.5 Hz.

**Power Consumption –** 30 W.

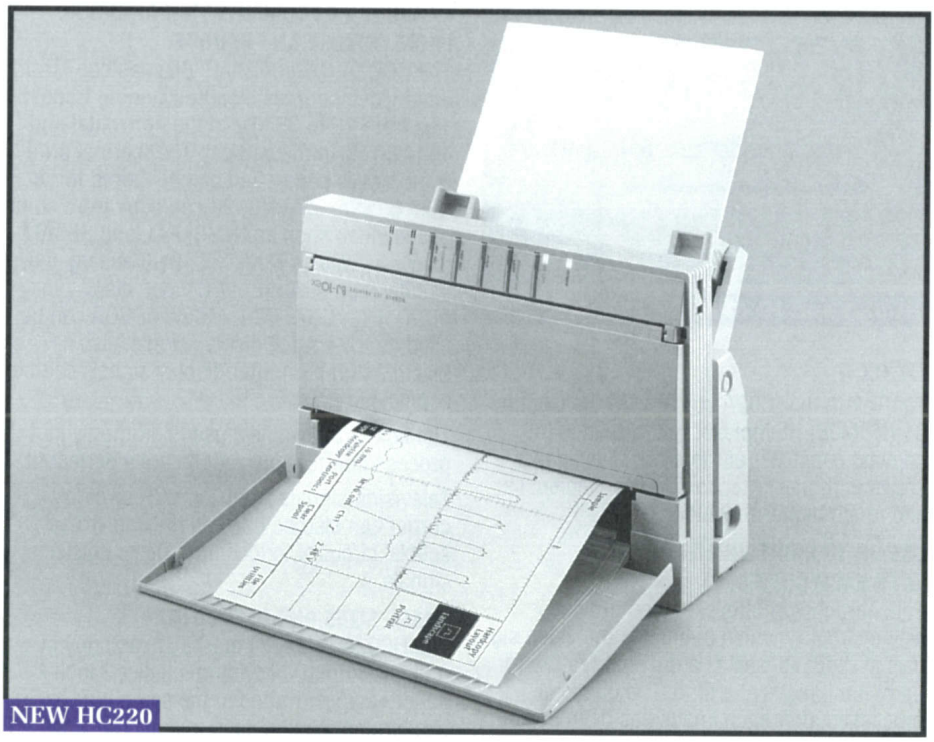
**PHYSICAL CHARACTERISTICS**

| Outside Dimensions | in. | cm |
|---|---|---|
| Width | 16.5 | 41.5 |
| Height | 3.2 | 8.1 |
| Depth | 10.8 | 27.2 |
| **Weight** | **lb.** | **kg** |
| | 13.2 | 6 |

# Four Color Plotter/ Low Cost Bubble Jet Printer

**HC100**
**HC220**






## Laser Quality Printer

The 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 (DPI), 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 time-consuming tractor feed edges to tear off or fuzzy ends. The more traditional dot-matrix printers make a lot of noise, while the whisper quiet HC220 (less than 45 dBA acoustic noise level) doesn't require bulky and ineffective noise suppression boxes. Finally, the versatile HC220 is compatible with your customer's PCs or other Centronics port instruments.

The HC220 comes standard with a 110V transformer/power cord, detailed instruction manual and an initial ink cartridge. Replacement cartridges are available at most computer or office supply stores. The optional automatic paper feeder is highly recommended for customers who print frequently. A one year manufacturer's warranty applies to the HC220.

## ORDERING INFORMATION

**HC100**
Color Plotter..... TD **$1,145**
**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 (070-6441-00); One pen cartridge (016-0876-00)

**Opt. 01** – 1M GPIB Cable. Order 012-0991-01 .....**+$115**

**Opt. 02** – DB-25 M to Centronics M Cable for PCs. Order 012-1250-00 (Both Opt. 01 and 02 may be ordered)....**+$53**

**Opt. 03** – Deletes GPIB I/F Board, and adds RS-232C I/F Board; includes DB-9 to DB-25. RS-232 Cable. Order 012-1298-00 .....**NC**

**Opt. 04** – Parallel Cable for use with oscilloscopes .....**+$30**

**Opt. 05** – Serial Cable for use with oscilloscopes.....**+$36**

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 .....**NC**

**Opt. A2** – United Kingdom 240 V, 50 Hz.....**NC**

**Opt. A3** – Australian 240 V, 50 Hz.....**NC**

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

**Opt. A5** – Switzerland 220 V, 50 Hz .....**NC**

See General Customer Information Section for additional description.

**ADDITIONAL ACCESSORIES**

**Extra Pen Cartridge** – Order 016-0876-00.....**$24**

**Pens** – Four colors (black, red, green, blue) in each package:
Fiber tip, aqueous ink. Order 016-0879-00.....**$13**
Fiber tip/oil-based ink. Order 016-0878-00.....**$13**
Ball point/aqueous ink. Order 016-0877-00.....**$13**

**Pens** – black, four
Fiber tip, aqueous ink. Order 016-0939-00.....**$13**
Fiber tip, oil-based ink. Order 016-0940-00.....**$13**
Ball-point, aqueous ink. Order 016-0941-00.....**$13**

**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 .....**$315**
RS-232C Interface Board Kit. Order 021-0458-01 .....**$395**

**Cable** – Data cable. 10 ft., male to male with 9-Pin DB connectors. Order 174-0537-01 .....**$21**

**HC100 Technical Manual** – Order 070-6441-00.....**$70**

**HC220**
Bubble Jet Printer..... TD **$349**

**Automatic Paper Feeder** – Order 436-0268-00 .....**$95**

**ADDITIONAL ACCESSORIES**

**36-Pin male to male Centronics 9 ft. Cable** – Order 012-1284-00.....**$35**

**DB-25 male to 36-Pin male Centronics 9 ft. Cable** – Order 012-1250-00.....**$55**

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571) or through TekDirect. Call 1-800-426-2200.

**HC02A**
**HCM08**

# Video Hardcopy

## HC02A and HCM08 Video Hardcopy System

*From multiple video displays to only one Video copier – introducing the HCM08.*

*From video terminal displays or IBM PC VGA or Mac IIs – introducing the HC02A.*

**HC02A**

- Archivable thermal prints
- Modular system
- Safety certified
- 8 inputs to one copier
- 256 grey levels, resolution to 544 x 640 lines on output
- HC02A can also copy from:
  – IBM PC
  – Macintosh II
  – Television
  – VCR
  – Camcorder

**APPLICATIONS**

- Replacement for Tektronix 4632 copiers in most video environments
- Multiplex input from:
  – Tektronix terminals
  – Foxboro terminals
  – IBM terminals
  – DEC terminals
  – HP terminals


HC02A and HCM08

### HC02A

The Tektronix HC02A copier with the Option 01 (HCM08) multiplexer unit provides the copying capability of the 4632 silver-paper copier with newer technology conveniences and much higher resolution.

**USE UP TO EIGHT VIDEO SOURCES WITH EACH COPIER.**

This hardcopy multiplexer also provides active circuitry which maintains the video signals at 0 dB, as well as a queuing feature for up to ten images at a time. The queue is processed after each image has been copied.

With the HC02A copier in autocut mode, the copier only needs to be tended when the paper supply runs out.

The HCM08 multiplexer unit, which is also available as the HC02A Option 01, is the perfect compliment to the HC02A. The time between copies can be adjusted from 5 seconds to 50 seconds, allowing the use of different copiers and copier capabilities.

The HCM08 has the following inputs: eight BNC video inputs; eight 15-Pin D connectors for 4632-compatible protocol; one timing adjustment knob for printing delay.

The HCM08 has the following outputs: one hardcopy trigger to HC02A; one BNC video output to HC02A.

**HARDCOPY DOCUMENTATION/ARCHIVAL FROM ALMOST ANY SOURCE**

The HC02A (Mitsubishi P78U) can copy from most video sources by autoscanning frequencies from 15 to 35 kHz in the horizontal and 45 to 80 Hz in the vertical. The thermal print is on plastic paper, and can be stored for at least 5 years. The HC02A can copy from composite video such as NTSC, PAL and SECAM inputs as well as from TTL, RGB analog and parallel inputs. An IBM PC video display in MDA, HGC, CGA, EGA, MCGA or VGA can be used as the source display signal, also Macintosh II computer display signals can be copied.

The Foxboro terminals used commonly in process control applications are a perfect fit.

Television signals from TV, VCR or camcorder can also be used as the copier has special circuitry to lock onto these noisier signals.

**IMAGE SIZES AND RESOLUTION**

The HC02A (Mitsubishi P78U) can copy in a multiple format, providing smaller 3 inch x 4 inch images printed in the same time as one large 6 inch x 8 inch image. The large print can be made in reverse, sideways or normal directions.

**Safety** – HCOM UL Listed 1950, Certified CSA C22.2 No. 231-M89.

## ORDERING INFORMATION

**HC02A**
Mitsubishi P78U High-Resolution Video Copier ..... **$3,200**
**Opt. 1** – Video Copier 8:1 Multiplexer unit (HCM08) ..... **+$1,590**

**HCM08**
Video Copier Multiplexer. ..... **$1,900**

**WARRANTY**
**HCM08** – Tektronix one year warranty.
**HC02A** – Mitsubishi warranty covers parts and labor for six months

**ADDITIONAL ACCESSORIES**
**Cables** – 50 Ω
10 in., male to male. Order 012-0208-00 ..... **$28**
18 in., male to male. Order 012-0076-00 ..... **$33**
24 in., male to male. Order 012-1342-00 ..... **$60**
36 in., male to male. Order 012-1341-00 ..... **$55**
36 in., precision (1%) male to male. Order 012-0482-00 ..... **$35**
42 in., male to male. Order 012-0057-01 ..... **$30**
18 in., male to female. Order 012-0104-00 ..... **$32**
18 in., BNC male to BSM female. Order 012-0127-00 ..... **$48**
**Cables** – 75 Ω
24 in., male to male. Order 012-1339-00 ..... **$55**
36 in., male to male. Order 012-1338-00 ..... **$55**
42 in., male to male. Order 012-0074-00 ..... **$33**
60 in., male to male. Order 012-1337-00 ..... **$55**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Recommended Camera Adapters





## RECOMMENDED CAMERA ADAPTERS

| Instruments | C-9 Hood | Price | C-30BP Bezel Adapter | Price |
|---|---|---|---|---|
| 300 Series*1 | None Available | | Opt. 01<br>016-0327-01 | $270 |
| 308*1 | Not Recommended | | Not Recommended | |
| 370, 371 | Opt. 07, 016-0357-03 | $48 | Not Recommended | |
| 400 Series*1 | Opt. 20<br>016-0359-03 | $48 | Opt. 01<br>016-0269-03 | $165 |
| 400 Series with 0.8 cm. graticule:<br>422, 453, 454, 485, 491*1 | None Available | | 016-0306-01 | $155 |
| 492A/P, 494/P, 495, 496/P | Opt. 07, 016-0357-03 | $48 | 016-0248-01 | $165 |
| 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 | $48 | 016-0248-01 | $165 |
| 529, 576 | None Available | | None Available | |
| 600 Series | Opt. 07<br>016-0357-03 | $48 | Opt. 01, 016-0248-01<br>(NR for 10x12cm size) | $165 |
| 1240 | Not Recommended | | Not Recommended | |
| 1400 Series (not 1480C) | Opt. 07, 016-0357-03 | $48 | 016-0248-01 | $165 |
| 1500 Series | None Available | | Opt. 01, 016-0327-01 | $270 |
| 1700 Series | Opt. 20<br>016-0359-03 | $48 | Opt. 01, 016-0269-03<br>(NOT 1740 or 1750 Series) | $165 |
| 2200 Series | Opt. 20*2<br>016-0359-03 | $48 | Opt. 01<br>016-0269-03 | $165 |
| 2300 Series | Opt. 1P, 20*2<br>016-0359-03 | $48 | None Available | |
| 2400 Series | Opt. 20<br>016-0359-03 | $48 | Opt. 01<br>016-0269-03 | $165 |
| 2700 Series*1 | Opt. 20<br>016-0359-03 | $48 | Opt. 01<br>016-0269-03 | $165 |
| 2754/55/P Spectrum Analyzers | Opt. 07, 016-0357-03 | $48 | 016-0248-01 | $165 |
| 5000 Series*1 | Opt. 07, 016-0357-03 | $48 | Not Recommended | |
| 5030, 5031*1 | None Available | | None Available | |
| 5400 Storage<br>5403/D41, 5441, D41 | Opt. 07<br>016-0357-03 | $48 | 016-0248-01 | $165 |
| 7000 Series*1 | Opt. 07,<br>016-0357-03 | $48 | Opt. 01<br>016-0248-01 | $165 |
| 7000 Large-Screen<br>7403, 7603, 7603N | Opt. 07<br>016-0357-03 | $48 | Not Recommended | |
| 11300 Series | Opt. 07, 016-0357-03 | $48 | Not Recommended | |
| 11400 Series | Opt. 11, 016-1099-01 | $85 | Not Recommended | |
| CSA Series | Opt. 11, 016-1099-01 | $85 | Not Recommended | |
| DSA600 Series | Opt. 11, 016-1099-01 | $85 | Not Recommended | |
| OF100, OF200 TDR | Opt. 07, 016-0357-03 | $48 | Not Recommended | |
| R7103 | Opt. 07, 016-0357-03 | $48 | 016-0248-01 | $165 |
| T900 Series*1 | Not Recommended | | None Available | |
| T922R | Opt. 07, 016-0357-03 | $48 | 016-0248-01 | $165 |
| TAS400 | Opt. 06, 016-1181-00 | $46 | | |
| TDS300, TDS400 | Opt. 04, 016-1154-00 | $75 | | |
| TDS500, TDS600, TDS800 | Opt. 1P, 05, 016-1145-00 | $70 | | |
| TLS216 | Opt. 1P, 05, 016-1145-00 | $70 | | |
| TM500<br>SC502, SC503, SC504 | None Available | | Opt. 01<br>016-0327-01 | $270 |
| WFM300 | Opt. 20, 016-0359-03 | $48 | 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.*

C-30BP
C-9

# Film Based Camera

## C-30BP Instrument Camera

*Photographic documentation for most Tektronix oscilloscopes.*

**C-30BP**

- Adaptable to Many Applications Instruments
- Ease of Use
- 0.7 to 1.5 Mag Ratio, Continuously Variable
- High Resolution Lens
- Swing Away Hinges

**APPLICATIONS**

- Single Shot and Fast Transition Capture from 2465B or 2467B Oscilloscopes
- Legal Proof

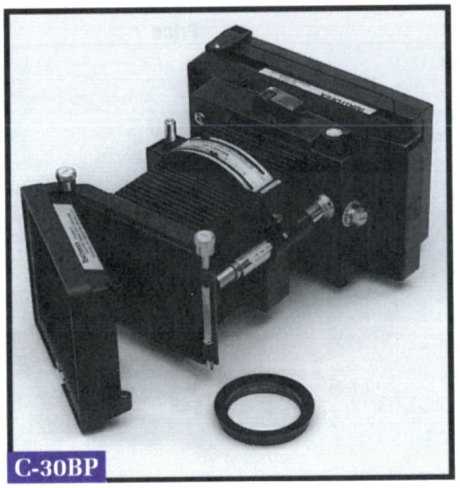
**C-9**

- Instant Documentation
- Small, Easily Shared
- Legal Proof
- Convenient Print Size
- Many Hoods Available
- Flash Available
- Motorized Back Available

**APPLICATIONS**

- Clean Rooms
- Scope Data Archival
- Patient Areas

TD
Product available through an Authorized Tektronix Distributor (listed on pages 570-571) C-9 also available through TekDirect. Call 1-800-426-2200.




*Option 01 with corrector lens off.*

### C-30BP Oscilloscope Camera

The C-30BP is an easy to use, compact, high resolution camera which uses Polaroid film packs. It provides versatility for use with most CRT screens, and presents a large image size.

The C-30BP is the only Tektronix camera with continuously variable magnification (from 0.7 to 1.5) to give you the greatest photographic flexibility.

The C-30BP camera features dual swing-away hinges which allow it to be swung out of the way, either to the left or to the right, for direct viewing of the CRT. By using supplied or optional bezel adapters, the camera will mount on a variety of scopes, spectrum analyzers, display monitors and other CRT-based instruments.

The C-30BP comes standard with 3.25 inch x 4.25 inch pack film back.

The standard C-30BP is used with older 400 Series Oscilloscopes that have 0.8 cm/div. CRTs: 453, 454, 485 and 491.

C-30BP Option 01 is used on 2445, 2455, 2465 and 2467 Oscilloscopes, as well as older 455, 464, 465B, 466, 468 and 475A scopes.

C-30BP Option 01 is optimized for use at 0.8 magnification only.

### Characteristics

**Aperture** – Variable from f/1.9 to f/16.

**Lens Speed** – f/1.9.

**Magnification** – Variable from 0.7 to 1.5 (0.8 magnification on Opt. 01 with C-30BP set to 1.0 magnification).

**Resolving Power** – (At 1:1 magnification) At Center: at least 25 lines/mm. At Corners: at least 10 lines/mm.

**Relative Light-Gathering Ability** – 1.0 (0.9 on Opt. 01).

**Shutter** – Mechanical: 1/125 s to 1 s, bulb and time.

**Synchronization Output** – X-sync contact closure.

**Field of View** – Standard: 7 cm x 9 cm. Opt. 01: 8 cm x 10 cm.

**PHYSICAL CHARACTERISTICS**

| Dimensions | mm | in. |
|---|---|---|
| Width | 191 | 7.5 |
| Height | 130 | 5.1 |
| Depth | 254 | 10.4 |
| **Weights ≈** | **kg** | **lb.** |
| Net | 2.2 | 4.8 |
| Shipping | 4.1 | 9.0 |

### C-9 Oscilloscope Camera

The C-9 is a CRT camera which uses Polaroid film packs. It provides documentation for most CRT displays.

The C-9 comes standard with a 3.25 inch x 4.25 inch pack film back.

The C-9 camera can be used with most Tektronix oscilloscopes, as well as most widely used CRT instrument displays. Hoods are available as options to fit Tektronix oscilloscopes.

A motorized film back is also optional for use in clean room environments and to reduce handling. A Polaroid AutoFilm system is incorporated to automatically eject a clean, dry, self-developed print. No peeling, timing or coating is necessary. There is no need to handle, tear apart or worry about chemical contaminations with Option 1A.

When one hand is busy, use a pistol grip. Option 1P allows the operator to take a picture with only one hand free.

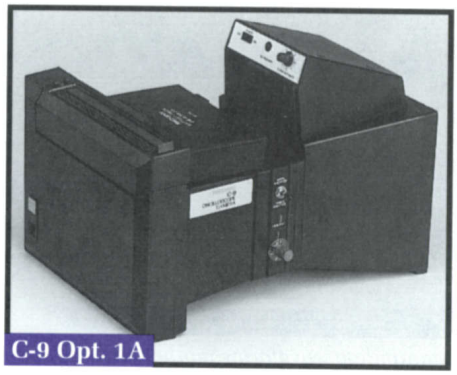
For scopes without graticule lighting, a flash unit is available. The variable xenon flash makes the CRT phosphor glow, which evenly backlights the graticule. This option is available for the small portable scopes as well as the 7K laboratory type scopes. Order Option 1F.

# Film Based Cameras

## C-9 Instrument Camera







C-9 Opt. 1A

### 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 SCOPE HOODS

| C-9 Hood Option | Scopes Supported | Height | | | | Width | | | | Mag. Ratio |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Inside (cm) | Outside (cm) | Inside (in.) | Outside (in.) | Inside (cm) | Outside (cm) | Inside (in.) | Outside (in.) | |
| C9-04 | TDS400 | 10.40 | 10.60 | 4.09 | 4.17 | 13.80 | 14.00 | 5.43 | 5.51 | 0.71 |
| C9-05 | TDS5/6/800 | 10.80 | 11.20 | 4.25 | 4.41 | 14.10 | 14.50 | 5.55 | 5.71 | 0.71 |
| C9-06 | TAS400 | *1 | *1 | *1 | *1 | *1 | *1 | *1 | *1 | *1 |
| C9-07 | 7K | 13.03 | 13.67 | 5.13 | 5.38 | 14.22 | 14.86 | 5.60 | 5.85 | 0.70 |
| C9-11 | 11K, CSA, DSA | 12.29 | 12.80 | 4.84 | 5.04 | 15.75 | 16.26 | 6.20 | 6.40 | 0.73 |
| C9-20 | Portable | 10.49 | 11.18 | 4.13 | 4.40 | 11.94 | 12.67 | 4.70 | 4.99 | 0.51 |

*1 *Contact your local Tektronix representative for price and ordering information.*

### RECOMMENDED POLAROID FILM PACKS

| Back Type | Film Type | ISO Speed | Color | Wide Gray Scale | Contrast | Special | Prints | Order # | Price |
|---|---|---|---|---|---|---|---|---|---|
| AutoFilm™ | 337 | 3200 | | √ | Medium | Clean room | 200 | 006-7350-00 | **$210** |
| | | | | | | | 60 | 006-7349-00 | **$63** |
| Manual | 612 | 20,000 | | | High | Panachromatic | 24 | 006-6822-00 | **$50** |
| Manual | 667 | 3000 | | | Medium | Coaterless | 500 | 006-6825-00 | **$470** |
| | | | | | | | 60 | 006-6824-00 | **$60** |
| Manual | 669 | 80 | √ | √ | Medium | Extended dynamic range | 48 | 006-6826-00 | **$77** |

*AutoFilm™ is a trademark of the Polaroid Corporation.*

### ORDERING INFORMATION

**C-30BP**

Camera ..... TD **$3,450**

**Includes:** Polaroid pack film back with split image focus plate (122-0752-02); Mounting Adapter (016-0306-01); Instruction Manual (070-2825-00)

**C-9**

Camera ..... TD **$590**

**Includes:** Camera body without hood (a hood is required), Instruction Manual. Order 070-8105-01

**Opt. 1A –** AutoFilm™ motorized film back ..... **+$245**

**Opt. 1F –** Graticule flash unit for use with Opt. 07 and/or Opt. 20 ..... **+$125**

**Opt. 1P –** Pistol grip handle with trigger ..... **+$75**

**Opt. 04 –** TDS400 Series scope hood ..... **+$60**

**Opt. 05 –** TDS500/600/800 Series scope hood ..... **+$60**

**Opt. 06 –** TAS400 Series hood ..... **+$40**

**Opt. 07 –** 7K Series scope hood ..... **+$40**

**Opt. 11 –** 11K, CSA, DSA Series scope hood ..... **+$70**

**Opt. 20 –** Portables (2000) Series scope hood ..... **+$40**

**ADDITIONAL ACCESSORIES**

**Graticule Flash –** Use with 7000 Series and 2000 Series scope hoods. Order 016-0642-02 ..... **$245**

**Pistol Grip –** Pistol grip hand with trigger. Order 122-0186-01 ..... **$85**

**Scope Hoods –**

TAS400. Order 016-1181-00 ..... **$46**

TDS400 Series. Order 016-1154-00 ..... **$75**

TDS500, TDS600, TDS800 Series. Order 016-1145-00 ..... **$60**

7000 Series. Order 016-0357-03 ..... **$48**

11000, CSA, DSA Series. Order 016-1099-01 ..... **$70**

2000 Series. Order 016-0359-03 ..... **$48**

**WARRANTY INFORMATION**

Tektronix one year warranty of all parts under normal operating conditions.

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571) C-9 also available through TekDirect. Call 1-800-426-2200.

# Digital Camera Imaging System



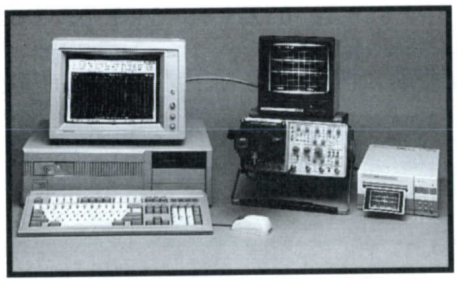
*Combines the best of analog and digital capabilities in a powerful waveform digitization and analysis system.*

**DCS01**

- Fast Transient Capture
- Digitize Analog Signals
- Computerized Data and Calculations
- Inexpensive DSO with Accuracies of Analog
- Installs in PC clones
- to 250 GS/s, 1 GHz Bandwidth
- More Accurate than Scope
- Fast & Powerful
- Three Triggering Methods: Save-on-Delta, Save-on-Light and Scope Gate Out

**APPLICATIONS**

- Logging Waveform Data
- Biomed, Physical Research
- Electrostatic Discharge Testing
- Imaging and Analysis
- A/D Education
- Presentations
- Long Record Length (VCR)



*The Digitizing Camera consists of a C1002 Video Camera, a DX01 Frame Store Board inside the PC, DSC01 software, and cables. The system shown includes the DSC01, TEK2467B scope under GPIB control from the DSC01 software, and a DX05 video monitor.*

## DCS01 Digital Camera Imaging System

The DCS01 high-speed transient capture system is incredible on the Tektronix "bright-eye" oscilloscopes. Coupled with a 2467B with Option 10 (GPIB), you need never touch the front panel of the scope as you change settings and test conditions.

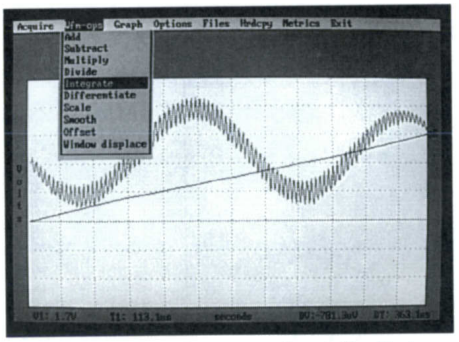
A DCS01/2467B digital scope system has greater than 400 MHz system bandwidth, even with picosecond risetimes in single-shot applications. The sampling speed is 100 GS/s, effective since the system is REAL TIME.

A DCS01/7104 digital scope system is the ultimate in transient capture! At 250 GS/s and 1 GHz bandwidth, no other REAL TIME digital system can provide accuracies beyond 99%.

The DCS01 provides a CCD camera (C1002) with 728 x 490 resolution and 256 gray levels. Also included is a full-size PC board compatible with XTs to 486 machines which captures the video data in a 512 x 512 array of 256 gray levels. Powerful software then analyzes the video data to decide where the waveform actually was, and to compensate for all the optics involved to within 1% error via a system calibration.

The waveform is presented in high resolution color graphics, with up to 22 pulse measurements made automatically. Built-in hardcopy procedures document the results on printers and plotters, and the camera view can be archived using the HC02A video hardcopy unit.

The award-winning manual and multitude of utility software programs are included when you order the DCS01.




*Manipulate waveforms mathematically by using such procedures as integration, differentiation, addition, and subtraction with DCS01GPH.*

## Camera

The camera is a 728 x 490 CCD array digitizer. A seven-element lens provides 0.3% distortion, eliminating keystoning and other optical geometric distortion problems. The focal range provides for near-infinity as well as CRT imaging. The camera is encased in a rugged body, and mounted using the same adapters as the C-30BP camera, so it can be easily swung away from the CRT. The standard NTSC (RS170) video can be used with VCRs, TVs, and video hardcopy units (see HC02A).

## DCS01 Software

DCS01GPH is a standard part of the DCS01. The installation program helps you set up your specific system, and load programs and batch files for your ease. The commands are presented in drop-down windows, and can be accessed with a mouse. The waveforms are presented in high resolution color graphics with up to 22 pulse parameters automatically computed 1 second after the two cursors have been positioned on the waveform graph. Hardcopy routines to Epson, IBM, HPGL and LaserJet are provided.

DCS01LIB provides you with source code and object libraries to build your own application software. You are in full control of the DCS01 hardware. You have complete control of the acquisition process, can read and write to the video memory on board, and can trigger or be triggered in many ways.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Digital Camera Imaging System





**FRAME STORE BOARD**
The board's REAL TIME video data pass-through or capture controlled by the software as 30 Hz interlaced video is sent to it from the C1002 camera. The captured data is stored in a 512 x 512 array of 256 gray levels. The eight-bit interface allows the board to be used in lowly XTs or high-powered 486 clones. An analog section on the board produces traceable calibration signals which are used in system calibration, mapping the entire video image in terms of geometrically corrected positioning. The board also senses a scope trigger out signal, and is used to reset the scope for single-shot events. DELTA TRIGGERING is available on a real-time basis, providing Save-on-Delta capability against previously acquired waveforms. Also, incoming video can be summed REAL TIME by the board, extending low-light capabilities.

## Characteristics (DCSO1)

**DIGITIZING CAMERA SYSTEM**
The following specifications are valid when the camera system is operated at a temperature between 0°C and 40°C.

**Digitizing Technique** – Scan conversion.

**System Writing Speed** – To the bandwidth of the 2467B or 7104, even in single-shot mode; other scopes are dependent on their photographic writing speed of the CRT and phosphor, but to their full bandwidth on repetitive signals.

**Geometric Distortion** – Calibrated signals less than 1%.

**Relative Light** – Gathering Ability - 1.0.

**"Shutter"** – Electronic; software controlled from 1/60 of a second to infinity.

**Power** – Provided by PC environment.

**Resolving Power** – 12 bits vertical nominal resolution, 512 points horizontal when calibrated.

**Multiple Channels** – To the PCs limit of available slots.

**Throughput Rate** – 3 Hz (to 5 Hz).

**Waveform Display** – Up to 6 in colors in Hercules, CGA or EGA displays.

**Calibration Signal** – Traceable; (during cal procedure) into 50 Ω: 20 KHz ±0.1%, vertically from 100 to 800 mV in 100 mV steps at ±0.2%.

**Scope Reset Signal** – 12 V pulse.

**Computer Compatibility** – At least: IBM XT, 1MB RAM, DOS 2.1, graphics capability; mouse, high capacity drives, 286 or better recommended. Video memory segment exclusion from memory managers required with DOS 5.0 and above. A National Instruments GPIB board (PCIIA) is required for use with a 2467B with Opt. 10 (GPIB).

## Characteristics (C1002)

**Focal length** – 10 mm at 5200 Å.

**F Number at Infinity** – F/1.3.

**Object-to-Image Distance** – 1633.54 mm at 0.075X, 144.72 mm at 0.833X.

**Field of View (Variable Mag.)** – 7.2 cm x 9.0 cm and 8.0 cm x 10.0 cm.

**Spectral range** – 350 nm to 1100 nm, 400 nm to 600 nm within 3 dB.

**Angular Range** – 23.45°

**Distortion** – Within 0.3% at image plane.

**Lens Resolution** – Center: 100 lines/mm. Edge: 20 lines/mm.

**Imaging Device** – Solid State, inter-line CCD.

**Pixels** – 490 vertical by 728 horizontal.

**Resolution** – 480 vertical lines by 540 horizontal lines.

**S/N Ratio** – Typical: 52 dB; minimum 50 dB. Gamma=1.

**Sensitivity** – 2.5 LUX.

**Video Output** – 1 V p-p composite video, 75 Ω.

**PHYSICAL CHARACTERISTICS**

| Dimensions | mm | in. |
|---|---|---|
| Width | 120 | 4.8 |
| Height | 104 | 4.1 |
| Depth | 241 | 9.5 |
| **Weight** | **kg** | **lb.** |
| With scope mounting adapter | 1.4 | 3.0 |

## ORDERING INFORMATION

**DCS01**
Digitizing Camera System ..... **$6,750**
**Includes:** Camera, Frame Store Board, DCS01GPH Software (062-9859-01) on 3.5 in. and 5.25 in. disks, 5-Pin Cable (174-0449-00), three SS-to-BNC Cables (174-0430-00) and Operator's Manual (070-6175-01). Requires optional camera to bezel adapter; see below.

**Opt. 1A** – Bezel Adapter for 11302, 5K and 7K scopes. (016-0248-01) ..... **+$165**

**Opt. 2A** – Bezel Adapter for Tek 2400 Series and scopes with 8 cm x 10 cm CRTs. (016-0269-03) ..... **+$175**

**Opt. 3A** – Bezel Adapter for Tek 485 Series and scopes with 7 cm x 9 cm CRTs. (016-0306-01) ..... **+$185**

**SOFTWARE**

**Windowed Color Graphics** – DCS01GPH. Included with DCS01. Order 062-9859-01 ..... **$1,010**

**Source Code and Object Library** – DCS01LIB. For custom applications. Order S58DC01 ..... **$595**

**ADDITIONAL ACCESSORIES**

**2467B with Opt. 10** – 400 MHz "BrightEye" Oscilloscope. See pages 124-128 ..... **$13,990**

**HC02A** – Video Copier. See page 498 ..... **$3,200**

**HC100** – Four Color HPGL Plotter with cable (Opt. 02) See page 496 ..... **$1,198**

**ADDITIONAL ACCESSORIES**

**Extra Length Camera to Power Supply Cables –**
4 meter. Order 174-1368-00 ..... **$200**
6 meter. Order 174-1369-00 ..... **$160**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Instrument Carts/Workstations

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## 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

| | | | NEW | | | | TEST |
|---|---|---|---|---|---|---|---|
| | K212 | K218 | K415 | K417 | K420 | K465 | K475 | STATION |
| **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 500,6000,800 Series | | • | • | | √ | • | • | |
| TAS Series | √ | • | • | • | | | | |
| 2500/2600 | | | • | | √ | • | | |
| TLS 216 | | | • | | √ | • | | |
| **Television/Spectrum Analyzers** | | | | | | | | |
| 1410R | | | • | √ | | | | |
| 1430/1440/1450/1470 | | | • | √ | | | | |
| 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 | | | • | | • | • | √ | • |
| **Curve Tracers** | | | | | | | | |
| 370A/371, 372 | | | | | | | √ | • |
| 577 | | √ | • | | | | | |

√ – *Recommended*
• – *Compatible*

# Instrument Carts/Workstations









## Value-priced Portability

The mid-height K417 has the same overall height as the K415, plus the added flexibility of the tilt shelf. The tiltable shelf with handle has infinitely adjustable positions between horizontal and 26 degrees. Reverse cradles enable instruments to be positioned on the cart without interference. The base and all shelves are silver gray colored.

## Characteristics

**Shelf Tilt –** 0° to 26°.

**Shelf Loading –** 75 lb. bottom, 35 lb. top.

**PHYSICAL CHARACTERISTICS**

| Dimensions | mm | in. |
|---|---|---|
| Width | | |
| Overall Cart | 635 | 25 |
| Top Shelf | 508 | 20 |
| Bottom Shelf | 508 | 20 |
| Height | | |
| Overall Cart | 907 | 35.7 |
| Depth | | |
| Overall Cart | 620 | 24.4 |
| Top Shelf | 419 | 16.5 |
| Bottom Shelf | 535 | 21 |
| **Weight** | **kg** | **lb.** |
| Net | 24 | 52 |

## 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 accessories drawer provides convenient storage for power cords, probes, manuals, and small parts.

## Characteristics

**Shelf Tilt –** 0° to 26°.

**Shelf Loading –** 75 lb. per shelf.

**Drawer Dimensions –** 18 in. x 19.5 in. x 4 in. (645 x 495 x 102 mm).

**PHYSICAL CHARACTERISTICS**

| Dimensions | mm | in. |
|---|---|---|
| Width | | |
| Overall Cart | 635 | 25 |
| Top Shelf | 502 | 19.75 |
| Bottom Shelf | 508 | 20 |
| Height | | |
| Overall Cart | 780 | 30.7 |
| Depth | | |
| Overall Cart | 620 | 24.4 |
| Top Shelf | 533 | 21 |
| Bottom Shelf | 533 | 21 |
| **Weight** | **kg** | **lb.** |
| Net | 26 | 57 |

### K417

- Sturdy, Steel and Aluminum Design For All Portable Instruments
- Low-cost Flexibility
- Enhances Sharing and Work Space
- Tiltable Shelf with Handle
- Locking Twin Wheel Casters
- Surge-Protected Four Outlet Power Strip Accessory
- Shipped Ready to Assemble

### 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

*Ergonomic design brings higher level of functionality.*

## ORDERING INFORMATION

**K417**
Lab Cart ..... TD **$595**
**Includes:** Probe Holders, Two Heavy Duty Nylon Instrument Straps, Instrument Manual, Retainer Bar, Hex Wrench, Level.

**K420**
Work Bench Cart ..... TD **$695**
**Includes:** Probe Holders, Two Heavy Duty Nylon Instrument Straps, Instrument Manual, Retainer Bar, Hex Wrench, Level.

**RECOMMENDED ACCESSORIES**
**Power Strip –** Four Outlet, 6 ft., Noise/Surge Suppression.
Order 131-5342-01 ..... **$45**

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571) and K417 also through TekDirect. Call 1-800-426-2200

# K465
# K475

# Instrument Carts/Workstations

*Stable and mobile rackmount capability.*

**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
- Wire Accessories Basket
- Tough Steel and Aluminum Construction Means a Secure Platform For All Your Instruments
- Shipped Ready to Assemble to Give Maximum Configurability

**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


NEW K465


NEW K475

## 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

**Shelf Tilt –** 0° to 26°

**Shelf Loading –** Top Shelf: 35 lb. (16 kg). Middle Shelves: 75 lb. (34 kg). Basket 50 lb. (23 kg).

**PHYSICAL CHARACTERISTICS**

| Dimensions | mm | in. |
|---|---|---|
| Width | | |
| Overall Cart | 635 | 25 |
| Tilt Shelf | 502 | 19.75 |
| All Other Shelves and Basket | 508 | 20 |
| Height | | |
| Overall Cart | 1415 | 55.7 |
| Depth | | |
| Overall Cart | 533.4 | 21 |
| Top Shelf | 419 | 16.5 |
| Middle and Bottom Shelves | 533.4 | 21 |
| **Weight** | **kg** | **lb.** |
| Net | 35 | 78 |

## 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 3 three-quarter shelves with loading capacity of 75 lb. per shelf.

### Characteristics

**Shelf Loading –** Top Shelf 35 lb (16 kg.) All other shelves 75 lb. (34 kg.).

**PHYSICAL CHARACTERISTICS**

| Dimensions | mm | in. |
|---|---|---|
| Width | | |
| Overall Cart | 635 | 25 |
| All Shelves | 508 | 20 |
| Height | | |
| Overall Cart | 1418 | 55.7 |
| Depth | | |
| Overall Cart | 676 | 26.6 |
| Middle Shelf | 676 | 26.6 |
| All Other Shelves | 370 | 16.5 |
| **Weight** | **kg** | **lb.** |
| Net | 38 | 83 |

## ORDERING INFORMATION

**K465**
Instrument Tower ..... TD **$795**
**Includes:** Two Probe Holders, Four Nylon Instrument Straps, Instrument Manual, Level, Hex Wrench,.Retainer Bar.

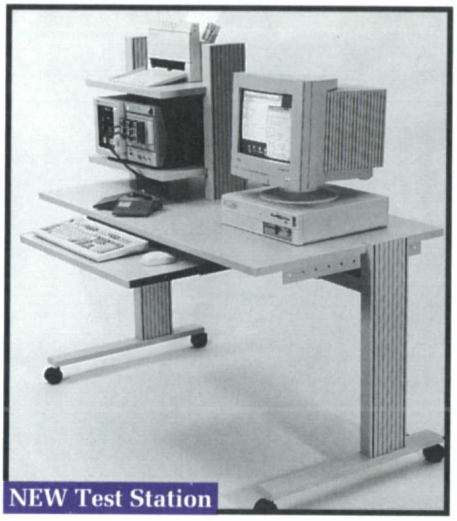
**K475**
Workstation Tower ..... TD **$895**
**Includes:** Two Probe Holders, Four Nylon Instrument Straps, Hex Wrench, Level, Instrument Manual.

**RECOMMENDED ACCESSORIES**
**Power Strip –** Four Outlet, 6 ft., Noise/Surge Suppression.
Order 131-5342-01 ..... **$45**

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571).

# Instrument Carts/Workstations

## TEST STATION K415


NEW Test Station


NEW K415

### TEST STATION

- Organize System Hardware
- Provides Additional Work Area
- Slide Out Keyboard
- Height Adjustability
- Practical and Sturdy
- Shipped Ready to Assemble

### K415

- Constructed of Extruded Aircraft Aluminum
- Tactile Fit and Hold Soft Form Handle
- Stable/sturdy Platform
- Easy Assembly
- Accessories Basket Holds Up to 50 lb..
- Height Adjustable Shelves

*Efficient system management and work space use.*

### 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 stand alone 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.

**PHYSICAL CHARACTERISTICS**

| Dimensions | mm | in. |
|---|---|---|
| Width | | |
| Overall Cart | 1442 | 56 |
| Shelf | 559 | 22 |
| Height | | |
| Overall Cart | 1295 | 51 |
| Depth | | |
| Overall Cart | 762 | 30 |
| Shelf | 533 | 21 |
| **Weight** | **kg** | **lb.** |
| Net | *1 | *1 |

*[1] Contact your local Tektronix representative.*

### 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 cart for holding Tektronix portable oscilloscopes, 1230 Logic Analyzers, and other general-purpose service instrumentation like the Tektronix TM5000 and 7000 Series. The K415 consists of 2 rack width shelves, plus a wire basket for storage.

### Characteristics

**Shelf Loading –** 75 lb. per shelf

**PHYSICAL CHARACTERISTICS**

| Dimensions | mm | in. |
|---|---|---|
| Width | | |
| Overall Cart | 635 | 25 |
| Top Shelf | 508 | 20 |
| Bottom Shelf | 508 | 20 |
| Height | | |
| Overall Cart | 907 | 35.7 |
| Depth | | |
| Overall Cart | 533 | 21 |
| Shelves | 533 | 21 |
| **Weight** | **kg** | **lb.** |
| Net | 30 | 65 |

TD K415 also available through an Authorized Tektronix Distributor (listed on pages 570-571) K415 also available through TekDirect. Call 1-800-426-2200.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

### ORDERING INFORMATION

**TEST STATION**
Order 016-1239-00 ..... **$1,195**
**Includes:** Slide Out Keyboard Tray, Cable Management Channel, Manual Holders.

**K415**
Transport Cart ..... TD **$675**
**Includes:** Two Probe Holders, Two Heavy Duty Nylon Safety Straps, Hex Wrench, Instruction Manual, Level.

**RECOMMENDED ACCESSORIES**
**Power Strip –** Four Outlet, 6 ft., Noise/Surge Suppression.
Order 131-5342-01 ..... **$45**

# K212
# K218

# Instrument Carts/Workstations

*Increase your efficiency and work bench space with Tektronix carts.*

**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

**K218**

- Tiltable Top Shelf with Positive Lock
- Accessories Drawer
- Rubberized Smooth Rolling four-inch Casters
- 4 Outlet Power Strip Standard
- Sturdy All Metal Construction


K212


K218

## Low Cost Portability

The K212 column and trays are made from high strength aluminum, the base is thermoset polyester.

**PHYSICAL CHARACTERISTICS**

| Dimensions | mm | in. |
|---|---|---|
| Width | | |
| Overall Cart | 435 | 17.0 |
| Shelf | 407 | 16.0 |
| Height | | |
| Overall Cart | 840 | 33.0 |
| Depth | | |
| Overall Cart | 550 | 21.6 |
| Shelf | 352 | 14.0 |
| **Weight** | **kg** | **lb.** |
| Net | 9 | 20 |

## Scopemobile®

The K218 cart is designed specifically to provide stable support and transport for midsize Tektronix oscilloscopes.

The sturdy welded construction of the K218 cart provides stable and safe instrument mobility with smooth rolling four inch casters. The tiltable top shelf has four positive locking positions between horizontal and 25 degrees. The K218 comes complete with an accessories drawer, a four-outlet surge protected power strip, four securing straps and two probe holders. The K218 is shipped with casters and handle unattached; assembly instructions and hex keys are included.

**PHYSICAL CHARACTERISTICS**

| Dimensions | mm | in. |
|---|---|---|
| Width | | |
| Overall Cart | 478.13 | 21.25 |
| Shelf | 48.26 | 19 |
| Height | | |
| Overall Cart | 745.7 | 29.36 |
| Depth | | |
| Overall Cart | 527.1 | 20.75 |
| Shelf | 431.8 | 17 |
| **Weight** | **kg** | **lb.** |
| Net | 30 | 65 |

TD Product available through an Authorized Tektronix Distributor (listed on pages 570-571) and K212 also through TekDirect. Call 1-800-426-2200

## ORDERING INFORMATION

**K212**

Portable Instrument Cart ..... TD **$395**
**Includes:** Two 1 in. x 5 ft. Securing Straps, Retaining Bar, Instruction Sheet, and Probe Holders.
**Opt. 10** – Add four Outlet Power Strip ..... **+$75**
**Opt. 12** – Add Second Tray ..... **+$80**
**Opt. 22** – Combines Opt. 10/12 ..... **+$145**

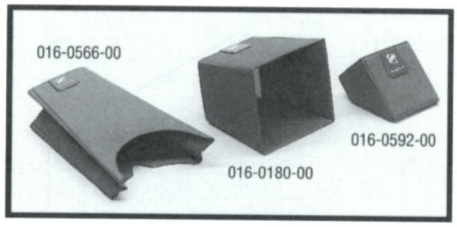
**RECOMMENDED ACCESSORIES**

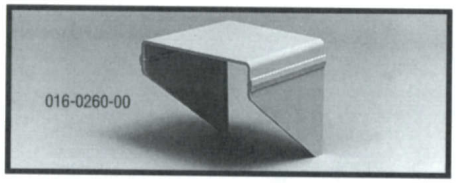
**Power Strip** – Four Outlet, 6 ft., Noise/Surge Suppression. Order 131-5342-01 ..... **$45**

**K218**

Scopemobile® ..... TD **$745**
**Includes:** Instrument Manual, Probe Holders, Four Retaining Straps, Retainer Bars, Two Hex Keys.
**Opt. 05** – Delete Power Strip ..... **–$25**

# Additional Accessories
## Viewing Hoods

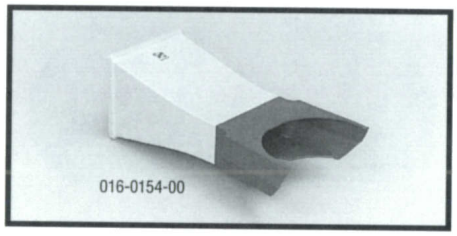



*Folding Viewing Hoods*

**VIEWING HOODS**
- Folding Binocular
- Collapsible
- Folding
- Noncollapsible
- Molded

The viewing accessories normally mount on the instrument graticule cover. Some may fit camera-mounted bezels. If you intend using a camera on your instrument, check with your Tektronix Sales Engineer for bezel-viewer compatibility.




*Non-collapsible Viewing Hoods*



### ORDERING INFORMATION

**FOLDING BINOCULAR –**
For 2200 series, 2445A/B, 2465A/B, 2467B, 271X Family, 434, 455, 464, 466,465B, 475, 475A. Order 016-0566-00 ..... **$30**

**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 Family, 432, 434, 455, 465/B, 475, 464, 466 (polarized). Order 016-0180-00..... **$100**

For 2200 series, 2445A/B, 2465A/B, 2467B, 271X Family, 464, 466, 455, 465, 465B, 475 (non-polarized). Order 016-0592-00..... **$20**

**FOLDING –**
For 576. Order 016-0259-00..... **$38**

For 577, 5000, 7000, 11000 Series. Order 016-0260-00..... **$85**

**NON-COLLAPSIBLE –**
For older Tektronix 5-in. oscilloscopes. Order 016-0001-01.... **$360**

**MOLDED –**
Gray polystyrene with polyurethane eyepiece. For 5000 and 7000 series, 528, 577. Order 016-0154-00..... **$130**

For 576. Order 016-0153-00..... **$100**

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# Additional Accessories
## Instrument Travel

*Avoid Scope Damage and Improve Portability*

*Special Protection for Transporting and Shipping Portable Instruments*

**TRAVEL LINE PACKAGE**
- Impact-Resistant Packaging
- Pouch and Cover
- Carrying Strap
- Rubber Shock-absorbing Bumpers

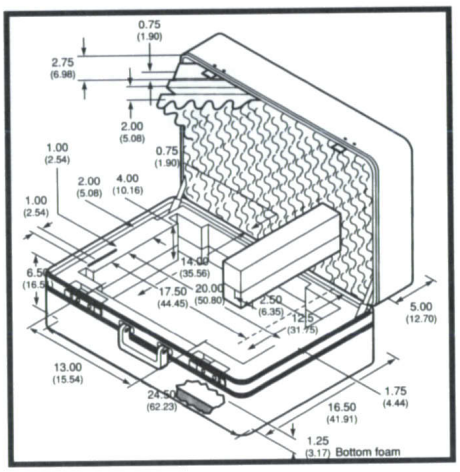
**PORTABLE INSTRUMENT TRANSIT/CARRYING CASES**
- High Strength
- Foam Padding
- Custom Fit

**PORTABLE INSTRUMENT PROTECTIVE COVERS**
- Custom Fit
- Waterproof Vinyl for Complete Enclosure of High Impact Plastic for Front Panel Enclosure

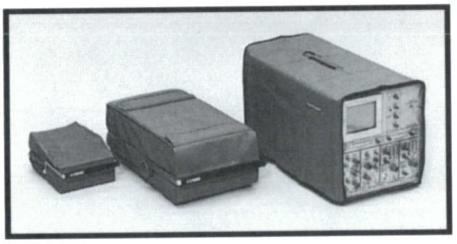
**FRONT COVERS**
- Snap-on Front Cover
- High-impact Plastic



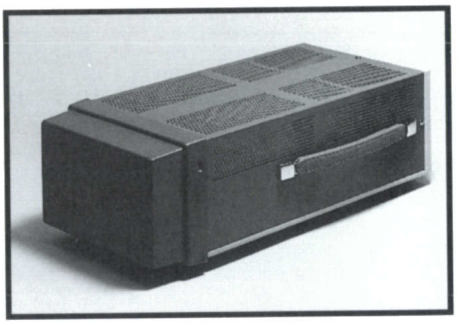
*Portable Oscilloscope*




*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 is 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 cover provides 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.

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# Additional Accessories
## Instrument Travel



### ORDERING INFORMATION – SELECTION GUIDE

**TRAVEL LINE PACKAGE**
Order Opt. 33 for specific instrument.

**2235A, 2236A –**
**Includes:** Rubber molding, accessory pouch, front panel cover, carrying strap. ..... **$295**

**2221, 2224, 2232 –**
**Includes:** Rubber molding, carrying strap. ..... **$295**

**TRAVEL LINE PACKAGE CONVERSION KIT**

**2235A** – Order 040-1188-03 ..... **$515**
**Includes:** Replacement cabinet and rear cover with the rubber moldings installed.

**2236A, 2221, 2224, 2232 –**
Order 040-1187-03 ..... **$300**
**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 ..... **$520**
2400 Series, 2200 Series. Order 016-0792-01 ..... **$455**
278X, 279X Family, OF150, OF235
Order 016-0658-00 ..... **$1,180**
TM 503A. Order 016-0565-01 ..... **$1,100**
TM 504. Order 016-0608-00 ..... **$965**
TM 515. Order 016-0643-00 ..... **$1,015**

**Soft Sided Case**
271X Family. Order 016-1158-00 ..... **$140**
278X, 279X Family, OF150, OF235
Order 016-0659-00 ..... **$190**

**Carrying Strap**
2200/2300 Series, 271X Family
Order 346-0199-00 ..... **$28**

**Accessory Pouch**
271X Family. Order 016-0677-02 ..... **$50**

**PORTABLE INSTRUMENT PROTECTIVE COVERS**
7300/7400/7600 Series. Order 016-0192-01 ..... **$35**
5000 Series. Order 016-0544-00 ..... **$22**
2400 Series. Order 016-0720-00 ..... **$41**
2200 Series. Order 016-0848-00 ..... **$28**
200 Series. Order 016-0512-00 ..... **$36**
434/464/466. Order 016-0365-00 ..... **$45**
314/335. Order 016-0612-00 ..... **$195**
TM 504. Order 016-0621-00 ..... **$55**
TM 503. Order 016-0620-00 ..... **$42**

**FRONT COVERS**
2400 Series. Order 200-3199-01 ..... **$14.75**
2245A, 2246A, 2247A.
Order 200-3232-01 ..... TD **$10**
2235A, 2236A/271X Family.
Order 200-2520-00 ..... TD **$17**
2201, 2205, 2211, 2225.
Order 200-3397-00 ..... TD **$10**
TM 506. Order 200-1728-00 ..... **$30**
TM 504. Order 200-1727-00 ..... **$24**
TM 503A. Order 200-3554-00 ..... **$36**
1700 Series. Order 200-3897-01 ..... **$18**

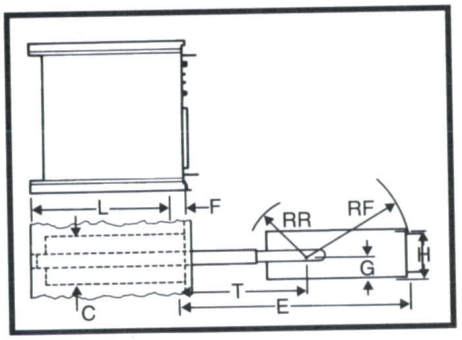
TD
Product also available within 24 hours through TekDirect. Call 1-800-426-2200

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99.

# Additional Accessories

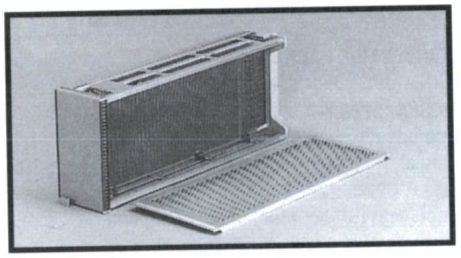
## Rackmount Kits

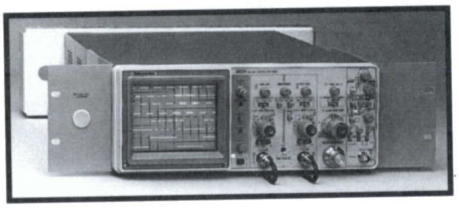
- Blank Plug-in Chassis
- Blank Panel
- Plug-in Storage Compartment






*Typical 2400 Series Rackmount*





*Typical 2200 Series Rackmount*

**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 TM500/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).

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

## ORDERING INFORMATION

**BLANK PLUG-IN CHASSIS**

| | |
|---|---|
| 11000 Series. Order 016-0829-00 | **$195** |
| 7000 Series. Order 040-0553-04 | **$310** |
| 5000 Series. Order 040-0818-04 | **$190** |
| TM 500 Series. Order 040-0652-06 | **$165** |

**BLANK PANEL**

| | |
|---|---|
| 7000 Series. Order 016-0155-00 | **$145** |
| 5000 Series. Order 016-0452-01 | **$110** |
| TM 500/TM 5000 Series. Order 016-0195-05 | **$60** |

**PLUG-IN STORAGE COMPARTMENT**

| | |
|---|---|
| Plug-in Storage Comp. Order 016-0362-02 | **$95** |

# Additional Accessories
## Rackmount Kits



### RACKMOUNT KIT SELECTION GUIDE

| Instrument | Part Number | H | | L | | F | | E | | D Min. | | D Max. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 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 | 040-1279-02<br>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 | – | – | – | – | – | – |
| 7000 Series Plug-in Storage Cabinet | 437-0126-03 | 5.25 | 13.3 | – | – | – | – | – | – | – | – | – | – |
| 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 |
| 2245A, 2246A, 2247A | 2240FIR | 7.0 | 17.8 | 18.3 | 46.5 | 2.2 | 5.6 | 24.8 | 62.9 | 12.8 | 32.5 | 24.5 | 62.2 |
| 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 | 016-0883-02 | 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 | 016-0819-03 | 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 | 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 | – | – | – | – | – | – |
| 1230 | 1230F05 | 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 | – | – | – | – | – | – |
| DAS9100 | 016-0463-00 | 8.75 | 22.3 | 23.5 | 59.7 | 0.75 | 1.9 | 26.5 | 67.3 | 23.38 | 59.4 | 27.3 | 69.5 |
| 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 |
| 91HS8, 92HS8 | 016-0884-00 | 3.5 | 8.9 | 23.5 | 59.7 | 0.75 | 1.9 | 26.5 | 67.3 | 23.38 | 59.4 | 27.3 | 69.5 |
| TM5006, TM506A | 040-0982-04 | 7.0 | 17.8 | 18.0 | 45.7 | – | – | – | – | – | – | – | – |
| TM5003 | 040-1257-02 | 7.0 | 17.8 | 18.0 | 45.7 | – | – | – | – | – | – | – | – |
| TM5003 to 4041 | 040-0984-01 | 7.0 | 17.8 | 18.0 | 45.7 | – | – | – | – | – | – | – | – |
| Two TM503s side by side | 040-0616-02 | 5.3 | 13.5 | 16.5 | 41.9 | 1.1 | 2.8 | 24.6 | 62.5 | – | – | – | – |
| TM503 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.*

**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 |

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# Additional Accessories
## Light Filters

*Light Filters*
*Mesh Filters*
*EMC Filters*

## ORDERING INFORMATION

**CATHODE-RAY TUBE LIGHT FILTERS**

| Instrument*1 | Color | Part Number | Price |
|---|---|---|---|
| **200 Series** | Blue | 378-0691-00 | **$8.50** |
| **324/335** | Blue | 378-2016-01 | **$2.70** |
| **490** | Amber | 378-0115-01 | **$4.20** |
| | Gray | 378-0115-02 | **$8.00** |
| | Blue | 378-0115-00 | **$3.75** |
| **434** | Blue | 378-0678-01 | **$27.00** |
| **455/465M** | Blue | 337-2122-00 | **$13.00** |
| **465/465B** | Blue | 337-1674-00 | **$14.50** |
| **475** | Clear | 337-1674-01 | **$13.25** |
| **464/466** | Smoke-grey filter | 337-1674-07 | **$21.00** |
| **576** | Blue*2 | 378-0616-00 | **$20.00** |
| **603/604** | Clear (603*2) | 337-1440-00 | **$6.00** |
| | Green | 337-1440-01 | **$7.75** |
| | Amber | 337-1440-02 | **$19.50** |
| | Blue | 337-1440-03 | **$24.00** |
| | Gray | 337-1440-04 | **$19.25** |
| | Graticule (8 x 10 div) | 331-0303-00 | **$18.75** |
| **605/606/607** | Blue | 337-1674-00 | **$14.50** |
| | Graticule (Clear) | 337-1674-10 | **$13.50** |
| | Clear Shield | 337-1674-13 | **$13.75** |
| | Gray*2 | 337-1674-06 | **$7.00** |
| **608** | Amber | 378-0704-00 | **$12.00** |
| | Graticule*2 | 337-2126-02 | **$12.00** |
| **2200 Series** | Blue*2 | 337-2775-00 | **$7.00** |
| | Clear | 337-2775-01 | **$9.40** |
| | Gray w/TV Graticule | 035-0175-00 | *3 |
| **2300 Series** | Blue Implosion Shield*2 | 337-2760-00 | **$10.25** |
| **2400 Series** | Blue*2 | 378-0199-03 | **$6.00** |
| | Clear Implosion Shield*2 | 378-0208-00 | **$2.50** |
| **271X Series** | Smoke Gray | 337-2775-02 | **$13.50** |

**CATHODE-RAY TUBE LIGHT FILTERS**

| Instrument*1 | Color | Part Number | Price |
|---|---|---|---|
| **5100 & 5400 Series (except 5441)** | Clear | 337-1440-00 | **$6.00** |
| | Green | 337-1440-01 | **$7.75** |
| | Amber | 337-1440-02 | **$19.50** |
| | Blue | 337-1440-03 | **$24.00** |
| | Gray | 337-1440-04 | **$19.25** |
| **5441** | Clear*2 | 337-1674-01 | **$13.25** |
| | Gray | 337-1674-07 | **$21.00** |
| **7603** | Blue | 378-0684-00 | **$15.50** |
| | Amber | 378-0684-01 | **$10.25** |
| | Gray | 378-0684-02 | **$13.50** |
| | Green | 378-0684-03 | **$21.00** |
| | Spectrum Analyzer Graticule | 337-1439-01 | **$14.50** |
| | Blue Implosion Shield*2 | 337-1700-01 | **$17.50** |
| | Clear Implosion Shield | 337-1700-04 | **$10.50** |
| **7613/7623/7623A/7633** | Spectrum Analyzer Graticule | 378-0625-07 | **$27.00** |
| | Green (UV) | 378-0625-08 | **$10.50** |
| **7844/7313** | Blue*2 | 378-0625-00 | **$17.25** |
| **7700 Series/7613/7623/7100 Series/7900** | Amber | 378-0625-01 | **$11.50** |
| | Gray | 378-0625-02 | **$17.25** |
| | Green | 378-0625-03 | **$26.00** |
| | Gray TV Graticule NTSC | 378-0625-06 | **$15.75** |
| | Clear Shield | | |
| | Spectrum Analyzer Graticule | 337-1159-02 | **$28.00** |

**CRT MESH/EMC FILTERS**

| Instrument*1 | Color | Part Number | Price |
|---|---|---|---|
| **314/326/335** | N/A | 378-0063-00 | **$80.00** |
| **432/434** | N/A | 378-0682-00 | **$80.00** |
| **422/491/453A/454A/485** | N/A | 378-0648-00 | **$105.00** |
| **465/465B/475/464/466/434** | N/A | 378-0726-01 | **$165.00** |
| **7400/7603** | N/A | 378-0696-00 | **$140.00** |
| **7100/7500/7700/7800/7900 Series/7613/7623/A/7633** | N/A | 378-0603-00 | **$180.00** |

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.*

**3 Contact your local sales representative.*

To order, contact your local sales office (listed on the inside back cover) or call the National Marketing Center at 1-800-426-2200, Ext. 99

# 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, waterfall, and cursors, plotting analysis, audio waveform display, auto-sequences 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 errors.

Addressing digital implementation and expansion in video environments, Tektronix introduced several products. Among them, the new WFM601 Serial Component Monitor for operational environments. It provides component displays including the Tektronix patented Lightning, and error detection and handling capability for thorough testing of digital signals. A full line of digital products including generators and synchronizers have been designed specifically for the needs in video environments.

Several new introductions for cable customers currently provide the broadest product offering for CATV test and measurement equipment. 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 low-cost generators, synchronizers, and VITS inserters has also been added to the list of new products. The application-specific products broke significant price performance barriers while maintaining Tektronix quality.

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# VM 700A Teletext

# Television Products
## Video Measurement Sets

*Emmy Award Winning VM 700A Automatic Video Measurement Set*

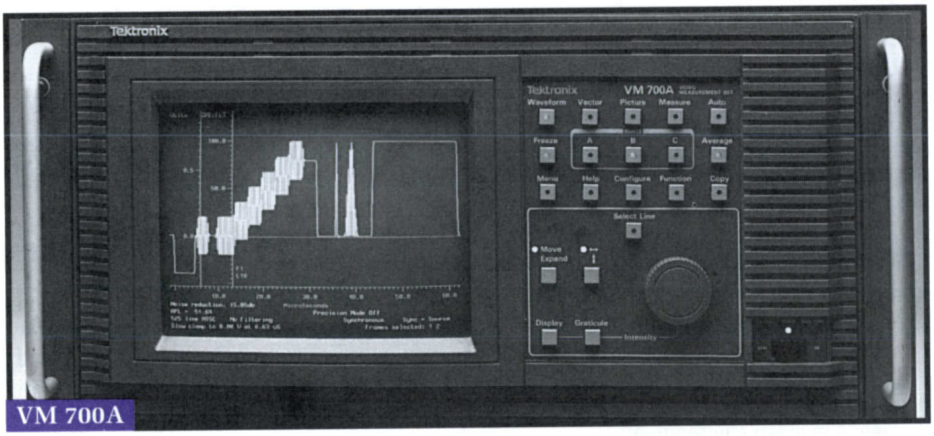
*AVTIME Audio to Video Delay Measurement Package*

*Teletext Measurements*

*Camera Measurements*

*Component Measurements*

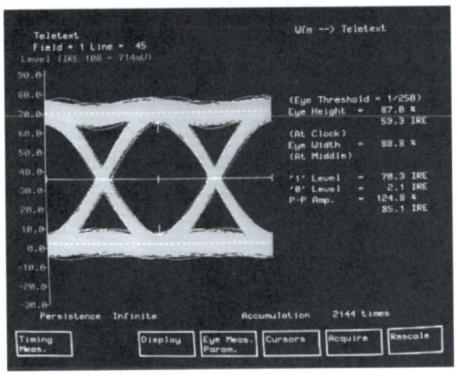
- VM 700A
  - Opt. 20
  - Opt. 21
  - Opt. 30
  - Opt. 41
  - Opt. 42
- AVTIME
- VMBKUP
- VMT
- VMREMGR
- 1780R/1781R




VM 700A

### 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
- 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
- Remote control operation
- Automatic measurement of short duration audio test sequence
- Measure frequency response, distortion, phase, crosstalk, and other important audio parameters



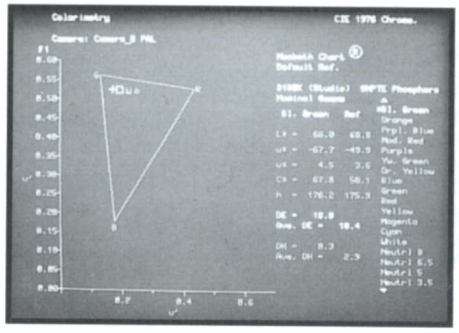

### VM 700A Option 20 Teletext Measurements

- Provides numerical results
  - Eye height
  - Eye width
  - Data levels (logical "0" and logical "1" levels)
  - Start of data code
  - Number of run-in bits
- 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

TV Catalog available. Please complete and return the reply card in the back of this catalog.

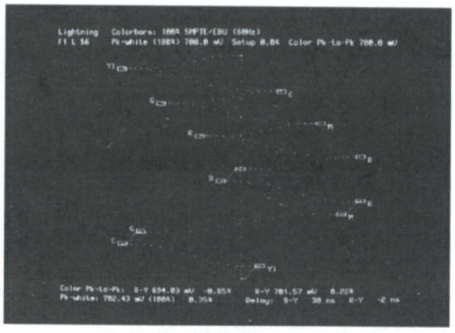
# Television Products
## Video Measurement Sets





### 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
  - Fixed Pattern Noise
  - CDD Defects
  - Frequency Response
  - Gamma
  - Geometry/Registration
  - Detail
  - Shading
  - Frequency Response with Aliasing
  - Vertical Smear



### 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

### NEW VM 700A Option 41
### Three Stereo Audio Inputs

Option 41 adds three stereo audio inputs to the VM700A. This provides the capability to measure the audio signals from three stereo audio sources via separate inputs. Each audio channel can be configured to follow one of the video inputs through the front panel video source selection.

- Three independent stereo audio inputs
- Same measurement capabilities as Opt. 40

### NEW VM 700A Option 42
### Audio to Video Delay Measurement

Option 42 provides the VM700A 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

### NEW VM 700A 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.

VMBKUP
VMT
VMREMGR
1780R/1781R

# Television Products
## Video Measurement Sets

**VMBKUP**
**VM 700A Backup and Remote Control Software**

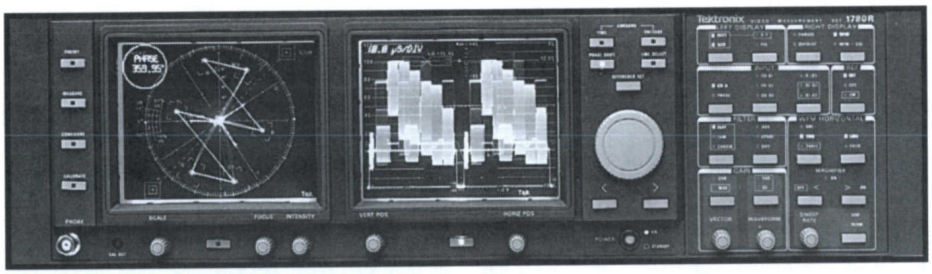
- Backup or restore sets of measurement configuration files, reference measurement files and function key definitions
- Perform individual file and directory operations on both the connected personal computer and VM 700A
- Use to restore backed up files to VM 700A after upgrade
- Control the VM 700A from a personal computer
- Use Serial Line Internet Protocol (SLIP) for data transfer over RS-232C connection

**VMT**
**VM 700A REMOTE CONTROL SOFTWARE**

- Controls the VM 700 or VM 700A
- Pull down and 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**
**VM 700A Remote Graphics Software**

- Display VM 700A graphics on a remote PC
- Perform front panel operations via mouse
- Issue remote commands
- Terminal operations




**1780R/1781R Video Measurement Sets**

- Full bandwidth analog processing
- Precision waveform and 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

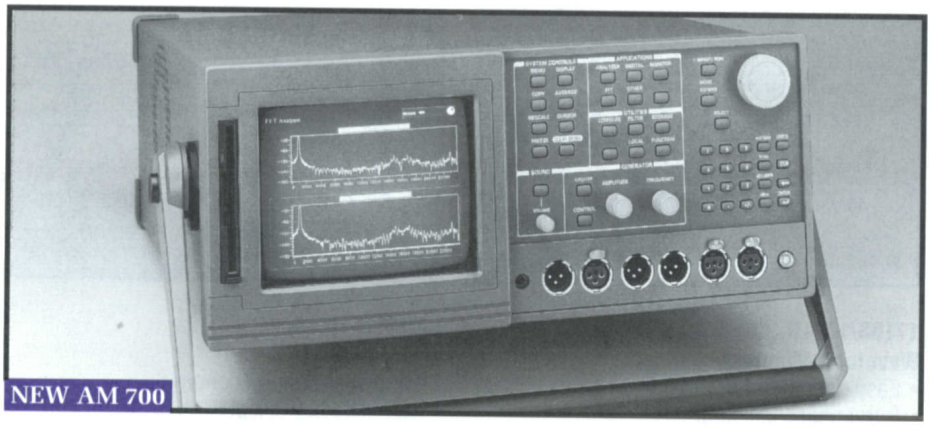
**VM 700A**
Video Measurement Set ..... **$16,500**
**Opt. 01** – NTSC Measurements ..... **+$4,500**
**Opt. 11** – PAL Measurements ..... **+$4,500**
**Opt. 20** – Teletext Measurements ..... **+$3,000**
**Opt. 21** – Camera Measurements ..... **+$6,500**
**Opt. 30** – Component Measurements ..... **+$2,500**
**Opt. 40** – Audio Measurements ..... **+$4,000**
**Opt. 41** – Three Stereo Audio Inputs ..... **+$4,600**
**Opt. 42** – Audio to Video Delay Measurement ..... **+$1,500**
**Opt. 48** – GPIB Interface ..... **+$2,500**
**Opt. 74** – White Phosphor CRT ..... **+$100**
**Opt. 1C** – Cabinet Version ..... **NC**
**Opt. 1P** – Printer Version (110 V only) ..... **+$625**
**Opt. 1Z** – Probe Adapter (067-1429-00) ..... **+$500**

**AVTIME**
Audio to Video Delay Measurement Package
**Opt. 01** – NTSC System with an ASG 140 ..... **+$31,300**
**Opt. 02** – NTSC System with an ASG 100 in place of an ASG 140. ..... **+$31,300**
**Opt. 11** – PAL System with an ASG 140 ..... **+$30,800**
**Opt. 12** – PAL System with an ASG100 in place of an ASG140 ..... **+$30,800**
**VMBKUP** – VM 700A Backup and Remote Control Software .... **$250**
**VMREMGR** – VM 700A Remote Graphics Software ..... **$250**
**VMT** – VM 700A Remote Control Software ..... **$195**
**1780R (NTSC)/1781R (PAL)** – Video Measurement Sets .... **$10,500**
**1780F02** – Portable Carrying Case for 1780R/1781R ..... **$295**
**1780F05** – Rack Mount Shelf ..... **$100**

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# Television Products
## Audio Measurement Set






- Programmable Audio Analyzer
- Programmable Audio Generator
- Analog Audio Inputs/Outputs
  – Balanced
  – Unbalanced
- Digital Audio Inputs/Outputs
  – AES/EBU
  – SPDIF
  – Optical
- Manual and Automatic Measurements
- Pass/Fail Testing
- RS-232 and GPIB Remote Control
- Function Key Programmability
- Benchtop or Portable Operation

*Programmable*

*Analog and Digital or Mixed Signals*

*Easy to Use*

*Portable*

*Remote Control*

**AM700 AUDIO MEASUREMENT SET**
The Tektronix new AM700 Audio Measurement Set 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, weighting filters and cursors is accomplished through touch-screen menus. The zoom mode provides variable frequency resolution. A unique tabular presentation of FFT data simplifies numerical data analysis. And as with all measurement routines in the instrument, 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, frequency and time. Cursors, zoom, relative-to-reference, min/max hold and pass/fail limits 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, and generates multitones compatible with the VM700A Video Measurement Set, as well as other popular test equipment.

**Auto Sequences**
Auto Sequence measurements, designed for split-site testing, perform rapid analysis of critical audio parameters. Standard tone sequences supplied by the ASG 100/140, such as the CCITT O.33 and TEK sequences, are compatible with the AM700. In addition, the AM700 can be programmed to generate and measure custom tone sequences to fit specific applications.

**Waveform Mode**
The "Waveform" provides oscilloscope displays of input, output, and residual signals like harmonic distortion. An internal speaker/headphone 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 circuity, this analyzer provides an eye pattern display, jitter, and time-domain measurements.

**Digital Data Analyzer**
The AM700 can be used as a "smart" break-out box for solving equipment interface problems quickly. The Digital Data Analyzer examines bit activity and data formatting. It enables users to find and correct problems like stuck bits, incorrect polarity, or illegal formats.

**Audio Generator**
For every function listed above, the internal programmable generator can produce a complimentary signal in digital or analog form (as appropriate).

## ORDERING INFORMATION

**AM 700**
Audio Measurement Set ..... *1

**ASW 100**
Dual 1x12 Output Switcher ..... *1

**ASW 100F**
Dual 12x1 Input Switcher ..... *1

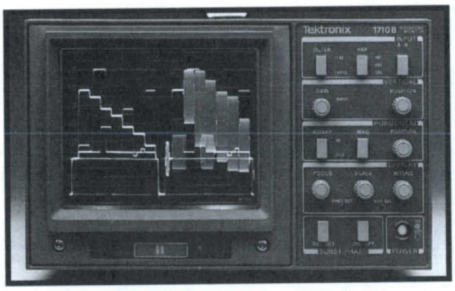
*[1]Contact your Tektronix Television Sales Manager for price/delivery.*

TV Catalog available. Please complete and return the reply card in the back of this catalog.

# Television Products
## Waveform Monitors/Vectorscopes

*Waveform Monitors and Vectorscopes for Composite, Component, Serial Digital, Dual Standard, Multiformat.*

- 1710B/1711B
- 1720/1721/1725
- 1720 SCH/1721 SCH
- 1730/1731/1735
- 1730 D/1731 D
- 1735 HD
- 1740A Series
- 1750A Series
- 1760 Series
- WFM 300A
- WFM601



**1710B/1711B**
**Waveform Monitors**
- Easy operation/cost effective
- Burst phase indicator
- Dual filter display
- Bright CRT display
- Available in NTSC or PAL standards



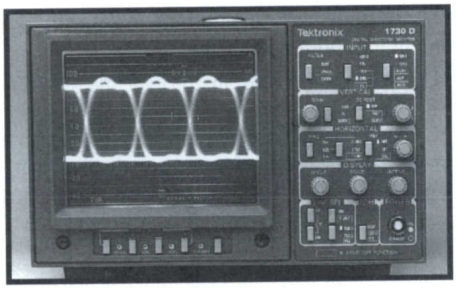
**1720/1721/1725**
**Vectorscopes**
- Performance and economy
- Simultaneous channel A & B display
- Stereo audio phase measurement
- R-Y output for differential phase measurement
- Available in NTSC, PAL or dual standard



**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 & B display
- Differential gain measurement
- One button front panel recall
- Dual filter display
- VTR servo rates
- Available in NTSC, PAL or dual standard

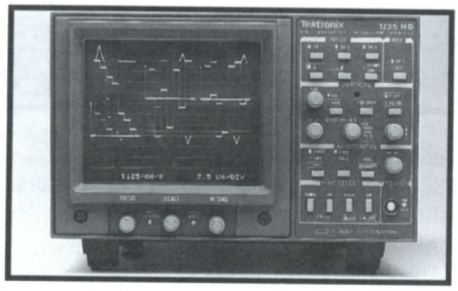


**1730 D/1731 D**
**Serial Digital Waveform Monitors**
- Two analog composite inputs
- Two serial digital composite inputs
- One parallel digital composite input
- Passive loop-through for serial inputs
- Precision analog display of digital input
- Full time DAC output
- Serial digital bit stream EYE Pattern display
- Error Detection and Handling display mode (EDH)
- Displays D-2 servo waveforms
- Available in NTSC (1730 D) and PAL (1731 D) versions

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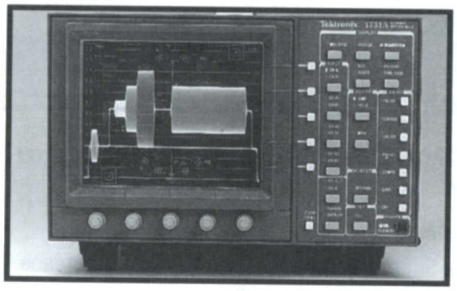
# Television Products
## Waveform Monitors/Vectorscopes





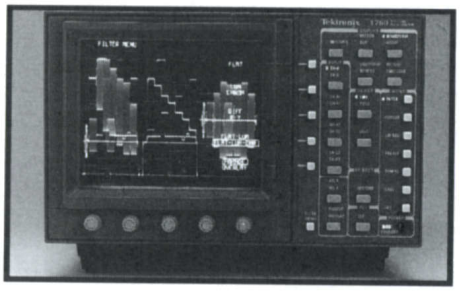
**1735 HD**
**Multiformat Waveform Monitor**
- Six video inputs
- 30 MHz video bandwidth
- Excellent performance in high magnifications
- High DC stability with front panel ground reference
- HDTV and standard video formats
- Full line select in each format
- Subtract mode for intersignal timing

**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



**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
- 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

**NEW WFM601**
**Serial Component Monitor**
- Two serial digital component video inputs
- Waveform parade and overlay displays
- Component vector display
- Tektronix Lightning and Diamond displays
- Waveform time and amplitude cursors
- EDH and gamut error alarm
- Picture display of Y channel
- RGB picture monitor outputs
- Eight user presets

## ORDERING INFORMATION

**1710B** (NTSC)/**1711B** (PAL)
Waveform/Burst Phase Monitor ..... **$1,795**

**1720** (NTSC)/**1721** (PAL)
Vectorscope ..... **$2,395**

**1725**
NTSC/PAL Vectorscope ..... **$3,400**

**1720 SCH** (NTSC)/**1721 SCH** (PAL)
Vectorscope ..... **$3,400**

**1730** (NTSC)/**1731** (PAL)
Waveform Monitor ..... **$2,395**

**1735**
NTSC/PAL Waveform Monitor ..... **$2,600**

**1730 D** (NTSC)/**1731 D** (PAL)
Serial Digital Waveform Monitor ..... **$3,350**

**1735 HD**
HDTV Waveform Monitor ..... **$5,900**

**1740A** (NTSC)/**1741A** (PAL)
Waveform/Vector Monitor ..... **$4,395**

**1745A**
NTSC/PAL Waveform/Vector Monitor ..... **$4,695**

**1750A** (NTSC)/**1751A** (PAL)
Waveform/Vector/SCH Monitor ..... **$5,900**

**1755A**
NTSC/PAL Waveform/Vector/SCH Monitor ..... **$6,200**

**1760** (NTSC)/**1761** (PAL)
Composite/Component Waveform/Vector Monitor ..... **$4,900**

**1765**
NTSC/PAL Composite/Component Waveform/Vector Monitor ..... **$5,200**

**Opt. SC** – (1760/1761/1765)
Adds SCH/Color Framing Display ..... **+$1,700**

**Opt. 74** – P4 White Phosphor.
Available on all half-rack 1700 Series products ..... **+$100**

**WFM 300A**
Component/Composite Monitor ..... **$3,900**

**Opt. 05** – Delete Color Shutter ..... **–$350**

**Opt. 10** – NTSC/BETA CAM Transcoder ..... **NC**

**Opt. 14** – NTSC/MII Transcoder ..... **NC**

**WFM601** – Serial Component Monitor ..... **$4,500**

**ACCESSORIES**

**1700F00** – Plain Case ..... **$65**

**1700F02** – Portable Case ..... **$100**

**1700F05** – Dual Rack Adapter ..... **$230**

**1700F06** – Blank Panel ..... **$60**

**1700F07** – Utility Drawer ..... **$155**

**1700F10** – DC Voltage Kit ..... **$230**

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# Television Products

## Generators/Inserters

**Serial Digital Video Interface**

*Generators, Inserters and D to A Converter*

*Parallel and Serial Digital*

*Digital Composite*

*Digital Component*

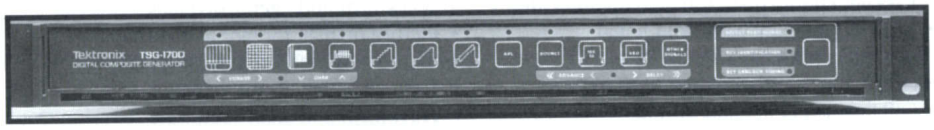
**DAC 422**
**TSG 170D**
**TSG 273**
**TSG 422**

- DAC 422
- Serial Digital Video Interface
- TSG 170D
- TSG 273
- TSG 422




**DAC 422 Precision Digital To Analog Converter**
- Precision digital to component analog video conversion
- Supports 525/60 and 625/50 line rates
- Supports SMPTE/EBU N10 color difference, Betacam, MII formats
- Accepts both parallel and serial digital inputs
- Provides reclocked serial digital output
- Compliments VM 700A Opt. 30 component measurements

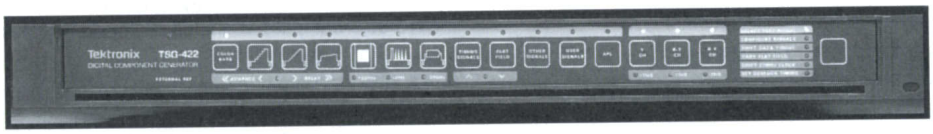
**Serial Digital Video Interface For TSG 170D, TSG 273, AND TSG 422 Generators**
- Conforms to standards for component, PAL, and NTSC composite serial digital video interfaces
- Includes error detection ancillary data
- Three BNC outputs each with its own driver




**TSG 170D Digital Composite Generator**
- NTSC digital and analog test signal outputs
- Optional serial digital video outputs
- Digital and analog audio tone outputs
- RS-170A black burst output for master SPG application




**TSG 273 PAL Composite Digital Signal Generator**
- PAL test signals
- Analog and parallel digital test signal outputs
- Optional serial digital video outputs
- Serial and parallel digital audio outputs
- PAL sync generator with genlock
- Full field character identification
- Tape leader countdown




**TSG 422 Digital Component Generator**
- D1 VTR and other 4:2:2 component digital equipment testing and maintenance
- Conforms to CCIR recommendation 601, 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

## ORDERING INFORMATION

**DAC 422**
Digital to Analog Converter ..... **$3,900**

**SERIAL DIGITAL VIDEO INTERFACE**
**Opt. 1S** – Adds serial digital video outputs to the TSG 170D, TSG 273, and TSG 422 Generators ..... **+$800**

**TSG 170D**
NTSC Digital Composite Generator ..... **$5,600**
**Opt. 1V** – VM 700A Signal Set ..... **NC**

**TSG 273**
PAL Composite Digital Signal Generator ..... **$7,375**

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

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# Television Products

## Generators/Inserters

**TSG 100**
**TSG 111**
**TSG 120**
**TSG 130A**
**TSG 131A**
**Pathfinder**
**TSG 200**



**TSG100 NTSC Signal Generator**
- Studio and transmission test signal sets
- 8-Bit digital generation
- Conforms to RS-170A timing specifications
- 1 kHz audio tone
- H or V rate scope trigger signal
- DC power option
- Compact and lightweight



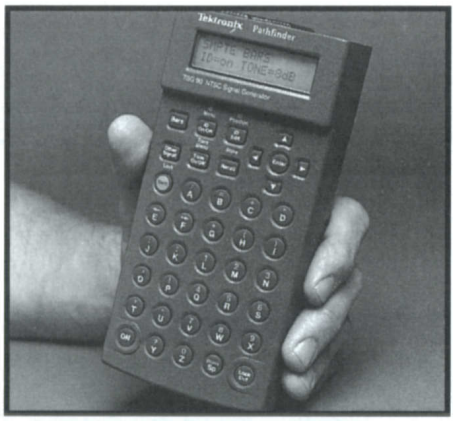
**TSG 111 PAL Signal Generator**
- Low cost test signal generator
- Tailored for service applications
- High accuracy (12-Bit) signal generation
- Two channels of audio tone with channel one identification
- Compact and lightweight



**TSG 120 YC/NTSC Signal Generator**
- Low cost test signal generator
- NTSC or PAL; Y,C and Y/C outputs
- Stereo audio outputs
- Ideal for equipment maintenance

**NEW Cable Option for TSG 120 (Option 02)**
- Special signals to test cable systems to FCC requirements

**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



**NEW Pathfinder TSG90 NTSC Signal Generator**
- 16 video test signals
- Extensive video ID capabilities
- Eight storable ID capabilities
- Two channels of audio tone
- 13 selectable audio tone frequencies
- Audio tone sweep
- Audio tone ID
- Front-panel-selectable tone levels
- Four front-panel user presets
- 10 to 16 hours alkaline battery life
- Optional rechargeable battery pack



**TSG 200 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 channel one identification
- 12 volt DC input
- Remote control
- Applications:
  - Small production system SPG
  - Bars/ ID source for microwave links

- TSG 100
- TSG 111
- TSG 120
- TSG 130A/TSG 131A
- Pathfinder
- TSG 200

*Generators*

*YC/NTSC*

*SVHS/PAL*

*Multiformat*

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### ORDERING INFORMATION

**TSG 100**
NTSC Test Signal Generator ..... **$1,250**

**TSG 111**
PAL Signal Generator ..... **$1,575**
**Opt. 10** – ±5 Hz internal reference ..... **+$100**

**TSG 120**
YC/NTSC Generator ..... **$1,850**
**Opt. 02** – Cable Signal Set ..... **NC**

**TSG 130A**
Multiformat Generator (NTSC) ..... **$2,595**

**TSG 131A**
Multiformat Generator (PAL) ..... **$2,595**

**PATHFINDER (TSG 90)**
Hand held Generator ..... **$695**

**TSG 200**
Signal Generator ..... **$1,950**

# TSG 271
# TSG 170A
# 1910

# Television Products
## Generators/Inserters

*Generators and Inserters*

*NTSC*

*PAL*

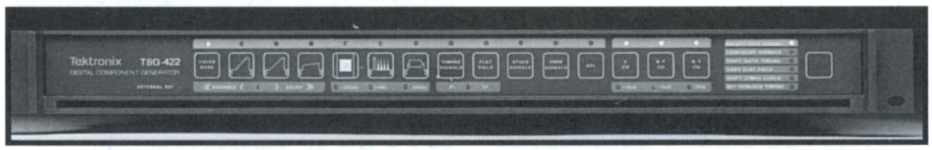
*Digital Genlock*

*Audio Tone*

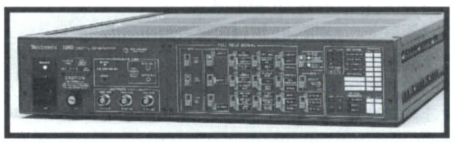
- TSG 271
- TSG 170A
- 1910




**TSG 271 PAL Television Generator**
- Precise 12-Bit digitally derived test signals
- SCH phase accuracy, guaranteed by use of a single DAC
- Conforms to EBU Statements D23 and D25
- Stable internal reference, ideal for master sync operation




**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)



**1910 NTSC Digital Generator/Inserter**
- Studio, transmitter, and transmission test signals
- 10-Bit signal generation
- User friendly RS-232C control port for added versatility
- Four external VITS inputs
- Nonvolatile memory to maintain selected VITS and full field signal configuration after power interruption
- Ghost Canceller Reference (GCR) signals available

## ORDERING INFORMATION

**TSG 271**
PAL Television Generator ..... **$5,200**
**Opt. 01** – Character ID and audio tone output ..... **+$635**
**Opt. 05** – PAL-D Signals ..... **NC**

**TSG 170A**
NTSC Television Generator ..... **$5,250**
**Opt. 01** – Adds separate SMPTE bars output with 12 character ID, audio tone output and tape leader countdown ..... **+$1,000**
**Opt. 1V** – VM 700A Signal Set ..... **NC**

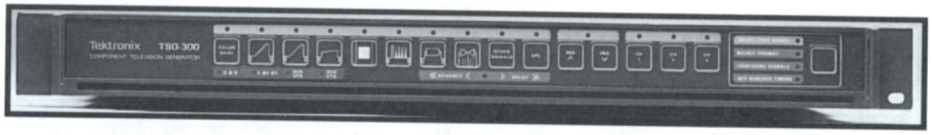
**1910**
NTSC Digital Generator/Inserter ..... **$7,500**
**Opt. 01** – GCR signal and 0% setup test signals ..... **NC**
**Opt. 03** – CBC test signals ..... **NC**

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# Television Products
## Generators/Inserters

**TSG 300** **SPG 1000**
**TSG 371** **PE1000**





**TSG 300 Component Television Generator**
- Multiple formats and standards
  - Y, B-Y, R-Y (Y,$P_b$ ,$P_r$; SMPTE/EBU)
  - GBR, Betacam®, MII
  - 525/60 and 625/50
- 10-Bit digital signal generation



**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




**SPG 1000 HDTV Sync Generator**
- Master sync generator for high definition television systems
- Sync locks to HDTV, NTSC, and PAL
- Supports proposed HDTV production standards
- Color bars and monitor setup test signals
- Provides genlock function for TSG 1000 Series Generators




**PE1000 PAL Encoder for TSG 1000 Series Generators**
- High accuracy, wide bandwidth analog PAL test signals
- Y, U, V test signal library included
- Full programmability with the SDP 1000 Signal Development Package
- Adds the PAL color burst to luminance zone plate signals
- Compatible with the:
  - TSG 1001
  - TSG 1050 with a RAM board (Opt. 07)
  - TSG 1250 with a RAM board (Opt. 07)
  - TSG 1125 with a RAM board (Opt. 07) and a 72 MHz external clock signal
- Test signal, black burst, and color frame reference outputs

- TSG 300
- TSG 371
- SPG 1000
- PE1000

*Generators and Encoder*

*Component*

*Composite HDTV*

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## ORDERING INFORMATION

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

**TSG 371**
Component/PAL Television Generator ..... **$5,050**

**PE1000**
PAL Encoder ..... **$4,500**

**SPG 1000**
HDTV Sync Generator ..... **$5,250**

**TVG F10** – Single Half-Rack Mount (for TSG 100 only) ..... **$100**

**TVGF11A** – Single Rack Mount Adapter ..... **$75**

**TVGF13** – Dual Rack Adapter ..... **$125**

**TVGF14** – Dual Half-Rack Adapter ..... **$125**

# TSG 1001 TPG 625 VITS 100 VITS 200 VITS 201 Television Products

## Generators/Inserters


*Generators and Inserters*

*Programmable*

*Multiformat*

*Test Patterns*

*VITS*

*VIRS*

*GCR*

*NTC7*

*FCC*


- TSG 1001
- TPG 625
- VITS 100
- VITS 200
- VITS 201




**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
- SMPTE/EBU, Betacam, MII, NTSC analog, NTSC composite digital, CCIR 601 component digital, and HDTV test signal libraries
- Internal or external clock operation
- 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 625 PAL Pattern Generator**
- PAL television test pattern
- Color monitor and receiver testing
- Programmable character identification
- 10-Bit digital generation
- Digital genlock
- Black burst outputs
- Special pattern for VM 700A Video Measurement Set (Opt. 01)

**VITS 100 NTSC Generator/Inserter**
- Low price generator/inserter
- NTC7, FCC, and VIR signals
- VM 700A recognizable vertical interval source identification
- NEW Cable signal set (Opt. 02)
- NEW 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)




**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 nonvolatile storage
- User programs for:
  - Insertion of internal, external, and source identification signals
  - Loss of program input modes
  - Text insertion

## ORDERING INFORMATION

**TSG 1001**
Programmable TV Generator ..... **$16,750**

**TPG 625**
Pattern Generator ..... **$5,775**
**Opt. 01** – PAL Pattern Generator for use with VM 700A ..... **NC**

**VITS 100**
NTSC Generator/Inserter ..... **$2,250**
**Opt. 02** – Cable signal set ..... **NC**
**Opt. 1M** – Special features for PAL-M systems ..... **+$250**

**VITS 200**
NTSC Generator/Inserter ..... **$4,950**

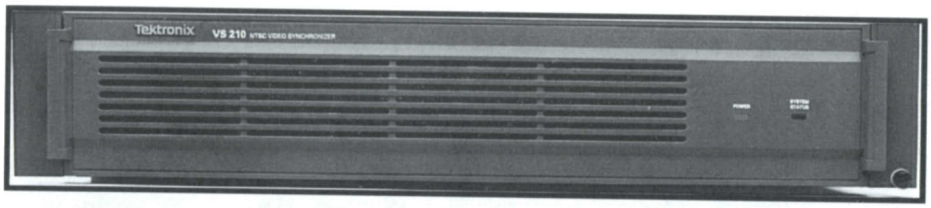
**VITS 201**
PAL Insertion Generator ..... **$4,200**

TV Catalog available. Please complete and return the reply card in the back of this catalog.

# Television Products
## Synchronizers

**VS 210**
**VS 211A**
**118-AS**






- VS 210
- VS 211A
- 118-AS

*Video and Audio Synchronizers*

*10-Bit Accuracy*

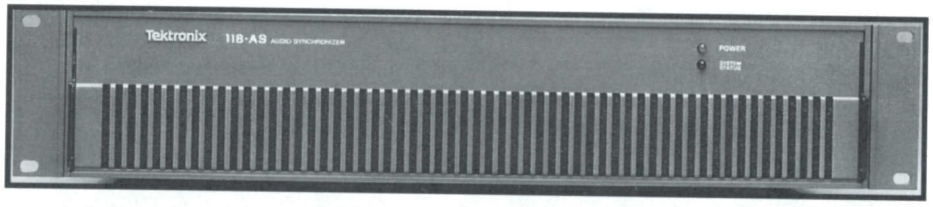
*NTSC*

*PAL*

**VS 210 NTSC Video Synchronizer**
- 10-Bit digitizing
- 8 $F_{sc}$ sampling
- 4 field memory
- Sync and burst insertion
- Digital processing amplifier functions
- Serial digital I/O
- Audio delay control signal output
- Remote control




**NEW VS 211A PAL Video Synchronizer**
- True 10-Bit accuracy and resolution
- Tracks signal into the noise
- Eight-field memory for highest picture quality
- Adaptive clamping – minimizes streaking on noisy signals
- Digitally precise sync and burst insertion
- Outputs analog and composite digital signals simultaneously
- Composite serial digital I/O option
- Digital processing amplifier
- Passes the vertical interval
- Powerful and user-friendly remote control
- Precalibrated boards and modular design




**118-AS Audio Synchronizer**
- Automatic or manual control of audio to video timing
- Simple one-wire interface to VS 210, or VS 211A Video Synchronizers
- Expandable to 3 channels for stereo and auxiliary channel
- Compensates for 30+ fields of video delay

### ORDERING INFORMATION

**VS 210**
NTSC Video Synchronizer ..... **$8,395**

**RC 210**
Remote Control for VS 210 ..... **$1,050**

**VS 211A**
PAL Video Synchronizer ..... **$7,995**

**RC211**
Remote Control for VS 211A ..... **$1,050**

**118-AS**
Audio Synchronizer ..... **$5,775**

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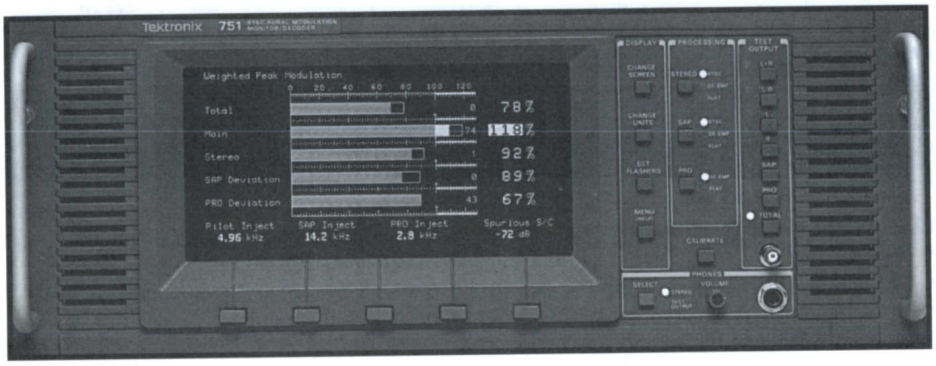
# Television Products

## Audio Products



*Audio Products*
*BTSC*
*NICAM*
*Nordic*
*DIN*
*NICAM Processing*
*Complete Audio Phase & Level Monitoring*
*Adds Audio Monitoring to a Vectorscope*
*Multitone Testing*
*RS 232 Remote Control*

- 751
- PC 751
- 728D
- 728E
- 760A
- 760N
- 760D
- ASG 100
- ASG 140




### 751 BTSC Monitor

- Precision modulation monitor for entire BTSC sound channel
- Simultaneously displays all components necessary to ensure modulation remains within legal limits
- Bars feature peak indicators with timed peak hold and easily set peak limits
- 4.5 MHz demodulator input available

The 751 BTSC aural modulation monitor/decoder provides accurate modulation monitoring and measurement of the BTSC encoded TV sound channel.

### PC 751 Remote Display Software

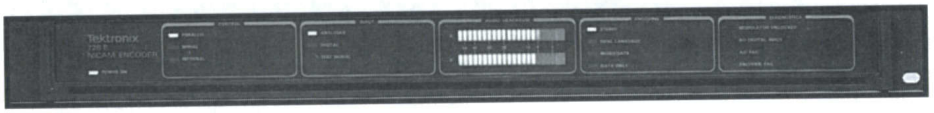
- Remote display of 751 Screens over RS-232 on a PC
- Real-time display of peak modulation and processed audio screens
- Data logging of the held peak data



### 728D NICAM Decoder

- Numeric Eye Height/Parity Display
- Monitoring Outputs
- Digital Bitstream Connection

The Tektronix 728D NICAM Decoder demodulates the NICAM-728 carrier and decodes the left and right analog audio channels and a monaural channel derived from them as well as providing access to the user data bits and 728 kB/s data stream. It also monitors the performance of the digital bitstream and provides indications for service type, loss of carrier, and errors.



### 728E NICAM Encoder

- Multi Systems (I and B/G)
- Analog Audio Inputs
- Digital Data Input
- Digital Data Outputs
- I.F. Mixer/Combiner Option
- Built-In Test Signals

The Tektronix 728E NICAM Encoder has been designed as a cost-effective solution to a broadcaster's requirements for NICAM-728 encoding and modulation.

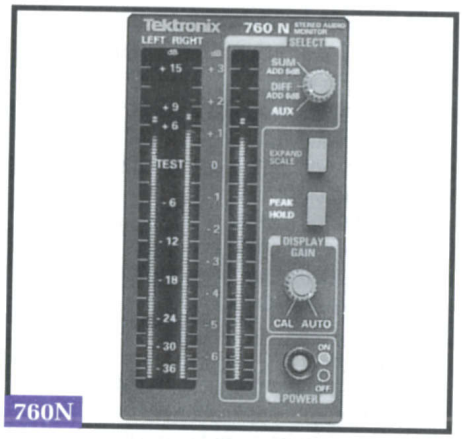
TV Catalog available. Please complete and return the reply card in the back of this catalog.

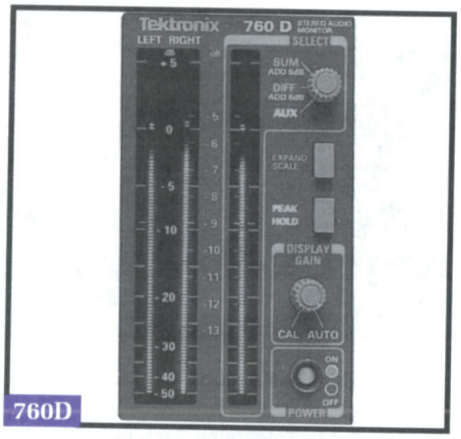
# Television Products
## Audio Products

**760A**
**760N**

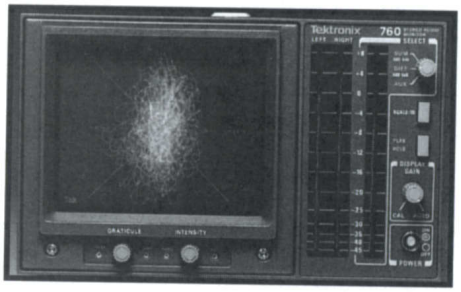
**760D**
**ASG 100**
**ASG140**






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




**ASG 100**
- 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

**NEW ASG 140**
- Four output channels
- 10Ω output impedance
- Ideal for VTR maintenance

**ASG 100/ASG140 Common Features**
- Short duration audio test sequence for rapid automatic checkout of audio lines
- Single button selection of line-up tone
- Manual mode allows selection of frequency and amplitude
- Quick identification of insertion point with voice ID
- RS-232 for remote control

## ORDERING INFORMATION

**751**
BTSC Aural Modulation Monitor/Decoder ..... **$12,000**
**Opt.01** – 4.5 MHz Demodulator Board ..... **+$2,000**

**728D**
NICAM Decoder ..... **$3,200**
**Opt. 01** – System I (6.552 MHz) ..... **NC**
**Opt. 02** – System B/G (5.85 MHz) ..... **NC**

**728E**
NICAM Encoder ..... **$8,000**
**Opt. 01** – Delete modulator ..... **–$2,500**
**Opt. 03** – Mixer/combiner board ..... **+$1,200**

**760A**
Stereo Audio Monitor ..... **$2,500**

**760D**
Stereo Audio Monitor ..... **$2,500**

**760N**
Stereo Audio Monitor ..... **$2,500**
**Opt. 74** – White Phosphor CRT (760 Series) ..... **+$100**

**ASG 100**
Audio Signal Generator ..... **$1,800**

**ASG 140**
Four Channel Audio Generator ..... **$1,800**

For complete product and ordering information, request a TV products catalog by completing the business reply card in the back.

TV Catalog available. Please complete and return the reply card in the back of this catalog.

# Television Products
## RF Products

**CMP500/ CSS500**

**TDC/ TDC-10**

**1450 SERIES**

*RF Products*

*Low Cost Spectrum Display of Satellite Signals*

*Measurement Quality Television Demodulator*

- CMP500/CSS500
- 1450 Series
- TDC/TDC-10



**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

**1450 Series Demodulators**

- Measurement-quality performance resulting in negligible distortion
- Precise Nyquist slope provided by surface acoustic wave filter
- Wide dynamic range with constant band-pass characteristics
- Synchronous detection eliminates quadrature distortion
- Envelope detection for determining differential phase

**1450-1 Only**

- Wideband audio output for BTSC multi-channel sound applications
- Wideband audio output compatible with Japanese stereo sound with FAX channel

**1450-2/1450-3A Only**

- NICAM intercarrier output compatible with 728D NICAM Decoder input

**TDC-10 Tunable Down Converter**

- Covers all Cable TV, VHF, and UHF channels up to 1 GHz
- Built in frequency counter for visual carrier frequency and aural carrier offset
- GPIB or RS232 remote control
- User programmable channel tables

## ORDERING INFORMATION

**CMP500**
Cable Measurement Package ..... **$56,000**
**Opt. 05** – Add Tracking Generator ..... **+$3,950**
**Opt. 10** – Deletes VM700A ..... **–$21,150**
**Opt. 11** – Deletes 2714 ..... **–$12,780**
**Opt. 12** – Deletes 14501 ..... **–$13,410**
**Opt. 13** – Deletes TDC-10 ..... **–$8,910**
**Opt. 20** – Substitute RS232 on 2714 ..... **NC**
**Opt. 34** – Add Rack Mount to 2714 ..... **+$595**
**Opt. 40** – Add Audio to VM700A ..... **+$3,800**
**Opt. 1C** – Adds Cabinet version to VM700A ..... **NC**

**CSS500**
Cable Measurement Package Software ..... **$2,000**

**1450-1**
Demodulator (System M) ..... **$14,900**
**Opt. 01** – 37 MHz Vision IF ..... **+$500**
**Opt. 02** – 38.9 MHz Vision IF ..... **+$500**
**Opt. 03** – 45.75 MHz Vision IF ..... **NC**

**1450-2**
Demodulator (System B/G) ..... **$15,500**
**Opt. NI** – NICAM ..... **+$2,500**

**1450-3A**
Demodulator (System I) ..... **$15,500**

**TDC**
Fixed Channel Down Converter (Specify Channel) ..... **$4,950**
**Opt. 01** – 37 MHz Vision IF ..... **NC**
**Opt. 02** – 38.9 MHz Vision IF ..... **NC**
**Opt. 03** – 45.75 MHz Vision IF ..... **NC**
**Opt. 11** – System M except Japan and Okinawa ..... **NC**
**Opt. 12** – System B/G/I countries ..... **NC**
**Opt. 14** – Japan and Okinawa ..... **NC**

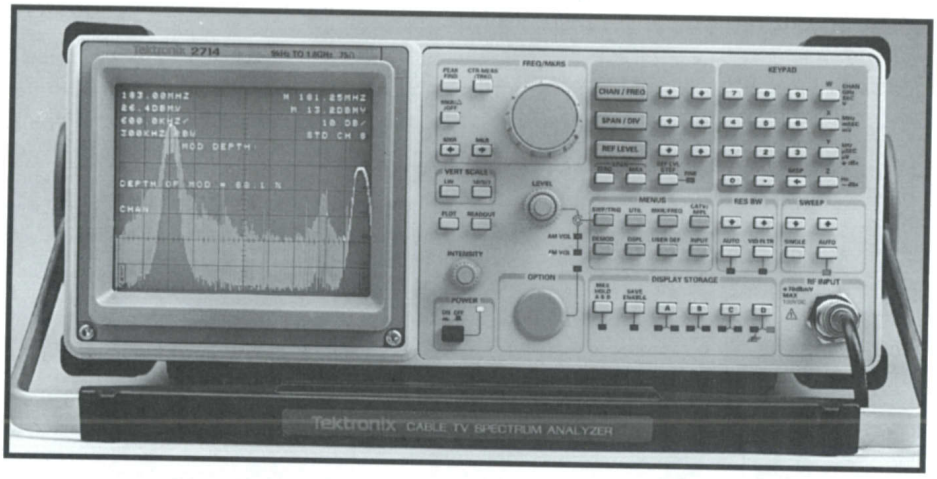
**TDC-10**
Tunable Down Converter ..... **$9,900**

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# Television Products
## RF Products

**2714**
**1705A**

**2721A/**
**2722A**

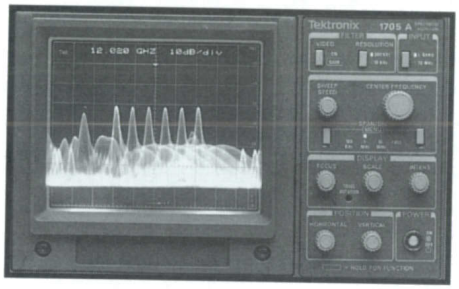



- 2714
- 2721A/2722A
- 1705A

*Automatic Cable TV RF Measurements.*

*Non-Interfering Cable TV System Sweep*

**2714 Cable TV Spectrum Analyzer**
- Automatic positioning of visual 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 news gathering
- 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
- Portable DC power and battery available



**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

## ORDERING INFORMATION

**2714**
Cable TV Spectrum Analyzer ..... **$14,200**

**2721A**
Sweep Transmitter ..... **$7,500**

**2722A**
Sweep Receiver ..... **$8,500**

**Opt. 01** – Chart Recorder ..... **+$950**

**1705A**
Spectrum Monitor ..... **$4,200**

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# Computer Graphics

## Computer Graphics Group

The Computer Graphics Group operates in three areas of the computer peripherals industry – Color Printers, Graphics Terminals, and Advanced Displays.

### 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 300 dots-per-inch output; true Adobe™ PostScript™ Level 2 page description language; and compatibility with PCs, Macs and workstations.

### GRAPHICS TERMINALS

Tektronix offers traditional graphics terminals and most recently, X terminals – devices that provide windowed access to multiple hosts and applications across a network.

### ADVANCED DISPLAYS

The Display Products Operation markets advanced technologies, including large, flat-panel displays; ultra-high resolution monitors; stereoscopic 3-D displays; and color shutter displays, which offer higher color definition than do conventional devices.

CONTENTS


**COMPUTER GRAPHICS**

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Terminals....540
Display Monitors....542

# Phaser Color Printers

*Fast, High-Quality, Desktop Color Printing for Technical and Business Work Groups*

**PHASER™ 200**

- 2 ppm, Full Color, Full Page
- 300 dpi
- Thermal Wax
- Paper or Transparencies



NEW Phaser 200

## MAIN FEATURES

| | 200e | 200i |
|---|---|---|
| **Printer Technology** | 300 dpi, thermal-wax | 300 dpi, thermal-wax |
| **Print Speed** | 2 ppm, full color , full page | 2 ppm, full color , full page |
| **Controller** | 16 MHz AMD29000 RISC-based processor | 24 MHz AMD29000 RISC-based processor |
| **Memory** | 4 MB standard, expandable to 8 MB | 6 MB standard, expandable to 14 MB |
| **Fonts** | 17 resident fonts, expandable to 39 | 39 resident fonts, SCSI external port allows hard disk drive storage of downloadable fonts |
| **Media** | Letter-size and A4-size Tektronix thermal papers and transparencies. Print on common laser paper using a ColorCoat™ transfer roll. | |
| **Maximum Print Area** | Letter-size: 8.1 x 10 in. Perforated letter-size: 8.1 x 10.6 in. A4-size: 200 x 271 mm Perforated A4-size: 200 x 287 mm | Letter-size: 8.1 x 10 in. Perforated letter-size: 8.1 x 10.6 in. A4-size: 200 x 271 mm Perforated A4-size: 200 x 287 mm |
| **Transfer Rolls** | 3-color (standard), ColorCoat, and Black | 3-color (standard), ColorCoat, and Black |
| **Language** | Adobe's PostScript™ Level 2 software, with HP-GL emulation | Adobe's PostScript™ Level 2 software, with HP-GL emulation |
| **Interfaces** | Parallel, Serial, and AppleTalk-standard; TCP/IP Ethernet, and DECnet-through optional 4511A Network Interface. SCSI-standard for external disk on Phaser 200i; EtherTalk-optional on Phaser 200i | |
| **Computer Compatibility** | IBM PC/compatibles (Windows and OS/2), Macintosh, Workstations (SUN, SGI, HP, IBM, DEC Ultrix, and VMS). | |
| **Color Systems** | PANTONE®* Color simulations, CIE and TekColor-based color matching | PANTONE®* Color simulations. CIE and TekColor-based color matching |

**Pantone Inc.'s check-standard trademark for color reproduction and color reproduction materials.*

In the U.S. call
1-800-835-6100
Product Literature
Dealer Locations
Printer Supplies

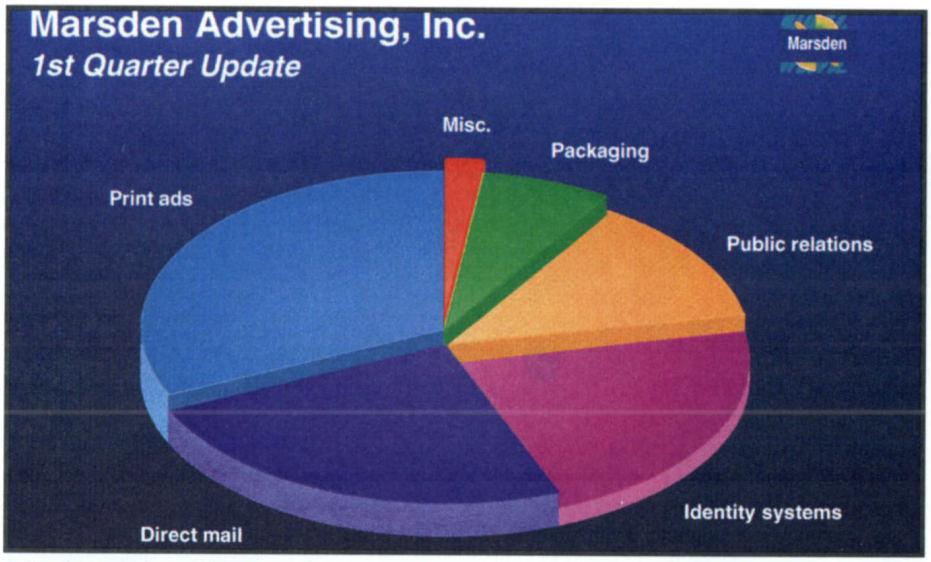
(503) 682-7450
HAL
Fax library of news, data sheets and answers to frequently asked questions.

To order, contact your local sales office (listed on pages 566-569)

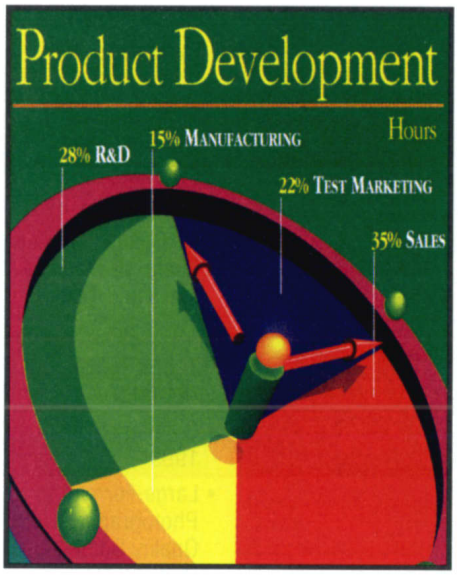
TekColor

# Phaser Color Printers

## Phaser™ 200




*Printed on a Tektronix Phaser™ III PXi*




*Printed on a Tektronix Phaser 200 Color Printer*

Transform your business presentations and reports from ordinary black-and-white to extraordinary color with the new Phaser 200 color printer. Only from Tektronix, the leader in work group color printing.

### Characteristics

**Temperature –**
Operating: 15° to 35°C (59° to 95°F).
Nonoperating: 0° to 40°C (0° to 104°F).

Storage (without media or transfer roll)
–20° to 60° (–4° to 140°F).

**Humidity –** Operating: 20% to 80% Relative Humidity, non-condensing. Nonoperating: 10% to 90% Relative Humidity, non-condensing.

**Altitude –** Operating: 0 to 15,000 ft. at 25° C. Nonoperating: 0 to 50,000 ft.

**Input Power –** Voltage (Switch-selectable)
87 to 128 VAC, 115 VAC nominal.
174-250 VAC, 220 VAC nominal.

**Safety and Emissions Standards –** FCC Part 15, Subpart J, Class B verified VDE 0871 Class B; EN55022 Verified (CISPR 22) UL 1950, listed CSA 22.2 #950, IEC 950 licensed En 60950.

### PHYSICAL CHARACTERISTICS

| | mm | in. |
|---|---|---|
| Height | 280 | 11 |
| Width: | 440 | 17.5 |
| Depth: | 340 | 13.4 |
| **Weight** | **kg** | **lb.** |
| Net | 18 | 40 |

### ORDERING INFORMATION

**PHASER 200i**
200i Basic configuration. Order 4681PXi ..... **$5,995**
**Includes:** Standard configuration (U.S.) 6 MB RAM, 39 internal fonts, a 24 MHz RISC processor, a SCSI port for external hard disk, one tray for perforated media (capacity 100 sheets paper or 50 sheets transparency film), sample thermal perforated paper and transparency film, one sample 3-Color Transfer Roll (for thermal-wax paper), cleaning kit, user manual (U.S. English), software diskettes in Macintosh, PC, and Sun SPARCstation formats, reference manual (for software diskettes), and U.S. power cord.

**PHASER 200e**
200e Basic configuration. Order 4681PXe ..... **$3,695**
**Includes:** Standard configuration (U.S.) 4 MB RAM, 17 internal fonts, and a 16 MHz RISC processor.

**Opt. 01 –** Metric media (A4-size) kit and tray (replaces U.S. media and tray) ..... **NC**
**Opt. 02 (200i) –** EtherTalk interface hardware ..... **+$695**
**Opt. 03 –** Lower Tray Assembly ..... **+$495**
**Opt. 04 –** 4 MB RAM ..... **+$495**
**Opt. 08 (200i) –** 8 MB RAM ..... **+$990**
**Opt. 1F (200e) –** Add 22 fonts (total of 39) ..... **+$595**

**INTERNATIONAL POWER CORD OPTIONS**
Opt. A1–A5 available.

**F-KITS AND ACCESSORIES**
**4690F4M –** 4 MB RAM ..... **$495**
**4694F1F (200e) –** Font SIMM kit ..... **$595**
**4681FTA –** Lower Tray Assembly Kit ..... **$495**
**4681FTA Opt.1 –** Metric (A4-size) Lower Tray Assembly Kit ..... **$495**
**4681FSS –** Plain-paper starter kit (ColorCoat Transfer Roll, perforated media paper tray, 500 sheets perforated premium laser paper) ..... **$195**
**4681FSS Opt. 1 –** Metric (A4 size) plain-paper starter kit (Same contents as 4681FSS in A4-size format) ..... **$195**
**4681FXi (200e) –** Phaser 200e to 200i upgrade kit ..... **$2,300**
**4511A –** TCP/IP Ethernet Interface ..... **$1,495**
**4690F22 –** Phaser Print: Sun Raster file (SRF), **xwd**, and PostScript printing utility for PostScript Level 2 printers ..... **$995**
**4690F41 –** PhaserSym (VMS Print Symbiont) ..... **$495**
**4680F02 (200i) –** EtherTalk interface hardware ..... **$695**
**011-0160-00 –** Thick net (10Base5) Ethernet Adapter ..... **$225**
**011-0161-00 –** Thin net (10Base2) Ethernet Adapter ..... **$225**
**011-0162-00 –** Twisted pair (10BaseT) Ethernet Adapter ..... **$225**
**200CART –** Printer cart with locking casters ..... **$395**

**WARRANTY PLUS SERVICE OPTIONS**
**Opt. S0 (46S0) –** Installation and set-up ..... **+$350**
**Opt. S1 (46CS1) –** One year of on-site service ..... **+$495**
**Opt. S2 (46CS2) –** Two years of on-site service ..... **+$1,035**
**Opt. S3 (46CS3) –** Three years of on-site service ..... **+$1,520**

**USER MANUALS**
**Opt. L1 –** French User Manual substitution ..... **NC**
**Opt. L2 –** Italian User Manual substitution ..... **NC**
**Opt. L3 –** German User Manual substitution ..... **NC**
**Opt. L4 –** Spanish User Manual substitution ..... **NC**

In the U.S. call
1-800-835-6100
Product Literature
Dealer Locations
Printer Supplies

(503) 682-7450
HAL
Fax library of news, data sheets and answers to frequently asked questions.

To order, contact your local sales office (listed on pages 566-569)

# Phaser™ IISDX

# Phaser Color Printers

*Photographic quality, dye sublimation color printing.*

**PHASER™ IISDX**

- Fast Image Processing
- High-Quality Color and Gray Scale Printing
- Networkable
- TekColor Photofine Sharpens Fine Lines and Text

**PHASER™ 480 FEATURES**

- Coming in Fall 1993
- Large-Format, Photographic-Quality Color Printing
- With All of the Speed, Accuracy and Image Quality of the Phaser IISDX
- Phaser 480 Offers Generously-Sized, Dye Sublimation Output up to 12.6 x 18.3 Inches
- Contact Your Authorized Tektronix Reseller for More Information



NEW Phaser™ IISDX

## MAIN FEATURES

| | | | | |
|---|---|---|---|---|
| **Print Speed** | 3-color: | 3.1 minutes Letter-size paper<br>3.8 minutes Legal-size paper<br>7 minutes Legal-size transparency | | |
| | 4-color: | 4.1 minutes Letter-size paper<br>5.1 minutes Legal-size paper<br>9.3 minutes Legal-size transparency | | |
| | Black: | 1.1 minutes Letter-size paper<br>2.5 minutes Legal-size transparency | | |
| **Print Quality** | Continuous-tone 300 dpi dye sublimation | | | |
| **Media Type** | Cut-sheet paper and transparency film;<br>50 sheets of paper or transparency film tray capacity | | | |
| **Media Size** | Letter-size:<br>Legal: | 8.5 x 11 in.<br>8.5 x 14 in. | A4-size:<br>A4-Special: | 210 x 297 mm<br>210 x 356 mm |
| **Maximum Print Area** | Letter-size:<br>Legal: | 8.1 x 8.6 in.<br>8.1 x 10.8 in. | A4-size:<br>A4-Special: | 200 x 238 mm<br>200 x 287 mm |
| **Transfer Roll Capacity** | 3-color and 4-color:<br>Black: | | 100 prints per roll<br>200 sheets per roll | |
| **Standard Fonts** | 39 resident fonts; built-in support for TrueType fonts,<br>SCSI port allows external hard disk drive storage of additional fonts. | | | |
| **Language** | Adobe™ PostScript™ Level 2 | | | |
| **Controller** | 24 MHz AMD 29000 RISC processor | | | |
| **Memory** | 16 MB standard; expandable to 64 MB | | | |
| **Connectivity** | Macintosh, IBM PC compatibles, IBM PS/2, Windows/DOS,<br>UNIX workstations (SUN, SGI, HP, IBM, and DEC ULTRIX), DEC VMS<br>workstations, mainframes | | | |
| **Interfaces** | AppleTalk, Parallel, RS-232 serial; optional EtherTalk™, TCP/IP;<br>all ports simultaneously active | | | |
| **Color Systems** | PANTONE®* Color simulations, CIE, and TekColor-based color matching | | | |

**Pantone Inc.'s check-standard trademark for color reproduction and color reproduction materials.*

In the U.S. call
1-800-835-6100
Product Literature
Dealer Locations
Printer Supplies

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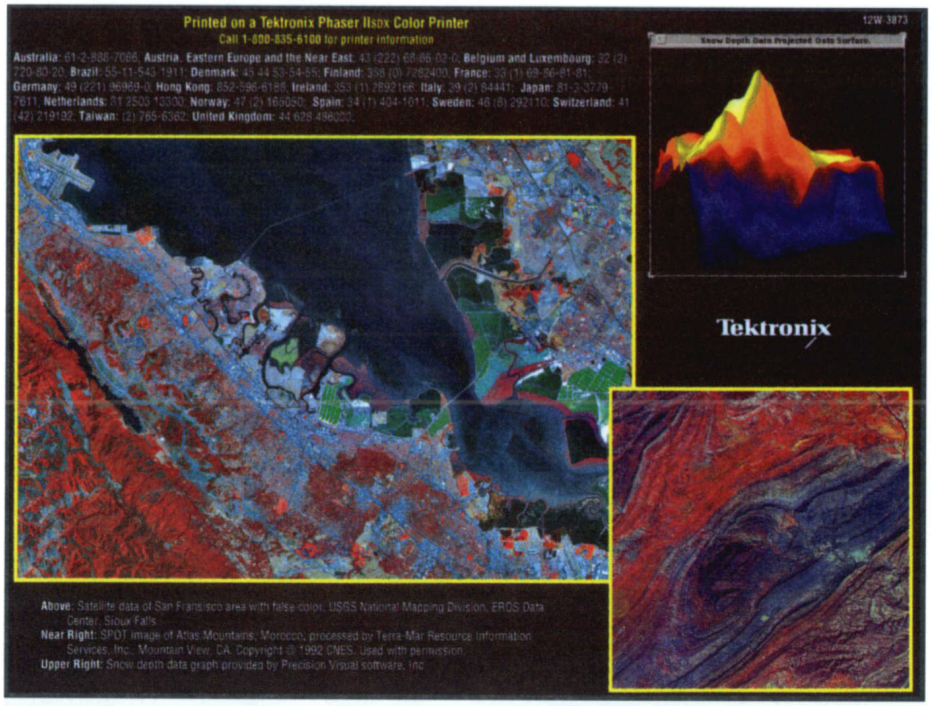
To order, contact your local sales office (listed on pages 566-569)

TekColor

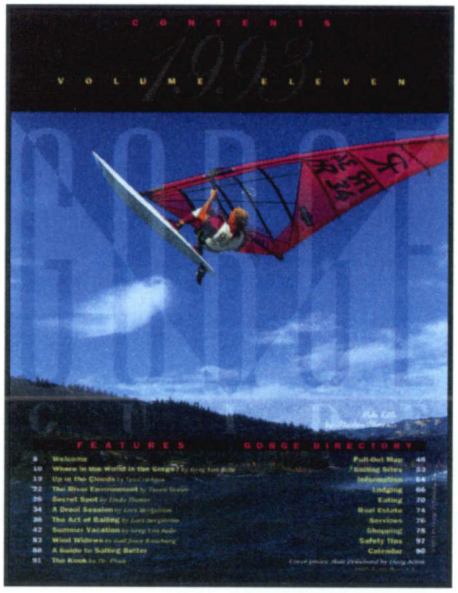
# Phaser Color Printers

## Phaser™ IIsdx






Above: Satellite data of San Francisco area with false color, USGS National Mapping Division, EROS Data Center, Sioux Falls.
Near Right: SPOT image of Atlas Mountains, Morocco, processed by Terra-Mar Resource Information Services, Inc., Mountain View, CA. Copyright © 1992 CNES. Used with permission.
Upper Right: Snow depth data graph provided by Precision Visual software, Inc.




Whatever your application – business presentations, graphic arts, engineering, or scientific – the new and improved Phaser IIsdx delivers photographic-quality, dye sublimation color printing on your desktop.

### Specifications

**Temperature –**
Operating: 15° to 35°C (59° to 95°F).
Nonoperating: 0° to 40°C (0° to 104°F).

**Humidity –**
Operating: 20% to 80% Relative Humidity, non-condensing.
Nonoperating: 10% to 90% Relative Humidity, non-condensing.

**Altitude –** Operating: 0 to 15,000 ft. at 25° C.
Nonoperating: 0 to 50,000 ft.

### PHYSICAL CHARACTERISTICS

| | cm | in. |
|---|---|---|
| Height | 37.3 | 14.7 |
| Width: | 44.2 | 17.4 |
| Depth: | 43.7 | 17.2 |
| **Weight** | **kg** | **lb.** |
| Net | 33 | 73 |

**Input Power –**
87 to 128 VAC or 174-250 VAC (internal switching required). 48 to 66 Hz: 235 watts peak.

**Safety and Emissions Standards –**
FCC Part 15, Subpart J, Class A Compliant; VDE 0871 Class B; UL 1950; CSA 1950; IEC 950/EN60 950.

### ORDERING INFORMATION

**PHASER IISDX**
Basic configuration. Order 4684 ..... **$9,995**
**Includes:** AMD 29000 24 MHz RISC-based image controller with 16 MB RAM, U.S. Letter-size input tray (adjustable for Letter- and Legal-size media), Universal output tray, U.S. power cord, media startup kit with paper and transfer roll, transfer roll tray, installation poster, user manual, cleaning kit, utilities, drivers, and sample images on diskettes in Macintosh, PC, and Sun workstation formats.

**Opt. 01 –** Metric media kit and input tray (replaces U.S. media and tray) ..... **NC**
**Opt. 02 –** Internal EtherTalk interface hardware (provides EtherTalk connectivity, network specific adapter required) ..... **$695**
**Opt. 04 –** 4 MB RAM Upgrade (total 20 MB) ..... **$495**
**Opt. 16 –** 16 MB RAM Upgrade (total 32 MB) ..... **$1,995**
**Opt. 32 –** 32 MB RAM Upgrade (total 48 MB) ..... **$3,990**

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

**UPGRADES AND ACCESSORIES**
**4684FDX –** Phaser IIsdx Upgrade (from Phaser IIsd) ..... **$195**
**4680F16 –** 16 MB RAM (Add one kit for a total of 32 MB; add two kits for a total of 48 MB) ..... **$1,995**
**4690F4M –** 4 MB RAM Upgrade ..... **$495**
**4680F02 –** EtherTalk interface hardware upgrade (provides EtherTalk connectivity, network specific adapter required) ..... **$695**
**011-0162-00 –** Ethernet 10BaseT Network Adapter ..... **$225**
**011-0161-00 –** Ethernet Thin Net Network Adapter ..... **$225**
**011-0160-00 –** Ethernet Thick Net Network Adapter ..... **$225**
**4511A –** TCP/IP Ethernet Interface (supports DECnet with 4690F41) ..... **$1,495**
**4690F22 –** Phaser Print for Sun Workstations ..... **$995**
**4690F23 –** Phaser Print for SGI Workstations ..... **$995**
**4690F41 –** PhaserSym (VMS Print Symbiont) ..... **$495**
**469CART –** Printer cart with three shelves ..... **$395**

**WARRANTY PLUS SERVICE OPTIONS**
**Opt. S0 (46S0) –** Installation and set-up ..... **$350**
**Opt. S1 (46AS1) –** One year of on-site service ..... **$995**
**Opt. S2 (46AS2) –** Two years of on-site service ..... **$2,065**
**Opt. S3 (46AS3) –** Three years of on-site service ..... **$3,040**

In the U.S. call
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Product Literature
Dealer Locations
Printer Supplies

(503) 682-7450
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Fax library of news, data sheets and answers to frequently asked questions.

To order, contact your local sales office (listed on pages 566-569)

# Phaser™ III PXi

# Phaser Color Printers

*Award-winning desktop color printing on plain paper.*

**PHASER™ III PXi**

- Prints on Nearly Any Paper from Vellum to Card Stock
- High-Quality Phase-Change Ink-Jet Color Printing
- Prints on 4 x 6 to 12 x18 Inch Media




Phaser III PXi

## MAIN FEATURES

| | |
|---|---|
| **Printer Technology** | 300 dpi, phase-change ink-jet |
| **Language** | Adobe's PostScript Level 2 software, with HP-GL 7475A plotter emulation |
| **Media** | Plain paper of varying grades: .003 to .010 in. thickness (.076 to .254 mm), 16 lb. Bond to 120 lb. Book (60 to 180 g/m$^2$); transparency film |
| **Media Sizes** | 4 x 6 in. to 12 x 18 in. (100 x 150 mm to 305 x 457 mm) |
| **Maximum Print Area** | 11.6 x 17.5 in. full-bleed (297 x 445 mm) |
| **Media Handling** | Automatic sheet-fed 16 to 24 lb. bond paper (60 to 90 g/m$^2$ paper), up to 8.5 x 11 in. (A-size), 210 x 297 mm (Metric) from letter-size tray, up to 12 x 18 in. (305 x 457 mm) from universal tray. Hand feed thin, or heavy papers from .003 to .010 (.076 to .254 mm) thick, up to 12 x 18 in. (305 x 457 mm) in size. |
| **Color Fidelity** | More than 8 million. TekColor Finepoint halftoning for sharper detail in scanned image printing. |
| **Color Systems** | PANTONE®* Color simulations, CIE, and TekColor-based color matching |
| **Memory** | 10 MB standard, expandable to 22 MB in 4 MB increments |
| **Controller** | 24 MHz AMD 29000 RISC-based processor |
| **Interfaces** | Parallel, Serial, AppleTalk, and SCSI (for external disk). Optional: EtherTalk interface or Ethernet TCP/IP (through 4511A Network Interface). |
| **Computer Compatibility** | Macintosh, IBM PC, IBM PS/2, Sun, DEC VMS and Ultrix, HP, IBM RS/6000, SGI and others |
| **Print Modes** | Draft (monochrome): 1 minute per letter-size page<br>Standard (color): 2 minutes per page<br>Enhanced (color): 4 minutes per page<br>Premium (color): 8 minutes per page<br>Black substitution: replace composite black with true black |
| **Standard Fonts** | 39 resident fonts; SCSI external port allows for hard disk drive storage of downloadable fonts. PXiJ version provides Kanji fonts on an external disk drive. |
| **Tray Capacity** | 200 sheets of 20 lb. bond paper<br>100 sheets of transparency film |

**Pantone Inc.'s check-standard trademark for color reproduction and color reproduction materials.*

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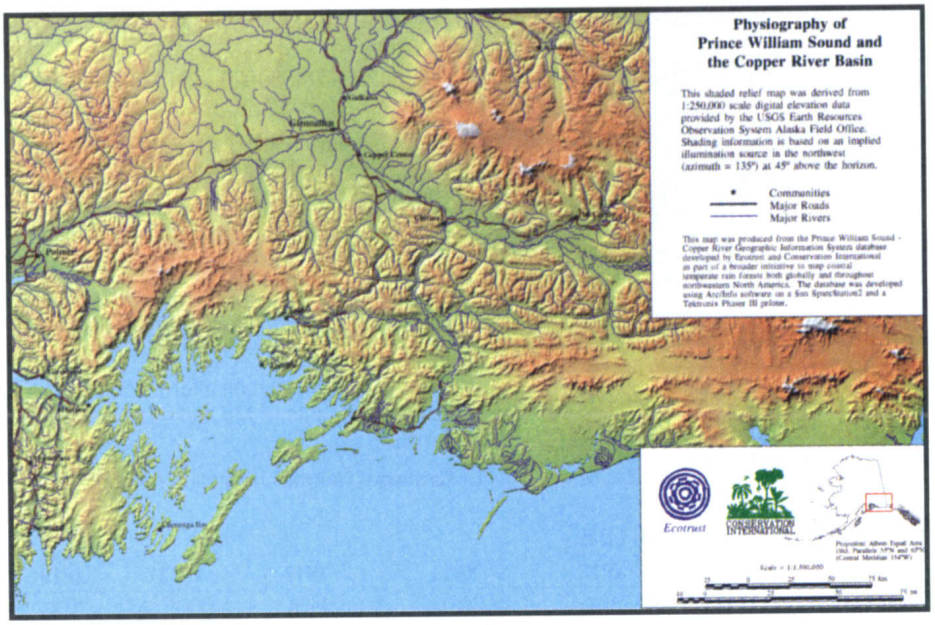
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TekColor

# Phaser Color Printers

## Phaser™ III PXi




The award-winning Phaser III prints vivid color images on transparencies or your choice of nearly any paper. Print on paper up to 12 x 18 inch (305 x 457 mm) in size. The Phaser III prints from Macs, PCs and workstations on a number of different networks, simultaneously.

### Specifications

**Temperature –**
Operating: 10° to 32°C (50° to 90°F).
Nonoperating: –30° to 60°C (–22° to 140°F).

**Humidity –**
Operating: 20% to 80% Relative Humidity, non-condensing.
Nonoperating: 10% to 95% Relative Humidity, non-condensing.

**Altitude –**
Operating: 0 to 8,000 ft. (2440 m) at 25° C.
Nonoperating: 0 to 50,000 ft. (15,240 m).

**PHYSICAL CHARACTERISTICS**

| | cm | in. |
|---|---|---|
| Height | 34.3 | 13.5 |
| Width: | 63.5 | 25 |
| Depth: | 68.6 | 27 |
| **Weight** | **kg** | **lb.** |
| net | 40.8 | 90 |

**Input Power –**
87-128 VAC or 174-250 VAC 48 to 66 Hz, 325 watts average, 650 watts peak, 230 watts standby.

**Safety and Emissions Standards –**
FCC Part 15, Subpart J, Class A Compliant; VDE 0871 Class B; CISPR 22 CLass B, UL 1950; CSA 1950; IEC 950/EN60 950.

## ORDERING INFORMATION

**PHASER III PXi**
Basic configuration. Order 4698PXi ..... **$9,995**
**Includes:** Letter-size input tray (adjustable for U.S. and Metric paper sizes); black, cyan, magenta, and yellow ColorStix™ ink sticks; universal output tray; US power cord; AMD 29000 RISC-based image controller with 10 MB RAM; media sampler kit with bond paper, cover stock, and transparency film; English User Manual; cleaning kit; utilities, drivers and sample images for Apple Macintosh, IBM PC/AT, PS/2 and compatibles.

**Opt. 01 –** Add universal input tray and ink startup kit (8 ColorStix each of black, cyan, magenta, and yellow) ..... **$395**

**Opt. 02 –** EtherTalk interface hardware ..... **$695**

**Opt. 04 –** Add 4 MB memory (total of 14 MB); this option is required to print a full image area on 12 x 18 in. (305 x 457 mm) media, also provides larger input buffers for enhanced throughput. ..... **$495**

**Opt. 08 –** Add 8 MB memory (total of 18 MB); this configuration provides extra memory for downloaded fonts and faster printing of complex images. ..... **$990**

**Opt. 12 –** Add 12 MB memory (total of 22 MB); provides extra memory for more downloaded fonts and faster printing of complex images. ..... **$1,485**

**Opt. L1 –** French User Manual substitution ..... **NC**

**Opt. L2 –** Italian User Manual substitution ..... **NC**

**Opt. L3 –** German User Manual substitution ..... **NC**

**Opt. L4 –** Spanish User Manual substitution ..... **NC**

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

**ACCESSORIES**

**4698CRT –** Phaser III printer cart with drawer and multi-position shelf for ink and media storage ..... **$695**

**436-0224-01 –** Letter-size input tray for A or A4-size media ..... **$125**

**436-0222-02 –** Universal input tray for A, A4, B, A3-size media and 12 x 18 in. (305 x 457 mm) ..... **$150**

**4680F02 –** EtherTalk interface hardware ..... **$695**

**4690F4M –** 4 MB SIMM for adding memory to the printer after initial purchase ..... **$495**

**4690F22 –** Phaser Print for Sun Workstations ..... **$995**

**4690F24 –** Screen copy software for HP workstations ..... **$995**

**469LAM –** Phaser Media Laminator. Optically improves projection of transparencies. Adds durability to transparencies and paper prints. Laminated prints are writable and erasable. ..... **$995**

**4511A –** Adapter to connect the printer into TCP/IP or DECnet Ethernet environments ..... **$1,495**

**PHASER III PXiJ**
Basic configuration. Order 4698PXJ ..... **$19,995**
**Includes:** All the same configurations and options as a Phaser III PXi plus Kanji fonts on a 100 MB external hard disk drive.

**WARRANTY PLUS SERVICE OPTIONS**

**Opt. S0 (46S0) –** Installation and set-up ..... **$350**

**Opt. S1 (46AS1) –** One year of on-site service ..... **$995**

**Opt. S2 (46AS2) –** Two years of on-site service ..... **$2,065**

**Opt. S3 (46AS3) –** Three years of on-site service ..... **$3,040**

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# XP350 SERIES XP10 SERIES Terminals

*Broad family of affordable price/ performance terminals.*

**XP350 SERIES**

- RISC X Terminals
- Fully Compatible with SUN, DEC and other UNIX Computer Environments
- Displays with Workstation Resolution and Quality
- Server is Optimized for Maximum Performance with a Broad Range of Demanding Technical and Engineering Applications for Superior User Productivity
- Worldwide Sales, Service and Support

**XP10 SERIES**

- Dual Access Via Ethernet and Serial Connection
- Fully Compatible with Sun, DEC and other UNIX Computer Environments
- Ergonomically Designed with User-Friendly Features, like Flicker-Free Resolution, Small Footprint, and Optional IBM, DEC, or UNIX Keyboard
- Validated with Hundreds of UNIX Applications
- World Wide Sales, Service and Support


XP10 Series

## XP10 Characteristics

**Standard features –** Logic unit, tilt/swivel display, 3 Ethernet interfaces, 3 button mouse, and power cord.

**Warranty –** One year return to depot, or 90 day on-site.

**Main CPU –** TMS34020 (32 MHz) and two Tektronix custom ASICS.

**SIMM Memory –** 4 MB standard expandable to 12 MB.

**LAN Ports –** 3 Ethernet: 10Base5 AUI (Thicknet), 10Base2 (Thinnet), and 10BaseT (Twisted-pair).

**Serial Ports –** Optional: One 9-Pin Serial port (XP11, XP13, XP17); Two 9-Pin Serial ports (XP12, XP18).

**Flash Memory –** Optional for X server, local clients, and fonts (2 MB and 4 MB); includes serial(s).

**Cooling –** Natural convection (no fan).

### XP10 SELECTION GUIDE

| | XP11 | XP12 | XP13 | XP17 | XP18 | XP19 |
|---|---|---|---|---|---|---|
| **Display Size** | 15 in. monochrome | 19 in. monochrome | 15 in. grayscale | 14 in. color | 17 in. color | 19 in. color |
| **Resolution** | 1024 x 768 | 1280 x 1024 | 1024 x 768 | 1024 x 768 | 1152 x 900 | 1152 x 900 |
| **Display Colors** | black & white | black & white | 16 shades of gray | 256 color | 256 color | 256 color |
| **Color Palette** | – | – | 256 | 16.7 million | 16.7 million | 16.7 million |
| **Refresh Rate** | 70 Hz | 72 Hz | 70 Hz | 70 Hz | 72 Hz | 72 Hz |
| **Display DPI /Dot Pitch** | 100 dpi | 100 dpi | 100 dpi | 100 dpi/ 0.28 mm | 100 dpi/ 0.28 mm | 100 dpi/ 0.28 mm |

### XP350 SERIES SELECTION GUIDE

| | XP350 | XP354 | XP356 | XP358 | XP338P PEX |
|---|---|---|---|---|---|
| **Display Size** | (Base Module Only) | 19 in. grayscale | 17 in. color | 19 in. color | 19 in. color |
| **Resolution** | – | 1280 x 1024 | 1280 x 1024 | 1280 x 1024 | 1280 x 1024 |
| **Display Colors** | – | 256 shades of gray | 256 colors | 256 colors | 256 colors |
| **Color Palette** | – | 256 grays | 16.7 million | 16.7 million | 16.7 million |
| **Refresh Rate** | – | 72 Hz | 72 Hz | 72 Hz | 72 Hz |
| **Display DPI/ Dot Pitch** | – | 100 dpi | 100 dpi/0.28 mm | 100 dpi/0.28 mm | 100 dpi/0.28 mm |

## XP350 Characteristics

**Standard features –** Logic unit, tilt display, 3 Ethernet interfaces (2 on XP338P), 3 button mouse, and power cord.

**Warranty –** One year return to depot, or 90 day on-site.

**Processors –** Main CPU: LSI Logic 33020 @ 33 MHz; Graphics Processor: integrated XP338P: MIPS R3000 @ 40 MHz with integral floating point and TMS34020 Graphics Processor.

**SIMM Memory –** 4 MB standard expandable to 68 MB; XP338P: 8 MB standard expandable to 32 MB.

**LAN Ports –** 3 Auto-selected Ethernet: 10Base5 AUI (Thicknet), 10Base2 (Thinnet), and 10BaseT (Twisted-pair). (Two on XP338P).

**Serial Ports –** Two 9-Pin RS232 ports.

**Parallel Port –** Optional: One 25-Pin DSUM IBM-style port. (Not available on XP338P)

**Flash Memory –** Optional for X server, local clients, and fonts (2 MB and 4 MB).

**Cooling –** Natural convection (no fan).

To order, contact your local sales office (listed on pages 566-569)

# Terminals







XP300 Series

## XPRESSWARE SOFTWARE FEATURES

| | |
|---|---|
| **Boot Options** | X Server code downloadable from host or optionally from Flash Memory |
| **Boot Protocols** | Standard: TFTP, NFS, Optional: MOP/DAP |
| **Network Protocols** | Standard: TCP/IP, TFTP, NFS, BOOTP, RARP: Optional: Serial Xpress, DECnet |
| **Network Management** | Standard: DNS, SNMP MIB IL, PING, Boot Monitor, DECnet Mirror, DECnet Trigger |
| **Parameter Set-up** | Motif-like set-up menu system and remote configuration files |
| **Printer Support** | Network printer support, local print screen, local BSD print spooler |
| **Server** | X server based on X11 Release 5; XP338P:X11R5 and PEX Protocol 5.1 |
| **Server Extensions** | Shape, Input, Multibuffer, XIE imaging extension, font catching, Xidle and Xtest extensions |
| **Local Clients** | Standard: TELNET, Console, Protocol Independent Chooser, Setup, Local Client Launcher, local xlock, low memory indicator. Optional: true OSF/Motif window manager, DECnet (Cterm, LAT), Serial Xpress, true OPEN LOOK window manager, Tek340 emulator, 3270 emulator, 3287 emulator, IBM graphics, 3179G+ emulator, XIE |
| **Terminal Emulation** | VT340, 3270 (Models 2,3,4,5), 3179G (Models 2,3,4,5), VT220, VT100 |
| **Fonts** | 27 Resident, 700+ available on server tape |
| **Font Service** | TPTP, NFS, Flash, Serial Xpress, DAP |
| **Boot/Font Tapes** | For SUN, HP, DEC (Ultrix, VMS), IBM R/S6000, SGI, and other UNIX platforms |
| **Tape Formats** | CD-ROM, Cartridge Tape, TK-50, 8 MM, 4 MM |
| **Input Options** | Tablet, touchscreen, barcode reader, light pen, trackball |

## ORDERING INFORMATION

**ALL XP TERMINALS INCLUDE:**
Logic unit, display monitor, Ethernet interface, 3 button mouse, keyboard, power cord, and user manual.

**XP11 –** 15 in. Monochrome Terminal ..... **$945**
**XP12 –** 19 in. Monochrome Terminal ..... **$2,445**
**XP13 –** 15 in. Gray-Scale Terminal ..... **$1,645**
**XP17 –** 14 in. Color Terminal ..... **$1,945**
**XP18 –** 19 in. Color Terminal ..... **$3,745**
**XP350 SERIES –** Contact your local sales office for information.

**KEYBOARD OPTIONS**

IBM 102 Keyboard, French. Order XPFXB ..... **$50**
IBM 102 Keyboard, Swedish/Finnish. Order XPFXC ..... **$50**
IBM 102 Keyboard, Danish/Norwegian. Order XPFXF ..... **$50**
IBM 102 Keyboard, German. Order XPFXG ..... **$50**
IBM 102 Keyboard, Italian. Order XPFXI ..... **$50**
IBM 102 Keyboard, Swiss-German. Order XPFXJ ..... **$50**
IBM 102 Keyboard, Spanish. Order XPFXS ..... **$50**
DEC Keyboard, North American. Order XPFVN ..... **$100**
DEC Keyboard, U.K. Order XPFVA ..... **$100**
DEC Keyboard, French. Order XPFVB ..... **$100**
DEC Keyboard, Swedish. Order XPFVC ..... **$100**
DEC Keyboard, Finnish. Order XPFVE ..... **$100**
DEC Keyboard, Danish/Norwegian. Order XPFVF ..... **$100**
DEC Keyboard, German. Order XPFVG ..... **$100**
DEC Keyboard, Italian. Order XPFVI ..... **$100**
DEC Keyboard, Swiss-German. Order XPFVJ ..... **$100**
DEC Keyboard, Spanish. Order XPFXS ..... **$100**
Unix Keyboard, North American. Order XPFUN ..... **$150**
3270 Keyboard, North American. Order XPFYN ..... **$150**

**WARRANTY**
One year return to depot or 90 day onsite.

To order, contact your local sales office (listed on pages 566-569)

# Display Monitors



*Excellent color saturation viewable in high ambient light, wide range of colors, and high resolution for better color definition and viewability.*

**NU 900M**

- Excellent Color Uniformity
- High Resolution
- Ultra-high Contrast
- Large Active Display Area
- AR Coated Front-glass
- Well-suited for Industrial Applications
- Wide Range of Colors
- Minimal Convergence Error
- Ruggedness
- No Shadowmask Constrictions

**APPLICATIONS**

- Test and Measurement Products
- Process Control Systems
- Medical Instrumentation
- Avionics Displays




## NU 900M 9-inch Color Display

The Nu 900M is a member of a new family of color display products. Based on a technology called NuCOLOR™, this 9-inch monitor contains a unique combination consisting of a monochrome CRT and a NuCOLOR Shutter. The NuCOLOR Shutter is an electrically switchable color filter made up of two fast liquid crystal optical switches, known as "pi-cells", plus a combination of color and neutral polarizers. Color is produced by sequentially displaying red, green, and blue field information on the monochrome CRT while the Shutter is switched to transmit red, green and blue respectively. Alternate fields, viewed through different colored filters, create full-color images.

## Characteristics

**MONITOR**

**CRT** – 9 in.

**Display Area** – 6.67 in. x 5.0 in.

**Resolution** – 640 x 480.

**Display Luminance** – >30 fL (white).

**Contrast** – 100:1 @ 42 foot candles.

**Geometric Distortion** – +0.75%.

**Video Risetime** – ≤4.4 ns.

**Horizontal Scan Rate** – 91 kHz.

**Input Signal** –

1. Parallel RGB (175 Hz) with separate horizontal and vertical syncs.
2. Parallel RGB (175 Hz) with composite syncs on green.
3. Serial RGB with composite syncs on green (Option 01).

Factory set for parallel input

Contact the factory for compatible VGA boards.

**ELECTRICAL**

**Power Input** – 87-250 VAC, 48-62 Hz.

**Power Consumption** – 100 Watts max.

**Internal Power** – 48 VDC @ 1.5 Amps.

**Anode Voltage** – 16 kV (typical).

**Reliability** – ≥33,000 hours (MIL-HNBK-217E).

**ENVIRONMENTAL**

**Temperature** – 0° to 50°C.

**Humidity** – 0 to 90% relative humidity.

**Altitude** – 15,000 feet operating; 50,000 feet Nonoperating.

**MECHANICAL**

**Safety** – UL 1950, CSA-950, IEC 950, EN6950.

**Dimension** –
9.16 in. (W) x 7.5 in. (H) x 12 in. (L).

**Weight** – ≤15 pounds.

## ORDERING INFORMATION

**NU900M**
9 in. Color Display System ..... **$1,095**

**INTERNATIONAL POWER PLUG OPTIONS**
**Opt. A1** – Universal Euro. 220 V, 50 Hz ..... **NC**
**Opt. A2** – United Kingdom. 240 V, 50 Hz ..... **NC**
**Opt. A3** – Australian. 240 V, 50 Hz ..... **NC**
**Opt. A4** – North American. 240 V, 60 Hz ..... **NC**
**Opt. A5** – Switzerland. 220 V, 50 Hz ..... **NC**
**Opt. 01** – Serial RGB Input ..... **NC**
**Opt. 02** – VGA controller ..... **$185**

To order, contact your local sales office (listed on pages 566-569)

# Display Monitors








## EX100HD

The EX100HD display offers several advantages over conventional shadowmask displays including: Resolution that is not limited by the matrix size of the shadowmask, elimination of mask induced color misconvergence, contrast ratios in excess of 100:1, and, for the same image size, a smaller mechanical package. As a result, the EX100HD offers the user excellent color saturation that is viewable even in high-ambient light, a wide dynamic range of colors, no shadowmask constrictions, and high resolution allowing better color definition and viewability.

## Characteristics

**MONITOR**

**CRT –** 1 in.

**Display Area –** 0.8(H) in. x 0.6(V) in.

**Addressability –** 640 x 480 @ 60 Hz, 800 x 600 @ 55 Hz Max nominal.

**Resolution –** 1,000 Lines/inch @ 15 fL.

**Display Luminance –** >30 fL (white).

**Contrast –** >100:1 @ 42 foot candles.

**Geometric Distortion –** ±1.0%.

**Optical Geometry Correction –** ±10% pincushion & barrel (adjustment range).

**Spot Size –** .0015 in. @ 30 fL (w/shutter).

**HORIZONTAL TIMING**

**Horizontal Front Porch –** 0.5µs, 40 pixels.

**Horizontal Sync Width –** 1.0µs, 80 pixels.

**Horizontal Back Porch –** 1.5µs, 120 pixels.

**Horizontal Blanking Interval –** 3.0 µs, 240 pixels.

**Multisync –** 60 kHz - 120 kHz.

**Pixel Clock –** 120.0 MHz.

**Pixel Period –** 8 ns, 1 pixel.

**VERTICAL TIMING**

**Vertical Front Porch –** 11 µs, 1 line.

**Vertical Active Display Time –** 5.28 ms, 480 lines.

**Vertical Blanking Interval –** 440 µs, 40 lines.

**Multisync –** 150 Hz to 200 Hz.

**Prior to Red Field:**

**Vertical Sync Width –** 66 µs, 6 lines.

**Vertical Back Porch –** 363 µs, 33 lines.

**Prior to Blue & Green Fields:**

**Vertical Sync Width –** 33 µs, 3 lines.

**Vertical Back Porch –** 396 µs, 36 lines.

**EX100HD**

- Excellent Color Uniformity
- High Resolution 800 dpi.
- Ultra-high Contrast
- Large Active Display Area
- Wide Range of Colors
- Minimal Convergence Error
- Ruggedness
- No Shadowmask Constrictions
- Optical Geometry Compensation

**APPLICATIONS**

- Virtual Reality
- Helmet-mounted Displays
- Simulators

*High resolution and excellent color saturation viewable in high-ambient light.*

## ORDERING INFORMATION

**EX100HD**
1 in. Color Display System ..... **$16,500**

**EX100D**
1 in. Color Display Head ..... **$7,000**

**EX100P**
Power Module ..... **$2,500**

**EX100G**
Controller Board Set ..... **$1,500**

**EX100M**
1 in. Color Monitor ..... **$9,500**

**INTERNATIONAL POWER PLUG OPTIONS**

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

**Opt. A2 –** United Kingdom. 240 V, 50 Hz ..... **NC**

**Opt. A3 –** Australian. 240 V, 50 Hz ..... **NC**

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

**Opt. A5 –** Switzerland. 220 V, 50 Hz ..... **NC**

To order, contact your local sales office (listed on pages 566-569)

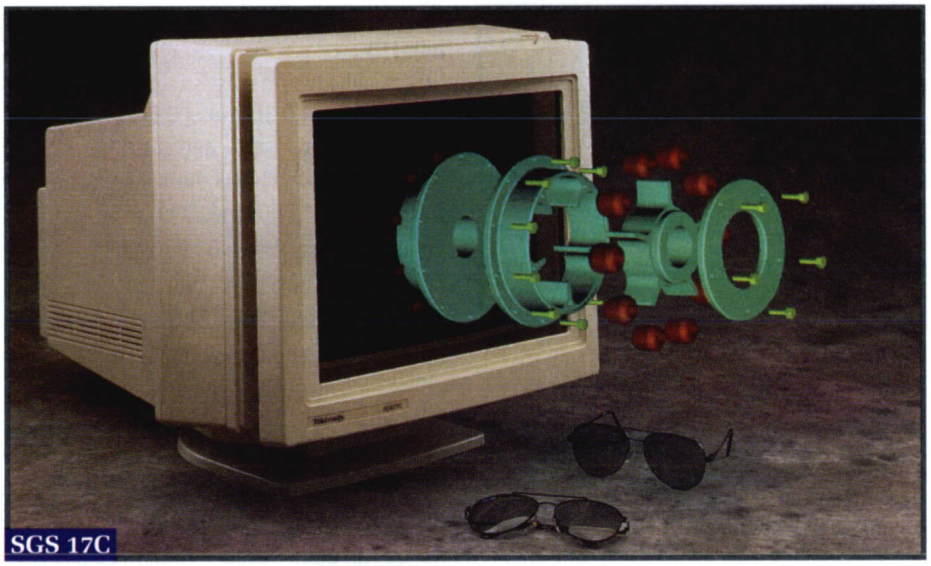
# Stereoscopic Products



*Designed for use in 2-D and 3-D stereoscopic modes.*

**SGS 17C**

- Compatible with Stereo-ready Workstations and Imaging Card Sets
- 17 in. Diagonal Stereoscopic/ Monoscopic RGB Color Display
- Easily Removable Liquid Crystal Modulator
- 1280 Pixels x 1024 Lines (60 Hz), 512 Lines (120 Hz)
- 2-D or 3-D Stereoscopic Viewing
- Wide Viewing Angle
- Excellent Image Quality
- Passive Stereo Viewing Glasses and Clip-ons




*SGS 17C 17-inch Stereoscopic 3-D Color Display.*

The Tektronix SGS 17C Stereoscopic 3-D color display is designed for easy adaptability to stereo-ready workstations and imaging card sets. It features a 17-inch screen size, a locking (but easily detachable) liquid crystal, stereoscopic modulator, and a high resolution aperture grill monitor.

The monitor can be used with any graphics systems that provide RGB signals at either 60 Hz frame rate (1280 pixels by 1024 lines) or 120 Hz field rate (1280 pixels by 512 lines).

The large area screen-sized liquid crystal modulator provides different polarization for the left and the right eye images. Special polarizing glasses worn by the user will decode the circularly-polarized images to provide the left and right eye views.

The display is designed to be used in both 2D and 3D stereoscopic modes. This design makes the system readily adaptable to many applications. The monitor has a stereo vertical scan rate of 100-130 Hz. The SGS 17C meets FCC (Class B) and VDE (Class A) EMI limits and is certified for safety by UL, CSA, and TUV.

**APPLICATIONS**

The excellent image and ease of use of the stereoscopic display makes it suitable for many applications, including:

- Mechanical CAD
- Cartography/Photogrammetry
- Molecular Modeling
- Non-destructive Testing
- Medical Imaging
- Remote Vision/Robotics

**WORKSTATION COMPATIBILITY**

The SGS 17C enables users with a 3D database to add a stereoscopic 3D display to their system. This display is compatible with stereo-ready workstations and imaging card sets that support 1280 x 1024 displays, and are capable of supplying an external TTL frame sync signal.

## ORDERING INFORMATION

**SGS 17C**
17 in. Stereoscopic 3-D Color Display.....**$6,495**

**INTERNATIONAL POWER PLUG OPTIONS**

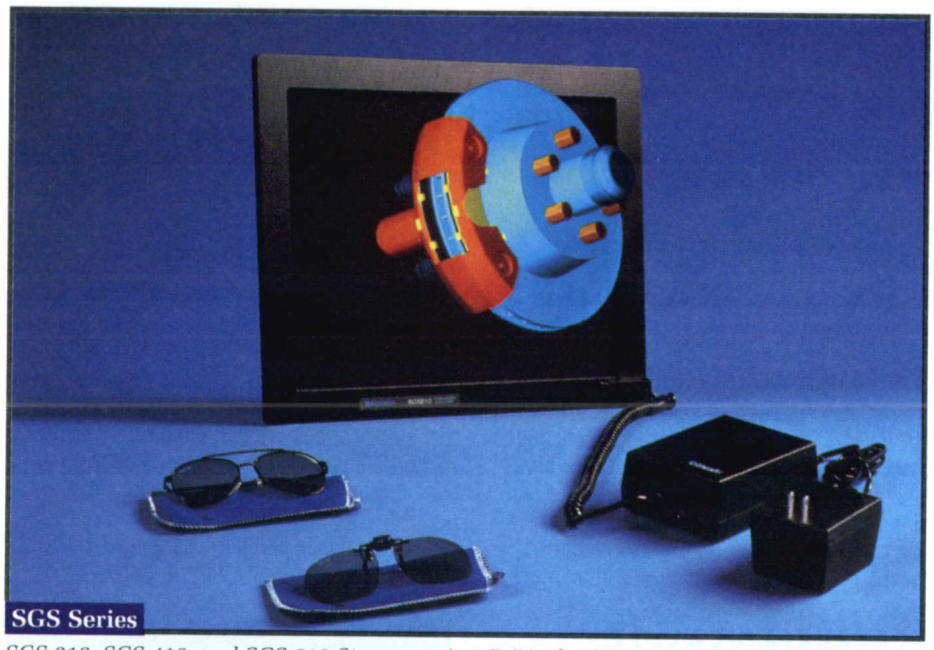
**Opt. A1** – Universal Euro. 220 V, 50 Hz .....**NC**
**Opt. A2** – United Kingdom. 240 V, 50 Hz.....**NC**
**Opt. A3** – Australian. 240 V, 50 Hz.....**NC**
**Opt. A4** – North American. 240 V, 60 Hz.....**NC**
**Opt. A5** – Switzerland. 220 V, 50 Hz .....**NC**

To order, contact your local sales office (listed on pages 566-569)

# Stereoscopic Products

**SGS 310**
**SGS 410**
**SGS 610**






*SGS 310, SGS 410, and SGS 610 Stereoscopic 3-D Display Kits.*

**SGS SERIES**

- Screen-sized Liquid Crystal Modulator
- 12 in. 3-D Display Kit (SGS 310)
- 16 in. 3-D Display Kit (SGS 410)
- 19 in. 3-D Display Kit (SGS 610)
- Stereo Modulator Driver
- Easy Mounting
- Four Pairs of Stereo Viewing Glasses

*Produce high quality stereoscopic 3-D images.*

The SGS 310, SGS 410, and SGS 610 are stereoscopic three-dimensional display kits for use with a customer-supplied monochrome or full-color monitor to obtain true stereoscopic three-dimensional displays. Composed of a liquid crystal modulator, viewing glasses, and driver box, these kits enable the user to produce high quality stereoscopic 3-D images.

To create these distinctive 3D displays, left eye and right eye images are alternately displayed on the monitor. The liquid crystal modulator mounted on the monitor encodes the images with circular polarization. The special glasses worn by the user decodes the images providing a clear stereoscopic 3-dimensional display.

**ADVANTAGES**

These 3D stereoscopic display kits, identified as SGS 310, 410, 610, have many advantages over other stereoscopic display technologies such as:

- Viewing glasses are not connected to the monitor. The user has complete freedom of movement.
- Circular polarization enables a wide field for stereoscopic viewing.
- High transmission created by the Liquid Crystal switch makes viewing possible even in brightly illuminated work areas.
- Anti-reflective coating on front surface of the SGS 610 minimizes reflections.
- Can be used with either 60 Hz or 120 Hz monitors.
- The stereo viewing glasses enable the user to view multiple, unsynchronized displays.
- The display provides full horizontal resolution for each eye.
- Can be used with raster or vector displays.

## ORDERING INFORMATION

**SGS 310**
Stereoscopic 3-D Display Kit ..... **$2,695**

**SGS 410**
Stereoscopic 3-D Display Kit ..... **$3,295**

**SGS 610**
Stereoscopic 3-D Display Kit ..... **$3,995**

**INTERNATIONAL POWER PLUG OPTIONS**

**Opt. A1** – Universal Euro. 220 V, 50 Hz ..... **NC**
**Opt. A2** – United Kingdom. 240 V, 50 Hz ..... **NC**
**Opt. A3** – Australian. 240 V, 50 Hz ..... **NC**
**Opt. A4** – North American. 240 V, 60 Hz ..... **NC**
**Opt. A5** – Switzerland. 220 V, 50 Hz ..... **NC**

To order, contact your local sales office (listed on pages 566-569)

# Display Monitors



*All 600 Series products are available in open frame configuration or with the optional cabinet. The products incorporate a Tektronix manufactured CRT and are backed up by the Tektronix World-Wide Sales and Service Organization.*

**606B**

- Very High Resolution
- Uniform Brightness
- Multi-Imaging Capability
- Ultra Sharp Images
- Image Stability
- High Reliability

**APPLICATIONS**

- Gamma Camera Recording
- Other Photographic Recording
- Scan-Conversion Imaging
- Scanning Electron Microscopy

**608**

- High Brightness
- High Resolution
- Excellent Gray Scale
- Optimum Viewing Capability
- High Ambient Viewing
- Photographic Quality Images

**APPLICATIONS**

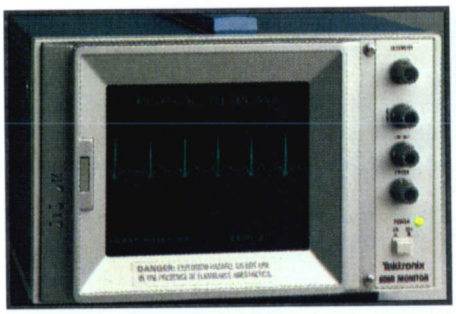
- Ultrasound Imaging
- Spectrum Analysis
- IR Imaging
- Mass Spectroscopy
- Test and Measurement

**620**

- Mechanically Rugged
- Versatile Modular Packaging
- Low Power Consumption
- Economical Display
- High Reliability

**APPLICATIONS**

- Ultrasound Analysis
- Electronic Equipment Testing
- Network Analysis
- Non-Destructive Testing



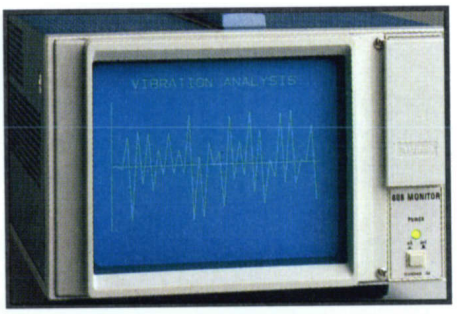
*606B Option 06*

## Very High Resolution

The 606B Very High Resolution X-Y Display is ideal for photographic recording applications in medical gamma camera systems, where image stability, gray scale performance and uniform brightness are critical. It is also superior in applications such as electron microscopy or radiation and thermal imaging.

**TEKTRONIX-HEWLETT PACKARD CROSS REFERENCE**

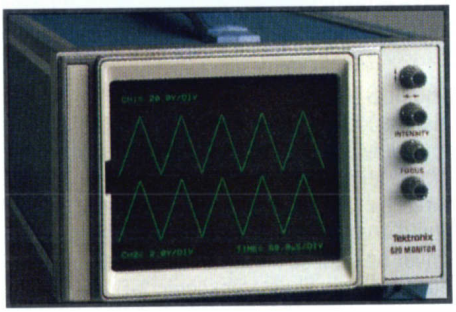
| | 606B | 608 | 620 |
|---|---|---|---|
| HP 1208A | | | X |
| HP 1208B | | | X |
| HP 1304A | X | | |
| HP 1332A | | X | |
| HP 1333A | X | | |
| HP 1336S | X | | |
| HP 1340A | | | X |
| TEK 602 | | | X |
| TEK 604 | | X | |
| TEK 624 | | X | |




*608 Option 23*

## High Brightness

The 608 High Brightness X-Y Display is designed for easy reading in high ambient light. Its sharp image is well-suited for medical and military imaging and electronic instrumentation. The high brightness (70 fL), 10-mil spot size and large screen (9.8 x 12.2 cm) allow high quality photography.




*620 Option 23*

## Mechanically Rugged

The 620 General-Purpose X-Y Display is economical, yet reliable and mechanically rugged. It is an ideal display for signal analyzers, yet rugged enough for vibration tests and non-destructive testing (NDT). Its 15-mil spot size and useable brightness (up to 30 fL) are appropriate for A-mode imaging in medical instrumentation.

To order, contact your local sales office (listed on pages 566-569)

# Display Monitors

**600 SERIES**



## SELECTION GUIDE

| Key Specifications | 606B | 608 | 620 |
|---|---|---|---|
| Spot Size*1 | 0.08 mm (3.1 mils) | 0.26 mm (10 mils) | 0.38 mm (15 mils) |
| Display Size | 8 cm x 10 cm | 9.8 cm x 12.2 cm | 9.8 cm x 12.2 cm |
| Acceleration Potential | 5.4 kV | 22.5 kV | 12.0 kV |
| Bandwidth, X-Y*2 | ≥3 MHz | ≥5 MHz | ≥2 MHz |
| Bandwidth, Z*2 | ≥5 MHz | ≥10 MHz | ≥5 MHz |
| Rise Time | ≤35 ns | ≤35 ns | ≤70 ns |
| Input R and C, X-Y*3 | 1 MΩ or 50 Ω "<" ≤47 pF | 1 MΩ, "<" ≤60 pF | 1 MΩ, ≤ "<" ≤47 pF |
| Input R and C, Z*3 | 1 MΩ or 50 Ω "<" ≤47 pF | 1 MΩ, "<" ≤60 pF | 1 MΩ, "<" < 47 pF |
| X-Y Phase Difference | ≤1° to 500 kHz | ≤1° to 1.5 MHz | ≤1° to 500 kHz |
| Recommended Source Impedance, X Y and Z*3 | <10 kΩ in 1 MΩ pos. | ≤10 kΩ | ≤10 kΩ |
| Temperature Range | 0°C to 50°C | 0°C to 50°C | 0°C to 50°C |
| Power Requirements*4 | 75 W | 61 W | 26 W |
| Included Accessories | Lined external Implosion shield (graticule) for adjustment purposes. | | |
| Recommended Cameras | C-9 Opt. 07 | C-9 Opt. 07 | C-9 Opt. 07 |

**1 Measured at 0.5 μA.*

**2 Full spec would read: "dc to. . ." appropriate figure.*

**3 "<" means "paralleled by less than."*

**4 Line-voltage selector allows operation from 100, 110, 120, 200, 220, and 240 V (±10% on each range), 48 to 440 Hz. Number given shows Watt max at nominal line voltage.*

## OPTIONS AND ACCESSORIES

| Feature | 606B | 608 | 620 | Option | Price |
|---|---|---|---|---|---|
| Internal Graticule | | • | • | Opt. 01 | +$15 |
| UL 544 (Includes handles, feet, and covers) | | | • | Opt. 06 | +$140 |
| UL 544 (Includes handles, feet, and covers) | • | | | Opt. 06 | +$135 |
| Screwdriver Front Panel Controls | • | | | Opt. 07 | +$45 |
| UL 544 Component Recognized | • | • | • | Opt. 09 | NC |
| 25-Pin Remote Program Connector | | • | • | Opt. 10 | +$55 |
| AC Delete | | | • (6,31)*1 | Opt. 20 | −$20 |
| Full Differential Inputs | | • | | Opt. 21 | +$70 |
| Extended Gain Range | | • | | Opt. 22 | +$45 |
| Handle,feet, and covers | | | • (6, 28, 31)*1 | Opt. 23 | +$120 |
| Handle,feet, and covers | | • (28)*1 | | Opt. 23 | +$130 |
| Linearized Z-axis | | • | | Opt. 24 | +$75 |
| TTL Blanking | | • | | Opt. 25 | +$75 |
| TTL Blanking | | | • | Opt. 25 | +$50 |
| Covers only | • (6)*1 | • (23)*1 | • (6, 23, 31)*1 | Opt. 28 | +$90 |
| Metal Bezel | | • | | Opt. 29 | +$75 |
| Delete all Rear BNCs, DC Power Connector and AC Power Supply and Switch | | | • | Opt. 31 | −$25 |
| GM (P7) Phosphor | | • | • | Opt. 76 | +$65 |

**1 Not available with these options.*

## ORDERING INFORMATION

**606B**
Monitor ..... **$5,375**

**608**
Monitor ..... **$3,320**

**620**
Monitor ..... **$1,910**

To order, contact your local sales office (listed on pages 566-569)

# General Customer Information

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# Tektronix Contacts

*Quality, support, and convenience.*

- Tektronix Sales and Service Offices
- Tektronix Distributors
- Tektronix Representatives
- NMC
- TekDirect™

Customer support programs vary according to country. Please contact your Tektronix representative for availability of programs in your locations.

## Tektronix Contacts

Tektronix has a number of ways for you to get the information you need quickly and conveniently.

## Tektronix Sales and Service Offices

Tektronix products and technical support are available through a worldwide network of sales and service offices. Your nearest Tektronix Account Manager is available to answer your questions. To find the sales and service office nearest you, see pages 566-569 (worldwide), inside back cover (U.S.).

## Federal Order Administration Office

Federal Agencies should obtain price, delivery and place orders directly with Tektronix Federal Order Administration at 1-800-682-1210. Federal Agency RFQ's, RFP's, IFB's, Purchase Orders and Contracts should be mailed or Faxed directly to:

Tektronix, Inc.
Federal Order Administration M/S 94-532
PO Box 4600
Beaverton, OR 97076

FAX: (503) 629-5388

If you use EDI for purchasing, please contact us through the phone number above, so we may establish a paperless link with you. Tektronix CAGE code is 80009.

## Authorized Tektronix Distributor & Manufacturers Representatives

We have Authorized Tektronix Distributors and Manufacturers Representatives for selective products and geographic areas. They will provide you with fast, convenient service and support. You may already be served by them, so ask if they carry Tektronix. We encourage you to take advantage of their support and purchase Tektronix products from them.

As you use this catalog watch for the (TD) icon. It identifies those products that are available through our distributors and representatives. For a listing of their names refer to page 570-571. Also, we are adding new ones all the time to better serve you needs, so call 1-800-426-2200 Ext. 99 in the U.S. for the one nearest you.

Watch for products identified as Tektronix Distributor (TD).

## Tektronix National Marketing Center (NMC)

The same quality support found in our sales and service offices is available toll free. In the U.S., call 1-800-426-2200, Ext. 99, Monday through Friday, from 8:00 am Eastern Time to 5:00 pm Pacific Time. Expert telephone sales engineers are available to provide technical support to help you choose the right equipment, answer questions, and take your order.

## TekDIRECT™

Call Direct – 1-800-426-2200 in the U.S. TekDirect provides all the same great benefits as above, plus VISA, MasterCard, American Express, or Discover accepted, 24 hour shipping with rush delivery available. TekDirect also provides the inside track to the latest trends in test and measurement. Great reconditioned equipment bargains are also available.

Billing – is any way you like. VISA, MasterCard, American Express, or Discover accepted. Or set up an account with Tektronix (30-, 60-, 90-day payment). Checks or money orders are also accepted. For future orders, ask us about pre-approved lines of credit.

Shipping – Anything you order from the TekDirect Catalog will be shipped within 24 hours.*[1] Our economical shipping and handling charges work like this: for regular surface shipping, add $5.00 for orders up to $1,000 and 1/2 of 1% for orders over $1,000 (except Alaska and Hawaii).

Need your gear in a day or two? We can also deliver via 1-day, 2-day, or overnight air services, at low rates.

Guarantee – When you buy once from TekDirect, we want you to be a satisfied customer for life. To support that goal, we offer a 30-day, money-back guarantee. If you return any purchase within 30 days, we'll either replace your instrument, exchange it for another one, or give you a refund. No questions! No bother!

Service – If you need to return something for calibration or repair, just drop it off at a Tektronix service center. Or mail it in. We offer service agreements that provide preferred turnaround time. Of course, we always pay the return freight.

Watch for products identified as TekDIRECT™ (TD).

*[1] *Note: large orders or custom configurations may require special scheduling.*

# Customer Support



## Total Solutions for Your Success

When you purchase your Tektronix product, you will find more in the box than a quality product. You'll find an array of services that provide total-solution coverage – coverage that begins with the first call to your customer service representative and continues after the sale through long-term product support. Our sales and service personnel work closely 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.

It all begins by contacting a customer service representative (CSR) located in your nearest Tektronix sales and service office. Our U.S. and international office locations are listed at the back of this catalog. The CSR will give you information on products and the names of sales engineers assigned to serve your product interests.

### WARRANTY COVERAGE

All Tektronix products are warranted to be free from defects in materials and workmanship during the applicable warranty period. See page 552-553.

### SERVICE OFFERINGS

Simply tell us what 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 554 to 557 for specific service offerings.

### CUSTOMER-SITE INSTALLATIONS

Tektronix provides on-site installations for most Tektronix-configured systems. Your Tektronix specialist will set up your product to meet all operating specifications. Contact your local sales and service 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. These products can be serviced pending part availability. Contact your local Tektronix service center for service quotes and information.

### TRAINING AND ASSISTANCE

Your Tektronix product is most useful to you when you are thoroughly familiar with it. Formal training classes and self-study aides can help you get up to speed faster. Ask your Tektronix sales representative for details about customer training.



### SEMINARS

To receive information about our free Tektronix product and technical seminars, contact your local sales office to be added to the seminar mail list. See page 559.

### OPERATIONAL AND APPLICATIONS SERVICE TRAINING WORKSHOPS

To help you achieve optimum utilization of your equipment, Tektronix provides 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 559.

### MODULE EXCHANGE SERVICES

Easily exchangeable modular components facilitate rapid troubleshooting and repair of many Tektronix products. 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 dock within 24 hours, and overnight delivery can be arranged for most US locations. To place an order, call the Tektronix *Fast*Parts Center at 1-800-848-5083.

### REPLACEMENT PARTS

Components of equal or improved quality can be supplied for over 5,000 Tektronix products. Replacement parts and supplies can be ordered by calling toll free between 5AM and 5PM, Pacific Time. Most items are stocked and will ship from our dock within 24 hours of order placement. Overnight shipment is available upon request. Call the Tektronix *Fast*Parts Center at 1-800-848-5083.

### TECHNICAL SUPPORT

Tektronix provides high quality Technical Support on applications, operation, measurement specifications, hardware, and software, by expert Application Engineers. See contact information at right.

### CUSTOMER SUPPORT PROGRAMS

- Service Offerings
- Warranty Coverage
- Customer-Site Installations
- Training and Assistance
- Product and Technical Seminars
- Operational and Applications Workshops
- Service Training Workshops
- Module Exchange Services
- Replacement Parts
- Long-Term Product Support
- Technical Support

*Providing you with worldwide service and support to complement your new product purchase.*

Request a copy of our Test and Measurement Service Brochure detailing service options available to you.

Technical Support
Call 1-800-835-9433, Ext. 2400
6:00 am to 5:00 pm Pacific Time.

Customer support programs vary according to country.

Software Bulletin Board
24 hrs, 7 days a week.
2400/9600 baud,
dial 503-627-5658.

For information on programs available in your location, contact your Tektronix representative (listed on the inside back cover).

# Warranty Summary



## Software Warranty Summary

Tektronix warrants that its software products will conform to the specifications in the documentation provided with the product, when used properly in the specified operating environment, for a period of three (3) months. The warranty period begins on the date of shipment, except that if the program is installed by Tektronix, the warranty period begins on the date of installation or one month after the date of shipment, whichever is earlier. If the software product does not conform as warranted, Tektronix will provide the remedial services as described in the documentation provided with the product.

For products offered without documentation, Tektronix warrants that the media on which the software product is furnished and the encoding of the programs on the media will be free from defects in materials and workmanship for a period of three (3) months from the date of shipment. If any such medium or encoding proves defective during the warranty period, Tektronix will provide a replacement in exchange for the defective medium. Except as to the media on which the software product is furnished, the software product is provided "as is" without warranty of any kind, either express or implied.

Tektronix does not warrant that the functions contained in any software product will meet Customer's requirements or that the operation of the programs will be uninterrupted or error-free.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and, for warranted products, make suitable arrangements for such service in accordance with the instructions received from Tektronix. If Tektronix is unable, within a reasonable time after receipt of such notice, to provide remedial service for warranted products or, for "as-is" products, to provide a replacement that is free from defects in materials and workmanship, Customer may terminate the license for the software product and return the software product and any associated materials for credit or refund.

The above warranties shall not apply to any software product that has been modified or altered by Customer. Tektronix shall not be obligated to furnish service under this warranty with respect to any software product a) that is used in an operating environment other than that specified or in a manner inconsistent with the User's Manual and documentation; or b) when the software product has been integrated with other software if the result of such integration increases the time or difficulty of analyzing or servicing the software product or the problems ascribed to the software product.

**THE ABOVE WARRANTIES ARE GIVEN BY TEKTRONIX WITH RESPECT TO THE LISTED PRODUCTS IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO PROVIDE REMEDIAL SERVICE WHEN SPECIFIED, REPLACE DEFECTIVE MEDIA, OR REFUND CUSTOMER'S PAYMENT, AS APPLICABLE, IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO CUSTOMER FOR BREACH OF EITHER WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.**

# Warranty Summary



## Hardware Warranty Summary

Tektronix warrants to its Customers that the products that it manufactures and sells will be free from defects in materials and workmanship for the periods set forth in the table below. If any such product proves defective during the applicable warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor or will provide a replacement in exchange for the defective product.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Tektronix will provide such service at Customer's site for certain categories of products, as indicated in the table below, if Customer's site is within the normal on-site service area. Tektronix will provide on-site service outside the normal on-site service area only upon prior agreement and subject to payment of all travel expenses by Customer. In all other cases, Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the service center is located. Customer shall be responsible for paying all shipping charges, duties and taxes, if the product is returned to any other location. The locations at which the services will be provided for different categories of products or product groups are set forth below.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty; a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair, or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; c) to repair any damage or malfunction caused by the use of non-Tektronix supplies; or d) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

**THIS WARRANTY IS GIVEN BY TEKTRONIX WITH RESPECT TO THE LISTED PRODUCTS IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO REPAIR OR REPLACE A DEFECTIVE PRODUCT IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.**

| General Product Categories*1 | Warranty Period | Service Location |
|---|---|---|
| Oscilloscopes: Including 2205 and 2402A TekMate (except all other 2200, 2300, 2400 Series), 11xxx Series/Plug-ins, DSA6xx, CSAxxx Series, HFS9xxx Series; SDxx, TM 250, TM 500/TM 5000 Series; Optical: Attenuators, Electrical Converters, Impulse Generators, Power Meters, TDR's (Optical and Metallic); AF and AW Generators; Logic Analyzers (except 9200 Series); Spectrum Analyzers (except 305x DSP Systems); SDH/SONET Receivers and Filters; Television Products (except 17xx/17xxA Series, WFM300A, WFM601, WVR500, 2721A, 2722A); Waveform Digitizers; Curve Tracers; Photometers/Radiometers; Cameras; Carts; Probes; CRTs; Isolators; Test System Interface Series; XP Series X-Terminals; XPTA Graphics Tablet; 468x and 469x Series Color Printers (except 4696 and 4697 Printers); TestLabs; Fourier Analyzer; RIC386 Instrument Controller; Signal Analyzer; Pulse Generator; RF16x Down Converter; CT100 | 1 year from date of shipment | Service Center designated by Tektronix |
| Oscilloscopes: 222 Series, 224, 2200 (except 2205), 2300, 2400 Series (except 2402A TekMate), TAS400 Series, TDSxxx Series; Television Products: 17xx/17xxA Series, WFM300A, WFM601, WVR500, 2721A, 2722A; Card Modular Instruments: 53A Series, 73A Series, CTS7xx Series, DMM Series, VXxxxx Series | 3 years from date of shipment | Service Center designated by Tektronix |
| Monitors: 606B, 608, 608YX, 620, 634, GMA 201, GMA 202, GMA 212, GMA 213C, GMA 213S | 3 months, except 1 year from date of shipment for CRT | Service Center designated by Tektronix |
| Color Printers 4696 and 4697, Graphics Tablets; Microprocessor Development Products (except V-Systems, MV Systems); 9200 Series Application Software; 305x DSP Systems | 3 months, except 1 year from date of shipment for CRT | Customer's site if within normal on-site service area |
| Color Graphics Terminals: 4205, 4207; Color Graphics Netstation: 4211; Digital Analysis Systems: 9200 Series (except 9200 Series Application Software); LV500 Series | 1 year from date of shipment | Customer's site if within normal on-site service area |
| Custom Systems; Microprocessor Development Products: V-Systems | 3 months, except 1 year for CRT, beginning on the date of installation by Tektronix, or one month from date of shipment, whichever is earlier | Customer's site if within normal on-site service area |
| Parts, Assemblies, Supplies and Test Fixtures: All 9-digit part numbered items (except Probes, CRTs) LCS: SGS 4xx, SGS 6xx; CAChe: CAxx, CAxxx, CGxx, RP88xx | 3 months from date of shipment | Service Center designated by Tektronix |
| Service | 3 months from date of shipment or date of completion if performed on-site | Location where original service was performed |

**1 Supplemental Individual Warranty Statements are available from your local Tektronix Sales Office. Many Advantest and Rohde & Schwarz products are now covered by a Tektronix Warranty. Contact your local Tektronix sales office for additional information.*

# Warranty-Plus Protection

***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."*

**WARRANTY-PLUS PROTECTION**

- Calibration
- Repair
- Calibration and Repair
- Comprehensive Systems Services
- On-Site Services

Request a copy of our Test and Measurement Service Brochure detailing service options available to you.

Warranty-Plus programs vary according to country.

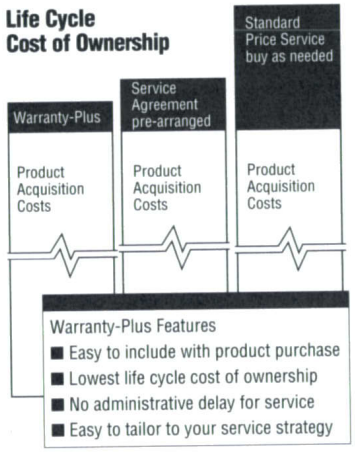
For information on programs available in your location, contact your Tektronix representative (listed on the inside back cover).

## Service Support

Because every industry and company is unique, we tailor our services to your individual requirements. You may choose from our standard services, mix established custom services, or work with us to create a unique service package adapted to your needs. Whatever your need, for services performed at your location or at a Tektronix Service Center, Tektronix Test and Measurement Service will provide fast, flexible, consistent service that keeps your products operating at peak performance.

### WARRANTY-PLUS PROTECTION

The purchase of a Warranty-Plus option at the time of your new product purchase will provide you with the most cost effective, long term service support available from Tektronix.




Warranty-Plus can be secured only as a one time investment on new purchases. Don't miss this prime opportunity. Your Tektronix sales representative can provide information about what options are available for the products you choose. Warranty-Plus options can be included on the product purchase order, or if you prefer, we can invoice separately.

Warranty-Plus protection is available in a number of combinations, as calibration only, repair only, or calibration and repair in one offering. Service can be performed at your local Tektronix Service Center or, for many products, at your place of business.

### WARRANTY-PLUS CALIBRATION

Purchase of Warranty-Plus Calibration allows you to keep your instruments working at peak precision, and with regularly scheduled calibration intervals, ensures your calibration certification is current. The price is well below what you would expect to pay if you waited to recalibrate and recertify your instruments as they became due.

Our calibration program provides NIST traceability and MIL–STD–45662A compliance at no additional charge, on all eligible products. This includes a Certificate of Traceable Calibration and calibration label showing our certification date and the due date for next calibration.

The Certificate of 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, and we maintain audit documentation of your instrument's performance in compliance with MIL–STD–45662A.

### WARRANTY-PLUS REPAIR

Priced significantly lower than the cost of even a single repair, extended repair protection can be arranged at the time of your instrument purchase. And, because it is arranged in advance, Warranty-Plus Repair coverage minimizes administrative delays in the unlikely event your instrument ever needs a repair.

Should it become necessary, we will repair your instrument, installing any component modification needed to make the repair. We then conduct a full 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.

### WARRANTY-PLUS CALIBRATION AND REPAIR

To ensure full coverage of your newly purchased instrument, the combination of Warranty-Plus Calibration and Repair protection is available for your convenience. This service combines the features of Calibration and Repair in one simple purchase.

### WARRANTY-PLUS COMPREHENSIVE SYSTEMS SERVICES

This service, available for most Tektronix Test and Measurement Systems, combines the features of Warranty-Plus Calibration and Repair protection with access to our Telephone Support Center and extended software support.

### WARRANTY-PLUS ON-SITE

Warranty-Plus protection can be provided for many products at your location. Our On-Site Warranty-Plus protection saves you the cost of shipping, and allows you to keep your instruments in place – a particular advantage for instruments integrated into larger systems. All the features of Warranty-Plus Calibration and Repair apply.

# Comprehensive Systems Services

These services are available for many Tektronix Test and Measurement Systems and combine the features of calibration and repair agreements as well as access to our Telephone Support Center and extended software support. A variety of services is available dependent on where you prefer the service to take place, at your site or at a Tektronix Service Center.

## 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 preventative 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 replacements for your failed module when you call. We take your failed module, refurbish it to like-new condition, and place it in our exchange inventory.

**REPAIR AND RETURN SERVICE**
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 MIL–STD–45662A calibrations, or full performance verifications to manufacturer's specification, as applicable.

**CALIBRATION OR PERFORMANCE VERIFICATION AGREEMENTS**
Tektronix provides MIL–STD–45662A calibrations, or full performance verification to manufacturer's specification, as applicable. We also provide recall notification, and do it at a discount from our per-incident rates.

## Custom Service Agreements

With all the system options we provide, we know that 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 800-numbers to resolve hardware and software operability, system integration, and fault-isolation issues.

**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."*

Request a copy of our Test and Measurement Service Brochure detailing service options available to you.

Systems services vary according to country.

For information on services available in your location, contact your Tektronix representative (listed on the inside back cover).

# Service Agreements

***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."*

Request a copy of our Test and Measurement Service Brochure detailing service options available to you.

Service agreements vary according to country.

For information and availability of agreements in your location, contact your Tektronix representative (listed on the inside back cover).

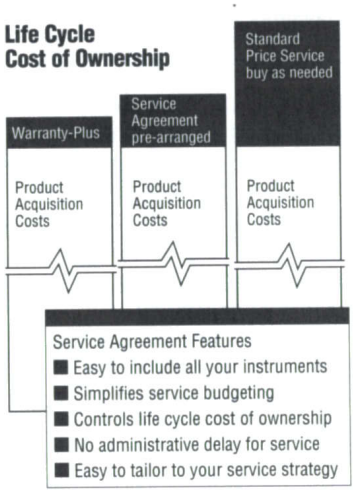
**SERVICE AGREEMENTS**

- Low Cost Protection
- A Variety of Offerings
- Discounts May Apply



## Low Cost Instrument Protection

Once your product warranty or Warranty-Plus 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. Agreements offer service protection purchased in increments of one to several years. 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**

Service Agreements are available for calibration only, repair only, and as a calibration and repair combination. Comprehensive Systems Service Agreements are available for many Tektronix Test and Measurement Systems and feature calibration and repair protection along with access to our Telephone Support Center and extended software support.

**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.

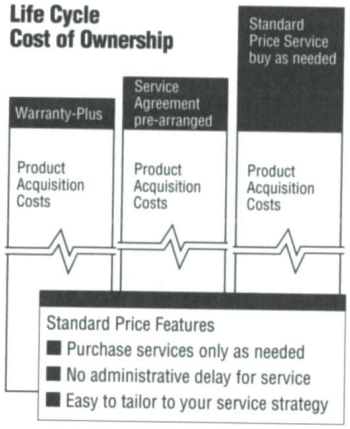
**ELIGIBILITY**

Products covered by a new product or service warranty, Warranty-Plus Repair Protection, or an existing Tektronix Service Agreement are automatically eligible for Tektronix Service Agreement coverage. Other products require inspection to determine eligibility for coverage under a Repair or Comprehensive Systems Service Agreement. To avoid possible inconvenience, we can waive inspection on most products for a fee.

# Standard Price Service

## 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.

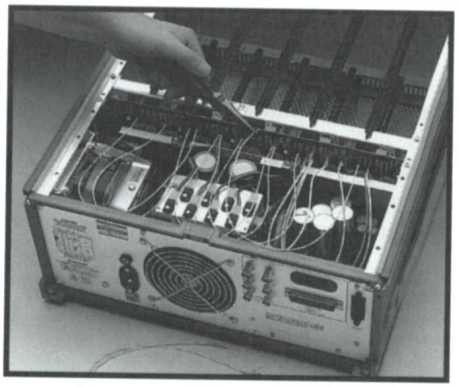



### STANDARD PRICE CALIBRATION

Our calibration program is designed to ensure the continued accuracy and precision of your instruments. It provides NIST traceability and MIL–STD–45662A 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, and we maintain audit documentation of your instrument's performance in compliance with MIL–STD–45662A.

### 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.

## Supplemental Service Information

### 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.

### STANDARD PRICE SERVICE

Services Available:

- Product Calibration
- Product Repair
- Dimensional Tools
- Obsolete Products

***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."*

Request a copy of our Test and Measurement Service Brochure detailing service options available to you.

Standard price service varies according to country.

For information on services available in your location, contact your Tektronix representative (listed on the inside back cover).

# Reconditioned Products

*An ideal solution for stretching the tight budget dollar.*

- Reduced Prices
- Quick Delivery
  - Many products are in stock and are immediately available.
- Warranty
  - Products meet Tektronix high standards for performance, quality and reliability.

## Reconditioned Products

If budget restrictions are in the way of getting the Tektronix product that you would like to have – Tektronix Reconditioned Products may be an ideal solution for stretching the tight budget dollar.

### THE ORIGINS

Tektronix Reconditioned Products are usually field, marketing, or training demo units. 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.

### REDUCED PRICES

Tektronix Reconditioned Products are usually sold at reduced prices – below new product prices. All standard and contract discounts normally apply.

### WARRANTY

We are confident in the reconditioning process. Accordingly, all Tektronix Reconditioned Products are warranted. 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.

## ORDERING INFORMATION

Check with your local Tektronix Sales Office to take advantage of Tektronix' Reconditioned Product bargains.

In the U.S. you may call the National Marketing Center Toll free line: 1-800-426-2200 (Test and Measurement Products).

Your Tektronix Account Manager will be pleased to discuss your instrument needs.

# Training and Seminars
## For Users and Service Technicians



### Test and 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**

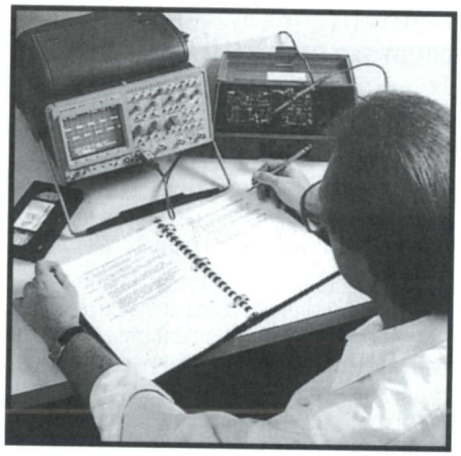
Maximize the efficient utilization of your Tektronix products by subscribing to one of the many Instrument User and Measurement Techniques Workshops offered by Tektronix Test and Measurement Training. These workshops combine classroom lectures with plenty of hands-on labs that emphasize the "Make Measurements" philosophy.

These workshops may be conducted at your 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/audio tapes and training packages which include exercises to help you quickly develop product familiarity and skills in fault diagnosis and repair.

Tektronix Test and Measurement product user self-study training packages provide interactive, hands-on instruction for comprehension of product operation and applications. Test and 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 page 412 for Self-Study package content and ordering information.



**TRAINING DOCUMENTATION**

Tektronix Test and 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 Test and 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 Armed Services with high acclaim. Join the team of professionals using training offered by Tektronix Test and Measurement Training.

**TEST AND MEASUREMENT PRODUCT AND TECHNOLOGY SEMINARS**

Tektronix offers a wide variety of free seminars ranging from product specific seminars to test and measurement technology seminars. Learn about the latest technology advances in the test and measurement field or about the latest product features. We want to support you in your need to stay on top of the rapid advances in technology. To receive information on seminars, call your local Tektronix sales office and have your name added to the seminar mail list.

**TEST AND MEASUREMENT (T&M) CUSTOMER TRAINING OFFERINGS:**

- T&M Product Service Training
- T&M User and Measurement Techniques Workshops
- T&M Self-Study Material
  - Self-Study Packages
  - Video Tapes
  - Audio Tapes
- T&M Training Documentation
  - Instructor/Training Guides
  - Service Manuals
- T&M Product and Technology Seminars

*Join the growing number of Tektronix-trained customers.*

Training and Seminar programs vary according to country.

For availability of programs available in your location, contact your Tektronix representative (listed on the inside back cover).

**ORDERING INFORMATION**

To register for formal training classes or for information on other training services, contact: Tektronix, Test and Measurement Training, Walker Road Industrial Park. Attention: T&M Training Registrar, P.O. Box 4600, M/S 94-925, Beaverton, OR 97076. Phone: (800) 835-9433 ext. WR1407.

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.

# Terms and Methods of Sale

*Terms of sale to meet varied purchasing objectives.*


- General Terms of Sale
- GSA Contracts
- OEM Components
- Tektronix Sales Offices


GSA Price List and/or Logistics Data Book available. Call 1-800-682-1210, or contact your Tektronix representative (listed on the inside back cover).

## General Terms of Sale

### CREDIT AND PAYMENT TERMS

Tektronix, Inc. offers many different terms of sale in order to meet varied purchasing objectives and to assist in financial planning. Credit accommodations must be arranged with Tektronix' credit department. Orders and requests for credit accommodations should be placed with your local Tektronix sales office.

If, in the judgment of Tektronix, the financial condition or payment record of the Buyer at any time does not justify shipment of order on the payment terms requested, Tektronix may refuse to ship unless it receives payment in advance, or at its option, payment upon delivery of equipment. Businesses established for six months or less may not meet minimum requirements for extended and/or installment terms of sales.

The following terms may be arranged with a Tektronix Sales Office. Outside of the United States, contact your local sales office to arrange payment terms:

**Net 30 Days Standard Terms**
Standard terms of sales are net 30 days following the date of invoice. There are no discounts for early payment.

**60, 90, and 120 Days Extended Terms of Sale**
Extended terms of 60 to 120 days are available on the same single payment basis as standard terms. Since the cost of extended terms is not included in catalog prices, a service charge is added to the invoice. The amount of the service charge depends upon the number of days the terms are extended. Request for extended terms must be made at the time of order placement.

### MINIMUM ORDER

The minimum acceptable order is $25.00.

### SHIPMENT

All prices, quotations, and shipments are FOB Beaverton, Oregon, unless otherwise specified. Shipment will be made via the most economical method. All shipments will be insured at full value unless your hard copy purchase order instructs otherwise.

## 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*
- General Purpose ADP Equipment and Software; FSC Group 70, Part I, *Section A*

An authorized GSA Price List for one of the above contracts is available through your nearest Tektronix office or call 1-800-682-1210.

### LOGISTICS DATA BOOK

A special Logistics Data Book on Tektronix products is also available to Federal customers. This manual contains information on Tektronix products which have been assigned a NSN or a military nomenclature, provisioned products, replacement product information, test and calibration systems, and calibration fixtures for servicing Tektronix products. Contact your nearest Tektronix office or call 1-800-682-1210.

## Tektronix T&M Leasing Program

Although Tektronix will continue to offer leasing opportunities through our well established leasing company partners, Tektronix customers now have the option to lease new equipment sold by the Test and Measurement Group directly from Tektronix. Since you can make arrangements to lease at the time product selections are made, leasing from Tektronix provides a quick and easy way to acquire instrumentation. The Tektronix leasing terms include a variety of 12, 24, and 36 month programs with a minimum order of $3000. In addition our FlexLease™ program offers a very competitive monthly rate for 39 months with many attractive features. Contact your local Tektronix Account Manager, or call the National Marketing Center at 1-800-426-2200.

## Rental/Leasing Program

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 Tektronix products, you will not need to look further than our list of Authorized Rental Companies. Trust your rental and leasing requirements to the very best, Tektronix and, in the U.S., 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. Rental/Lease | **1-800-GE-RENTS** |
| Genstar Rental Electronics, Inc. | **1-800-422-3300** |
| McGrath RentCorp | **1-800-352-2900** |
| McGrath RenTelco | **1-800-233-5807** |
| Telogy, Inc. | **1-800-TELOGY-I** |

# OEM Components/Power Sources



## OEM Components

At Tektronix, we offer many products with terms, conditions, and pricing for OEMs. Computer graphics components, small screen displays, certain cameras, TV signal test and measurement instrumentation – we offer these and other products on a special basis to the original equipment manufacturer.

- **Choose the Performance Level to Match Your System**

In many product areas, our wide range of OEM components allows you to select just the optimal performance you need for the system you are building. When your systems demand highest performance, Tektronix will provide the quality products to meet your standard. In price-sensitive situations, the wide Tektronix selection usually allows you to select exactly the performance level you need – no more, no less.

- **Special OEM Terms and Pricing Help Keep You Competitive**

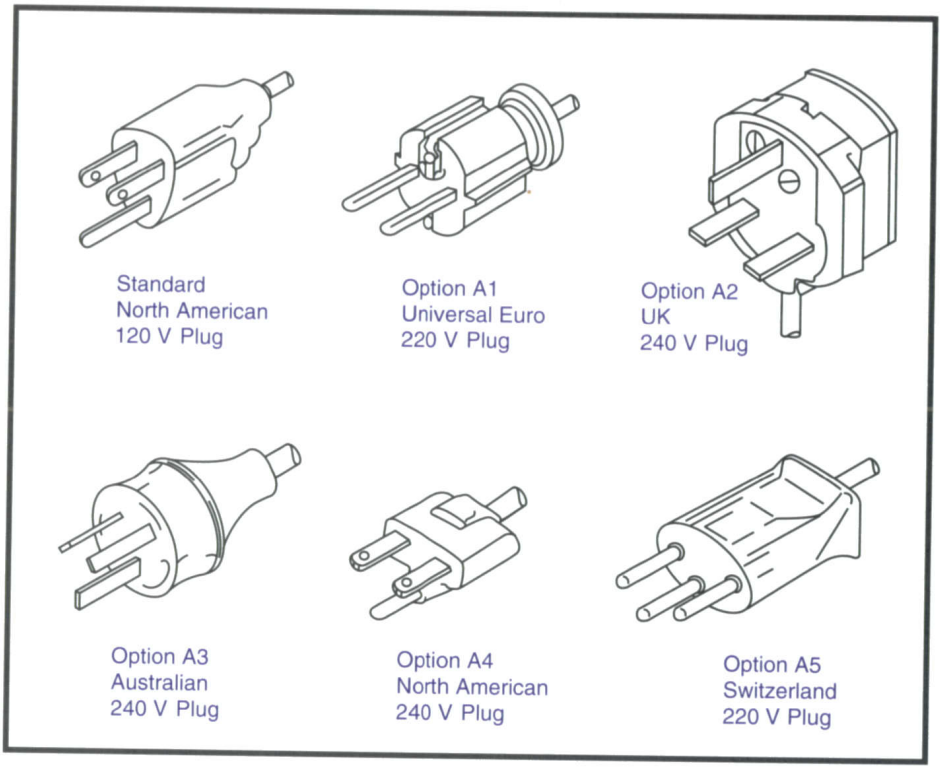
Ask your local Tektronix representative about the special OEM terms and pricing available to you.

- **Service and Support – When and Where You Need It.**

Tektronix has service centers in many countries around the world. We offer long term parts support to protect your investment. If you need applications assistance, we are ready to help. Our OEM specialists are trained to help solve interface problems. That is solid support when you need it.

- **You and Tektronix – A Quality Partnership**

Explore the advantages of working with Tektronix: excellence in products, support, and service. Your local Tektronix representative can help you obtain full details on how you can profit from a quality partnership with Tektronix. See how our OEM expertise can add value to your system.




## Power Sources

Most Tektronix instruments provide wide-range regulated supplies, or quick change line-voltage selectors for convenient selection of line-voltage operating ranges.Transformer taps in a few instruments can be changed to accommodate specific line-voltage operating ranges or can be factory wired for a specific range if specified on the purchase order.

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.

The power cord/plug options may become available on instruments not specified in this catalog. Contact your local Tektronix representative for information.

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 instruments 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 |

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*Tektronix has a full library of information to support your needs.*

**YOU NOW HAVE TWO WAYS TO OBTAIN APPLICATION/ TECHNICAL INFORMATION FROM TEKTRONIX:**

- New INFOFax 24 Hour Service. Perfect For Information You Need Immediately.

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Tektronix is pleased to provide 24 hour automated information service on over 100 of our fine measurement products.

Through your touch tone telephone, follow our voice-prompted selection process and immediately receive application information or specification data directly from your office or home fax machine.

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| **Products with Application/Technical Notes available through INFOfax service:** | **To Receive: Call INFOfax and** |
|---|---|
| • Oscilloscopes | **SELECT "1" IF YOU KNOW THE DOCUMENT NUMBER FOR PRODUCT** |
| • Digitizers | |
| • Logic Analyzers | **OR** |
| • Spectrum Analyzers | |
| • Telecommunications | |
| • Systems | **SELECT "2" FOR THE DOCUMENT INDEX** |
| • Instrument Controllers/Software | |
| • Modular Instruments | |
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| Title/Description | Order Number |
|---|---|
| **Oscilloscopes** | |
| **GENERAL INFORMATION** | |
| The Effects of Bandwidth on Measurement Accuracy | 40139 |
| **DIGITIZING, DIGITAL + ANALOG STORAGE** | |
| **TDS Series** | |
| TDS 640 Debugging Application | 11142 |
| TDS Display Modes | 40010 |
| TDS 500/600 Video Trigger | 11284 |
| TDS 400 HiResolution | 40011 |
| TDS 400 Video Trigger | 40012 |
| Measuring Clock/Data Timing with the TDS 820 | 40140 |
| TDS Acquisition Modes | 40058 |
| TDS Advanced Triggering | 40059 |
| Real Time vs. Equivalent Time | 40060 |
| HFS Signal Management | 40103 |
| Picosecond Measurements | 40104 |
| Prop. Delay Setup & Holdtime | 40115 |
| **DSA Series/11000 Series** | |
| DSA600 Constellation Display Application | 11144 |
| DSA600 Scanning Stored Waveforms | 40048 |
| DSA600 Series De-Jitter | 40049 |
| DSA600 Smoothing | 40050 |
| DSA600 Interpolation | 40051 |
| DSA600 Intel | 40056 |
| Power Supply Test & Evaluation | 40109 |
| DSA600 FFT Spectral Estimation | 40110 |
| Statistical Data Base | 40111 |
| TB-Color Grading/Statistical DB | 40112 |
| 11400 Auto Timing Measurements | 40039 |
| 11400 Equivalent Time | 40040 |

| DSA Title/Description | Order Number |
|---|---|
| **Oscilloscopes** | |
| **DSA Series/11000 Series Cont.** | |
| 11400 Probes | 40041 |
| 11400 Enhanced Accuracy | 40042 |
| 11400 Using Windows | 40043 |
| 11400 Single Shot Digitizing | 40044 |
| 11400 Time Measurements | 40045 |
| 11403 High Resolution Timing | 40052 |
| 11403 Measurement Statistics | 40053 |
| 11800 Sampling Primer | 40046 |
| 11800 SD Series Sampling Head | 40047 |
| Using Filtering to Control Risetime 11800/CSA 803 | 40141 |
| Z-Profile™ Algorithm | 40142 |
| 11800 Coupled Lines Differential | 40054 |
| 11800 Differential Ohms Measurements | 40055 |
| Parallel Acquisition in the 11801 and SM-11 | 47W-7763 |
| 11800 Characterizing a Differential Amplifier | 47W-7499-1 |
| 11800 Crosstalk Characterization of a Ribbon Cable | 47W-7498-1 |
| Sampling Head Bandwidth Verification and Frequency Characterization | 47W-7298 |
| TDR Tools in Modeling Interconnects and Packages (IPA 310) | 40143 |
| **2400 Series** | |
| 2400 Series Mate/CIIL | 40001 |
| 2400 Series Complex Timing | 40002 |
| 2430A | 40003 |
| 2430A TV Waveform | 40004 |
| T1 Signal Quality | 40005 |
| 2400 Series Resolution Energy | 40006 |
| DSI Mask Testing SW Algorithm | 40007 |

*Continued on next page.*

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| Title/Description | Order Number |
|---|---|
| **Oscilloscopes** | |
| **200 Series** | |
| 222 Uninterruptible Power Supply | 40027 |
| 222 Differential Measurement | 40116 |
| More Than Sample Rate | 40028 |
| 222PS Troubleshoot Power Elect. | 40029 |
| **ANALOG STORAGE** | |
| **2400 Series** | |
| 2445/ 2465 Video Measurement | 40008 |
| Digital Video | 40009 |
| BrightEye - Microchannel Plate | 40105 |
| **2200 Series** | |
| 2225 Trace & X-Y Phase | 40037 |
| 2225 Setup & Analysis | 40038 |
| SCD Series ESD Events | 40033 |
| High Bandwidth Digitizer | 40034 |
| Rapid Sequential Digitizers | 40035 |
| High Resolution Digitizers | 40036 |
| **Spectrum Analyzers** | |
| Spectrum Analyzer Fundamentals | 11024 |
| Spectrum Analyzer Wideband Amplifier Performance | 11143 |
| Spectrum Analyzer Dynamic Range Meas. | 11145 |
| 271X Tracking Generator | 11151 |
| 271X CATV Applications | 11172 |
| 2782 Phase Noise | 11184 |
| Random Noise Measurement | 40119 |
| 2782 Microwave High Spectrum Analyzer | 40120 |
| 49X AMD/275X Spectrum Analyzers | 40122 |
| 492PGM Microwave Spectrum Analyzer | 40123 |
| Television RF Measurements | 40124 |
| EMI Measurements with Preselector | 40125 |

| Title/Description | Order Number |
|---|---|
| **Spectrum Analyzers (continued)** | |
| Pre-Amp | 40126 |
| Choosing a Preamplifier | 40127 |
| Spurious Free Signal Range | 40128 |
| Sweep Time in Spectrum Analysis | 40129 |
| Signal to Noise Ratio | 40131 |
| **Logic Analyzers** | |
| **DAS9200 Series** | |
| 92DM12 80486SX/ 80487SX Support Application | 11146 |
| DAS9200 & IBM PC/XT/ZT Host | 40061 |
| DAS9200 SW VHXIC Signal Levels | 40062 |
| DAS9200 Graphics Display | 40063 |
| DAS9200 92HS8 External Async | 40064 |
| DAS9200 P6461 Probe Use | 40065 |
| DAS9200 92A16 | 40066 |
| LV500 CMOS Device Testing | 40068 |
| LV500 DUT Loading Effects | 40069 |
| LV500 Full Scale Signal | 40070 |
| DAS9200 92SX109/ 92SX118 | 40072 |
| DAS9200 Using Symbols | 40073 |
| DAS9200 92A16 Intermodulation Signal | 40074 |
| DAS9200 50 & 100 MHz Combination | 40075 |
| LV500 Variable Timing | 40076 |
| LV500 ECL | 40077 |
| DAS9200 92A16 | 40078 |
| DAS9200 Transporting Selected Portions | 40080 |
| DAS9200 92A16/ 92S16 Intermodulation | 40081 |
| DAS9200 91HS8/ 92HS8 Configurations | 40082 |
| DAS9200 68030 Disassembler | 40083 |
| DAS9200 VME Bus Interface | 40085 |
| DAS9200 with ECL Logic | 40086 |
| DAS9200 Keyboard Macros | 40087 |
| DAS9200 Modified IC Chip Performance | 40091 |

# Application/Technical Notes





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| Title/Description | Order Number |
|---|---|
| **Logic Analyzers (continued)** | |
| **SERIES 3000** | |
| Series 3000 Importing into Aldus | 40094 |
| Series 3000 Correlate Data | 40095 |
| Series 3000 30DM27/ 30DD27 | 40096 |
| Series 3000 30MPX PDT Operation | 40097 |
| Series 3000 Increasing PDT Functionality | 40098 |
| **1230 Series** | |
| 1230 GPIB Interfacing Feature | 40030 |
| 1230 Data Compare | 40031 |
| 1230/PC RS232 | 40032 |
| **Signal Sources** | |
| Arbitrary – Generators Creating Waveforms | 11258 |
| 11801A and HFS 9000 Characterizing Propagation Delay, Setup Time and Hold Time | 40115 |
| Characterizing High-Speed Digital Designs with the HFS 9000 Stimulus System and the DAS 9200 Digital Acquisition System | 40132 |
| Picosecond Time Interval Measurement Considerations (HFS9000/CSA 803) | 40140 |
| **Telecommunications** | |
| Measuring Fiber Optic Return Loss | 11195 |
| Application Note - Two Levels of Measurement | 40026 |
| CSA803 Mask Testing | 40057 |
| OIG 502 Optical Reflection Test | 40106 |
| Fiber Optic Transmitter Standards | 40107 |
| Optical Extension Ration | 40108 |
| 1750 S | 40117 |
| FiberScout Echoes & Reflections | 40118 |
| 1503C MTDR/LAN Applications | 11287 |

| Title/Description | Order Number |
|---|---|
| **System Solutions** | |
| VX4820 Pin & Strobe Timing | 40092 |
| VX4280 Interface Considerations | 40093 |
| **Instrument Controllers/Software** | |
| Integrated Systems/Single Shot | 40130 |
| WaveWriter/AWE Familiarization Packet with Demo Disk and user Application Guide | 40144 |
| **Modular Instruments** | |
| TM500 Analog Multiplexer | 40101 |
| TM500 AA501 | 40102 |
| **Semiconductor Testers** | |
| Testing the Bipolar Transistor with the 370 Curve Tracer | 40145 |
| Testing the Power MOSFET with the 370 Curve Tracer | 40146 |
| **Accessories** | |
| **PROBES** | |
| **High Frequency/Active Probes** | |
| FET Probe Primer | 40099 |
| Floating Scope Measurements & Safety | 40100 |
| Microwave Probes Calibration | 40113 |
| Probing High Frequency/Digital Circuits | 40114 |
| Active Probes: Their Unique Characteristics and Applications | 40099 |
| The Effect of Probe Input Capacitance on Measurement Accuracy | 40138 |

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FAX: 43(1) 6026141-14

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America Central y El Caribe
PO Box 2761, 01901
Guatemala, Guatemala

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Beaverton, OR 97077 USA
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Telex: 192825 TEKTRONIX
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FAX: 38 (41) 442273

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FAX: 38 (41) 442273

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Nicosia, CYPRUS
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FAX: 357(2) 365177
Telex: 605 2395 (8680)

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**Proteco Coasin Cia Ltda. Quito**
12 de Octubre 2449 y Orellana
Casilla 7-03-228A Quito
Phone: 593 (2) 52-6759, 52-9684
FAX: 593 (2) 56-1980
Telex:
(393) 22865 PROTEC ED
22085 ESAND ED

**Guayaquil**
Miraflores Av. Principal 204 y Calle Segunda
Guayaquil
Phone: 593 (4) 201529

## EGYPT

**Giza Systems Engineering Co.**
2, El Mesaha Sq.
DOKKI, A.R.E.
P.O. Box 1913
CAIRO 11511
Phone: 20 (2) 3490140
FAX: 20 (2) 3609932
Telex: 93644 ALKAN UN

# Worldwide Sales and Service Offices



## FINLAND

**Tektronix Oy**
Larin Kyöstin tie 4,
FIN-00650 HELSINKI
Phone: 358(0) 7282 400
FAX: 358(0) 7520033

## FRANCE

**Tektronix S.A.**
**Orsay**
ZAC Courtaboeuf,
4 Av. du Canada B.P.13
91941 Les Ulis Cédex
Phone: 33(1) 69 86 81 81
FAX: 33(1) 69 07 09 37
Telex: (842) 604332
TEKOR A

**TekDIRECT**
Phone: 05 00 22 00

**After Sales Service — France**
ZAC. Courtaboeuf,
4 Av. du Canada, B.P.13
91941 Les Ulis Cédex 3
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FAX: 33(1) 69 86 11 44
Telex:
(842) 601012 TEKSAV

**Appels interventions aprés-vente France métropolitaine:**
numéro vert 05 27 38 04

**Aix-en-Provence Region Center**
Immeuble Tertia 1-ZI d'Aix
13763 Les-Milles Cédex 3
Phone: 33 (16) 42 24 45 03
FAX: 33 (16) 42 24 41 20
Telex: (842) 440045

**Lyon Region Center**
Les Jardins d'Entreprise
213 rue de Gerland, Bât. F1
69007 LYON
Phone: 33 (16) 78 58 15 38
FAX: 33 (16) 78 69 52 55
Telex:
(842) 300150 TEKLYON

**Rennes Region Center**
RUE de la Rigourdière
35510 Cesson Sévigné
Phone: 33 (16) 99 83 40 40
FAX: 33 (16) 99 83 36 23

**Strasbourg Region Center**
Parc d'Activités des Tanneries
2a, Route de la Rivière
67380 Lingolsheim
Adresse postale:
BP 98 -
67833 Tanneries Cedex
Phone: 33 (16) 88 76 15 45
FAX: 33 (16) 88 76 09 89

**Toulouse Region Center**
Peri-Sud 2, Z.I. du Palays
13 Rue Villet Bat. 1
31400 Toulouse, France
Phone: 33 (16) 62 16 64 00
FAX: 33 (16) 61 34 84 52
Telex:
(842) 530243 TEKTOUL F

## GERMANY, FEDERAL REPUBLIC OF

**Tektronix GmbH**

**Köln**
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51067 Köln
Phone: 49(221) 9 69 69-0
FAX:49(221) 9 69 69-362

**Geschäftsstellen:**
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10587 Berlin
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FAX: (030) 3 13 3132

**Albert-Einstein-Ring 9**
22761 Hamburg
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FAX: (40) 8 90 98-159

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**Lyoner Straße 14**
6000 Frankfurt 71
Tel: (069) 66 90 02-0
FAX: (069) 6 66 40 93

**Neureuter Straße 37a-b**
76185 Karlsruhe
Tel: (0721) 79 08-0
FAX: (0721) 79 08-300

**Ehrenbreitsteiner Straße 28**
80993 München
Tel: (089) 14 85-0
FAX: (089) 1 85-250

## GREECE

**Mercury Ltd.**
6, Loukianou Str.
GR-10675 Athens
Phone: 30(1) 7210241
FAX: 30(1) 3645885
Telex: 214887 (merc gr)

## HONG KONG

**Tektronix Hong Kong, Ltd.**
22nd Floor,
Dah Sing Financial Ctr
108 Gloucester Road
Wanchai, Hong Kong
Phone: (852) 598 6188
FAX: (852) 598 6260
Cable: TEKHKGLTD

## HUNGARY

**Rohde & Schwarz**
Budapesti Iroda
Etele ut. 68
H-1115 Budapest XI
Phone: 36/1/1613415
FAX: 36/1/1850835

## INDIA

**Hinditron Tektronix Instruments, Ltd.**
**Bangalore**
No. 5, Crescent Rd
Highgrounds
Bangalore 560 001
Phone: 91-080-2654/70
265471/263474
FAX: 91-080-260669
Telex:
0845-2151 HIPL IN
Cable: TEKHIND, BANGALORE

**Ahmedabad**
17 Payal Bungalows
Surendra Mangaldas Road
(Satellite Road)
Ahmedabad - 380 015
Phone: 0272-423447/
423448
Telex: 0121-7046 HCPL IN

**Bangalore Service Centre**
33/44-A, 3rd Main Road
Raj Mahal Vilas Extn.
Bangalore - 560 080
Phone: 080-348266/
340068
FAX: 080-345022
Telex:0845-2741 HSPL IN
Cable:
FLUKHIND, BANGALORE

**Bombay - Sales**
Industry House
23-B, Mahal Ind. Estate
Mahakali Caves Road
Andheri East
Bombay - 400 093
Phone:
91-022-8364560/8326590
FAX: 022-8364682
Telex: 91-011-79286 HIPL IN
Cable: Mahalind, Bombay

**Bombay Service Centre**
17-B, Mahal Ind. Estate
1st floor, Mahakali Caves Road
Andheri East
Bombay - 91-400 093
Phone: 91-022-8349123/
8348260/8348263/
8370088/8382515/8382516
FAX: 91-022-8370087
Telex:
011-79387NHEMC IN
Cable: EQUIPTRON

**Calcutta**
Castle House, 5th Floor,
5/1-A, Hungerford Street,
Calcutta 700 017
Phone: 91-033 247-9094,
247-6844, 247-2049
FAX: 91-033 400194
Telex: 021-4153 HSPL IN
Cable:
FLUKHIND, CALCUTTA

**Lucknow**
15/30 Indira Nagar
Lucknow
U.P.
PIN: 226016

**Madras**
No. 22, II, Balaji Avenue
Off Thirumalai Pillai Rd.
T. Nagar
Madras 600 017
Phone:
044 8261286, 8269480
FAX: 91 (44) 827-6722
Telex: 041-6188 HCPL IN
Cable:
FLUKHIND, MADRAS

**New Delhi**
201-206 Hemkunt Tower
98, Nehru Place
New Delhi 110 019
Phone: 91-011 641-0380,
643-0519, 643-5278
FAX: 91-011 642-9118
Telex:
(953) 0425 6973 HCPL IN
Cable: TEKCENTRE, DEHLI

**Secunderabad**
5th Floor, Emerald House
114 Sarojini Devi Road
Secunderabad 500 003
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843753, 847007, 814741
Telex: 0425 6973 HCPL IN
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TEKHIND, SECUNDERABAD

## INDONESIA

**(Test and Measurement, TV, Telecom)**

**Mecomb Tehnik**
Jl. Raya Jakarta Bogor
Km. 26
Jakarta 13740
Mail: PO Box 1278
Jakarta
Phone: 62(21) 871-1540
FAX: 62(21) 871-0625
Telex: 48275 GURU IA

**(Color Printer Products)**
**INMAC PT**
Indo Permai Citradata
Delta Bldg., Block A34-36
Jl. suryopranoto No. 1-9
Jakarta 10011
Phone:
62 (21) 374372, 377443
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## ISRAEL

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33638 RONIX IL

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20141 Milan
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Tokyo Int'l, Tokyo 100-31
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FAX: 81(3) 3444-0318
Telex:
(781) 2422850 STTYO J

**Atsugi**
Pastoral Bldg
1-8-6 Asahi-cho
Atsugi 243
Phone: 81 (462) 28-6768
FAX: 81 (462) 28-8043

**Chiba**
Taiso Center Bldg.
2-7-2 Shinchiba
Chiba 260
Phone: 81 (43) 242-1911
FAX: 81 (43) 242-2291

**Fukuoka**
Nihon Seimei
Hakataekimae Bldg.
2-1 Hakataekimae-3,
Hakata-ku
Fukuoka 812
Phone: 81 (92) 472-2626
FAX: 81 (92) 472-2627

**Hiroshima**
HIROSHIMA INTES
10-10 Hashimoto-cho
Naka-ku, Hiroshima 730
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FAX: 81 (82) 222-7225

**Nagoya**
Sanko Building
21-7 Meieki 3-Chome,
Nakamura-ku
Nagoya 450
Phone: 81 (52) 581-3547
FAX: 81 (52) 563-7637

**Omiya**
Omiya Sawada Building
1-12-5 Sakuragicho
Omiya 331
Phone: 81 (48) 646-0711
FAX: 81 (48) 646-0859

**Osaka**
Osaka Ohbayashi Building
4-33 Kitahama-Higashi
Chuo-ku, Osaka 540
Phone: 81 (6) 947-0321
FAX: 81 (6) 941-3861

**Sendai**
Sendai NS Building
2-25 Ichibancho-1
Aoba-ku, Sendai 980
Phone: 81 (22) 267-2181
FAX: 81 (22) 262-3290

**Tama**
2-45-10 Fujimidai
Kunitachi, Tokyo 186
Phone: 81 (425) 73-2111
FAX: 81 (425) 73-2170

**Tsuchiura**
Sumitomo Seimei
Tsuchiura Bldg.
16-12 Sakuracho-1
Tsuchiura 300
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FAX: 81 (298) 24-2606

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Dai-ichi Yamashitacho Bldg.
74-1 Yamashitacho
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## JORDAN

**Mideast Data Systems (MDS)**
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Salam Street
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UNITED ARAB EMIRATES
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FAX: 971(2) 213 741
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(893) 24325 MDSUAE EM

## KOREA, REPUBLIC OF

**(Test and Measurement, TV, Telecom)**

**CSC, INC.**

**Seoul Office**
9th Floor, Guhsung Bldg.
541 Dohwa-Dong, Mapo-Gu
Seoul 121-701
Phone: 82 (2) 706-6701
FAX: 82 (2) 706-6704

**(Color Printer Products and Network Display Products)**

**Myoung System, Inc.**
2/F, Chungrok Bldg.
721-29, Yeoksam-Dong
Kangnam-ku
Seoul, 135-080
Phone: 82 (2) 538-9942
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**(Service, All Products)**

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## KUWAIT

**Tareq Company Ltd.**
P.O. Box 20506
13066, Safat, Kuwait
Phone: 965 () 243-6045
FAX: 965 () 243 7700
Telex:
(496) 22315 ZUAITER KT

## LEBANON

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FAX: 971(2) 213 741
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## MALAYSIA

**Mecomb Malaysia Sdn. Bhd.**
Lot 20, Jalan 225
46100 Petaling Jaya
Mail:
P.O. Box 24
46700 Petaling Jaya
Selangor
Phone: 60 (3) 7743422
FAX: 60 (3) 7743414
Telex: (784) 37764 MA

**Ipoh Office**
Bangunan Tractors
Batu 4, Jalan Lahat
Bukit Merah
30730 Ipoh
Phone: 60 (5) 221-239
FAX: 60 (5) 210-543

**Penang Office**
No. 2487, Jalan Glugor
11700 Penang
Phone:
60 (4) 861373, 863042
FAX: 60(4) 863658

**(Color Printers and Network Display Products)**

**Sime Darby Systems**
Wisma Sime Darby
17th Floor, East Wing
Jalan Raja Laut
50350 Kuala Lumpur
Phone: 60 (3) 2939322
FAX: 60 (3) 2939376
Telex:
(784) 32807 SDMAL MA

**(Color Printers Only)**

**Micro Express Sales (M) Sdn. Bhd.**
3rd Floor, Tower Block
Menara Tun Razak
Jalan Raja Laut
50350 Kuala Lumpur
Phone: 60 (3) 293-6000
FAX: 60 (3) 293-5500

## MALTA

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Mühldorfstraße 15,
D-81671 München
Phone: 49(89) 4129-0
FAX: 49(89) 4129-3115
Telex: 523703-20 rsd

## MEXICO

**TEKTRONIX S.A. DE C.V.**
Viena 71, 1º Piso
Col. El Carmen, Coyoacan
04100 Mexico, D.F.
Phone: 52(5) 659-4986,
659-8080, 659-7080
FAX: 52(5) 658-7982

**(Color Printers Only)**

**Genetec, SA de CV**

**Monterrey Office**
Blvd Diaz Ordaz #126
Col. Santa Maria
CP 64650
Monterrey, N.L.
Mexico
Phone: 52 (83) 46-8040
FAX: 52 (83) 47-5466

**Mexico City Office**
Blvd. Manuel Avila
Comacho #1
200 Piso Edifico Plaza
Comermex
C.P. 11560
Mexico, D.F.
Phone: 52 (5) 395-9633
FAX: 52 (5) 395-9571

## MOROCCO

**(All products except CGG)**

**Tradec-Signal**
Place Khaibar
Angle Bd de la Gironde et
Rue d'Ifni
Casablanca 03
Phone: 212 (*) 24 85 43
FAX: 212 (2) 24 85 66
Telex: 25992

## THE NETHERLANDS

**Tektronix Holland N.V.**
Sales and Service Office
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2132 HL Hoofddorp
Mail: P.O. Box 226
2130 AE Hoofddorp
Phone: 31(2503) 13300
FAX: 31(2503) 37271
Telex:
(844) 74898 TEKSO NL

## NEW ZEALAND

**Datamatic Network, Ltd. Wellington Office**
8-10 Herbert St.
Lower Hutt Wellington
Mail: P. O. Box 31-252
Lower Hutt,
New Zealand
Phone: 64 (4) 566-3412
Toll Free: 0508-655-535
FAX: 64 (4) 566-4630

**Auckland Office**
17A William Pickering Dr.
Mail: P.O. Box 33-326
Takapuna, Auckland
Phone: 64 (9) 415-6928
FAX: 64 (9) 415-6939

## NIGERIA

**Obodex Nigeria Ltd.**
21A Airport Road
P.O. Box 6352
Lagos
Phone: 234(1) 962124
FAX: 234(1) 2617569
Telex:(961) 26744 DATA NG

## NORWAY

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0905 OSLO 9
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FAX: 47(22) 165 052

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## PAKISTAN

**Pakland Corporation (Pvt) Ltd.**
Farhat Mansion
Iqbal Road
P.E.C.H. Society
Karachi 75400
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FAX: 92 (21) 455-5384
Telex: (952) 25230 JALAL PK
Cable: PAKLAND, KARACHI

## PANAMA

**Executive Marketing Corp.**
Ave El Paical, No. 30
Urbanizacion Los Angeles
Mail:
Apartado 4929
Panama 5, Rep. de Panama
Phone:
507 (*) 36-0114, 36-0722
FAX: 507 (*) 36-1820
Telex: (328) 3483

## PERU

**Importaciones y Representaciones Electronicas S.A. (IRE Ingenieros)**
Jr. Pumacchua 955
Lima 11 Peru 1
Phone: 51 (14) 23-5099
FAX 51(14) 31-0707

## PHILIPPINES

**(Color Printers Only)**

**Distributed Processing Systems, Inc. (DPSI)**
Don Chua Lamko Bldg.
H V dela Costa corner
Alfaro Sts
Salcedo Village, Makati,
Metro Manila
Phone: 63 (2) 818-9640,
818-9646, 818-9343
FAX: 63 (2) 817-4804
Telex: (742) 66284 DPSI PN

**(All Products)**

**Philippine Electronic Ind., Inc.**
3rd Floor,
Rose Industries Bldg
11 Pioneer Street
Pasig, Metro Manila
P.O. Box 1586
CPO, Makati,
Metro Manila, 1255
Phone: 63 (2) 631-1321,
631-1322, 631-1323
FAX: 63 (2) 631-1324

## POLAND

**Rohde & Schwarz**
Oddzial w Warszawie
ul. Stawki 2
PL-00-193 Warszawa
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FAX: 48/2/6353544

**Local Service Representatives:**

**RSM SERVICE**
ul. Tarnogajska 11/13
PL-50-950 Wroclaw
Phone: 48/71/673893
FAX: 48/71/673893
Telex: 863/712357

**Tespol**
ul. Tarnogajska 11/13
PL-50-950 Wroclaw
Phone: 48/71/673893
Telex: 863/712357

## PORTUGAL

**Decada Equipamentos de Electronica e Cientificos, SA**
Rua Margarida Palla, 11 B
Miraflores/Alges
1495 Lisbon
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FAX: 351 (1) 410-1844
Telex: (832) 15515 ESPEC P

## QATAR

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UNITED ARAB EMIRATES
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## ROMANIA

**Tektronix Representation Office Bucharest**
Str. Uranus 98
Sc 2, Et 5, Ap. 36
R-76102 Bucuresti, Sector 5
Phone: 40/1/6316878
FAX: 40/1/3122013

**Local Service Representative**

**Vega Electronics SRL**
Sos.Colentina 30
R-72444 Bucuresti
Phone: 40/1/6556764
FAX: 40/1/6556764
Telex: 865/10076

## SAUDI ARABIA

**Electronic Equipment Marketing Co. (EEMCO)**
P.O. Box 3750
11481 Riyadh
Phone: 966 (1) 477 1650
FAX: 966 (1) 478 5140
Telex:
(928) 401120 ZUHAIR SJ

**Rohde & Schwarz International GmbH**
Mühldorfstraße 15,
D-81671 München
Phone: 49(89) 4129-0
FAX: 49(89) 4129-3115
Telex: 523703-20 rsd

## SINGAPORE

**Mecomb Singapore Ltd.**
Sime Darby Centre
896 Dunearn Road, 04-02
Singapore 2158
Phone:
(65) 469-8833, 468-0978
FAX: (65) 467-1905

**(Color Printers Only)**

**Micro Express Sales Pte. Ltd.**
989 Bukit Timah Rd
2nd Storey, Bldg. 9
Singapore 2158
Phone: (65) 462-3088
FAX: (65) 462-2571

**Tektronix Singapore Pte. Ltd.**
21 Collyer Quay, #17-02A
Hong Kong Bank Building
Singapore 0104
Phone: (65) 227-5793
FAX: (65) 227-6397

## SLOVENIA

**Sales Office:**
**Rohde & Schwarz**
Repräsentanz
Langusova 8
SLO-61000 Ljubljana
Phone: 386/61/1232331,
386/61/262882

**Distributor: Commerce p.c.**
Einspielerjeva 6
SLO-61109 Ljubljana
Phone: 38/61/329265
FAX: 38/61/329171
Telex: 862/31283

**Local Service Representative:**
**TMM Servis**
C.V.Gorice 38
SLO-Ljbljana
Phone: 38/61/264066
FAX: 38/61/264066

## SOUTH AFRICA

**Protea Technology Ltd. Johannesburg**
746 6th Street
Wynberg, Sandton 2199
PO Box 39127
Bramley 2018
Phone: 27 (11) 786-3647
FAX: 27 (11) 887-1479

**Capetown**
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Gardens, 8001
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FAX: 27 (21) 461 0019

## SPAIN

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FAX: 34 (3) 424.6607

## SWEDEN

**Tektronix AB Stockholm**
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## SWITZERLAND

**Tektronix International A.G.**
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CH-6300 Zug 2
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FAX: 41(42) 217784
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## TAIWAN

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**Kaohsiung Office**
2nd Floor-2
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Kaohsiung 80103
Phone: 886 (7) 215-2212
FAX: 886 (7) 215-2619

## THAILAND

**Dynamic Supply Engineering R.O.P.**
12 Soi Ekamai 2
Ekamai (Sukhumvit 63)
Bangkok 10110
Phone: 66 (2) 392-5313
(8 Lines)
FAX: 66 (2) 381-1467

**(Color Printers Only)**

**Comgraph Co., Ltd.**
199/1 Soi Sueksavittaya
North Sathorn Road
Bangkok 10500
Phone: 66 (2) 233-2679,
234-2782
FAX: 66 (2) 237-5011

**(Color Printers Only)**

**The Value Systems Co., Ltd.**
7th Floor, Central Chidlom
Tower
22 Soi Somkid,
Ploenchit Rd., Pathumwan
Bangkok 10330
Phone: 66 (2) 254-7088
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## TURKEY

**Inter Mühendislik Danismanlik Ve Ticaret A.S.**
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Kizkulesi Sokak 36/3-4
G.O. Pasa 06700 Ankara
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FAX: 90(4) 436 4493
Telex: (821) 46780

## UNITED ARAB EMIRATES

**Mideast Data Systems (MDS)**
Ahmed Bin Ghannoum Bldg.
Salam Street
P.O. Box 7899
Abu Dhabi
Phone: 971(2) 213 000
FAX: 971(2) 213 741
Telex:
(893) 24325 MDSUAE EM

## UNITED KINGDOM

**Tektronix U.K. Limited**
Fourth Avenue
Globe Park
Marlow, Bucks SL7 1YD
Phone: 44 (0628) 48 6000
FAX: 44 (0628) 47 4799
Telex:
(851) 847277, TEKMARG
(851) 847378, TEKMARG

## UNITED STATES

### ALABAMA

**Huntsville**
Phone: (205) 830-9212
FAX: (205) 837-2666

### ALASKA

Served by Frigid North Company
(Representative)
Anchorage
(907) 561-4633

### ARIZONA

**Phoenix**
Phone: (602) 438-1011
FAX: (602) 437-9210

### ARKANSAS

Served by EnTest, Inc.
(Representative)
Dallas, Texas
(800) 955-0077

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Pacific Plaza
Phone: (510) 932-4949
Fax: (510) 932-8596

**Irvine**
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TELEFAX: (GP1)
(714) 660-8080 X311
FAX: (714) 474-1490

**Lawrence Livermore**
Phone: (510) 423-8521
FAX: (510) 423-5720

**Los Angeles**
Phone: (818) 999-1711
FAX: (818) 340-9840

**Santa Clara**
Phone: (408) 745-1114
FAX: (408) 745-1894

**Sunnyvale**
Phone: (408) 496-0800
TELEFAX: (GP1)
(408) 496-0800 X137
FAX: (408) 745-1894

**San Diego County**
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Phone: (310) 643-6977

### COLORADO

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Phone: (303) 799-1000
FAX: (303) 790-4754

### CONNECTICUT

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### DELAWARE

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### DISTRICT OF COLUMBIA

See MARYLAND

### FLORIDA (NORTH)

Served by EMSCO
(Representative)
Orlando
(800) 275-3554

### FLORIDA (SOUTH)

**Orlando**
Phone: (407) 660-2727
FAX: (407) 660-8585

**Pensacola**
Phone: (904) 932-4080
FAX: (904) 932-5642

### GEORGIA

**Atlanta**
Phone: (404) 449-4770
FAX: (404) 449-0358

**Warner Robbins**
Phone: (407) 249-1600

### HAWAII

**Honolulu**
ComTest Technologies, Inc.
Phone: (808) 831-0600
FAX: (808) 831-0017

### IDAHO

Served by Seltech, Inc.
(Representative)
Beaverton, OR
Phone: (503) 643-9202

### ILLINOIS

**Chicago**
Phone: (708) 259-7580
FAX: (708) 259-8388
Service FAX: (708) 259-1394

### INDIANA

**Indianapolis**
Served by the Chicago, Illinois field office
Phone: (708) 259-7580

**Kokomo**
Phone: (317) 888-7322
FAX: (317) 888-7333

### IOWA

Served by the Chicago, Illinois field office
Phone: (708) 259-7580 or
Dallas, Texas field office
Phone: (800) 852-4043

### KANSAS

**Kansas City, MO**
Served by Electronics Supply Co.
(Representative)
Phone: (816) 931-0250

### KENTUCKY

Served by the Dayton, Ohio; St. Louis, Missouri field offices

### LOUISIANA

Served by EnTest, Inc.
(Representative)
Dallas, Texas
(800) 955-0077

### MAINE

Served by Beta Lambda
(Representative)
Freehold, NJ
Phone: (800) 282-5632

### MARYLAND

**DC**
Phone: (301) 948-7151
FAX: (301) 921-9273
Service: (301) 948-6316
Service FAX: (301) 926-4329

### MASSACHUSETTS

**Boston**
Phone: (617) 861-6800
FAX: (617) 863-5994

### MICHIGAN

**Detroit**
Phone: (313) 348-9070
FAX: (313) 348-4819

### MINNESOTA

**St. Paul**
Phone: (612) 635-0520
FAX: (612) 635-0716

### MISSISSIPPI

Served by EnTest, Inc.
(Representative)
Dallas, Texas
(800) 955-0077

### MISSOURI

**St. Louis**
Phone: (314) 275-4474
FAX: (314) 569-1061

### MISSOURI (WEST)

Served by Electronics Supply Co.
(Representative)
Kansas City, MO
Phone: (816) 931-0250

### MONTANA

Served by Seltech, Inc.
(Representative)
Beaverton, OR
Phone: (503) 643-9202

### NEBRASKA

Served by Electronics Supply Co.
Kansas City, MO
Phone: (816) 931-0250

### NEVADA (NORTH)

Served by Ward Davis Associates
(Representative)
Santa Clara, CA
Phone: (408) 245-3700

### NEVADA (SOUTH)

Served by Ward Davis Associates
(Representative)
Redondo Beach
Phone: (310) 643-6977

### NEW HAMPSHIRE

Served by the Boston, Massachusetts field office

### NEW JERSEY

**Woodbridge**
Phone: (908) 636-8616
FAX: (908) 636-7234

### NEW MEXICO

**Albuquerque**
Phone: (505) 884-2828
FAX: (505) 888-3558

**Los Alamos**
Los Alamos 87544
Phone: (214) 401-1666

### NEW YORK

**Albany**
Phone: (518) 458-7291
FAX: (518) 458-7361

**Long Island**
Phone: (516) 231-9400
From NYC: (718) 895-8010
FAX: (516) 231-9624

**Rochester**
Phone: (716) 383-0070
FAX: (716) 383-0022

### NORTH CAROLINA

**Raleigh**
Phone: (919) 481-3800
FAX: (919) 469-8823

### NORTH DAKOTA

Served by the Tektronix T&M National Marketing Center, Beaverton, Oregon
(800) 426-2200

### OHIO

**Cleveland**
Phone: (216) 243-8973

**Dayton**
Phone: (513) 438-1165

### OKLAHOMA

**Oklahoma City**
Served by EnTest, Inc.
(Representative)
Dallas, TX
Phone: (800) 955-0077

### OREGON

**Portland**
Phone: (503) 627-7999
FAX: (503) 627-7995
Toll Free: (800) 621-1966

### PENNSYLVANIA

**Philadelphia**
Phone: (215) 825-6400
FAX: (215) 825-8839

**Pittsburgh**
Phone: (412) 244-9800
FAX: (412) 244-1948

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### SOUTH CAROLINA

Served by the Atlanta, Georgia and Raleigh, North Carolina field offices

### SOUTH DAKOTA

Served by the Tektronix T&M National Marketing Center, Beaverton, Oregon
(800) 426-2200

### TENNESSEE

Served by the Gaithersburg, MD office

### TEXAS

**Austin**
Served by the Houston and Dallas, Texas field offices

**Dallas**
Irving 75063, Suite 101
Phone: (214) 401-1666

**El Paso**
Phone: (915) 593-8090

**Houston**
Phone: (713) 784-1800
FAX: (713) 784-4440

**Kelly**
Phone: (210) 432-1341
FAX: (210) 432-1859

### UTAH

Served by Seltech, Inc.
(Representative)
Beaverton, OR
Phone: (503) 643-9202

### VERMONT

Served by Beta Lambda
(Representative)
Freehold, NJ
Phone: (800) 282-5632

### VIRGINIA

**Crystal City**
Phone: (301) 948-7151

**Hampton**
Served by the Gaithersburg, MD office

### WASHINGTON

**Seattle**
Phone: (206) 821-9100
FAX: (206) 821-3607

### WEST VIRGINIA

Served by the Gaithersburg, MD office

### WISCONSIN

Served by the Chicago, Illinois, and St. Paul, Minnesota field offices

### WYOMING

Served by the Tektronix T&M National Marketing Center, Beaverton, Oregon
(800) 426-2200

## URUGUAY

**Coasin Uruguaya S.A.**
Libertad 2529
Mail:
Casillade Correus 1400
Correo Central
Montevideo
Phone: 598 (2) 789015
FAX: 598 (2) 79-7338
Telex: (UY) 23010 COAUR

## VENEZUELA

**Equilab, C.A. Caracas**
Centro Sequros La Paz,
Piso 6, Ofic. E-61
Av. Francisco de Mirada
Boleita
Caracas 1070
Phone: 58 (2) 239-3233
FAX: 58 (2) 239-5205
Telex: 21860 EQUIX

## YEMEN ARAB REPUBLIC

**Mideast Data Systems (MSD)**
Ahmed Bin Ghannoum Bldg.
Salam Street
P.O. Box 7899
Abu Dhabi
UNITED ARAB EMIRATES
Phone: 971(2) 213 000
FAX: 971(2) 213 741
Telex:
(893) 24325 MDSUAE EM

## ZIMBABWE

**Protea Medical Services (Pvt) Ltd.**
111 Kelvin Road South
Graniteside
Mail:PO Box 2766, Harare
Phone: 263 (4) 704094/9
FAX: 263 (4) 704652
Telex:
(987) 2-4102 PROTA ZW

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## FOR FEDERAL ORDERS

Tektronix, Inc.
Federal Order Administration
MS/94-532
PO Box 4600
Beaverton, OR 97076
Phone: (800) 682-1210
FAX: (503) 629-5388

## CORPORATE OFFICE

Tektronix, Inc.
26600 SW Parkway
PO Box 1000
Wilsonville, Oregon
97070-1000
(503) 682-3411
(800) 426-2200

# Distributors, Representatives, and Rental/Leasing Companies

## Nationwide Distributors

### TEST AND MEASUREMENT PRODUCTS

**Arizona**
**Metermaster**
Tempe, AZ
(800) 366-3837
**Jensen Tools Inc.**
Phoenix, AZ
(800) 426-1194

**California**
**Marshall Industries, Inc.**
El Monte, CA
(800) 522-0084

**New Jersey**
**Brownell Electro, Inc.**
Edison, NJ
(800) 828-1552

**New York**
**Transcat**
Rochester, NY
(716) 458-4801
(800) 828-1470
(Outside New York)

**Texas**
**Allied Electronics**
Ft. Worth, TX
(800) 433-5700

## Regional Distributors

### TEST AND MEASUREMENT PRODUCTS

**Alabama**
**Innovative Measurement Products (IMP)**
Huntsville, AL
(205) 883-6699

**Alaska**
**Frigid North**
Anchorage, AK
(907) 561-4633

**Arizona**
**Zeus Electronics**
Phoenix, AZ
(800) 528-4512

**Arkansas**
**Carlton Bates**
Little Rock, AR
(800) 482-9313

**California**
**Fry's Electronics**
340 Portage Ave.
Palo Alto, CA
(415) 496-6000
**Instrument Engineers**
San Diego, CA
(800) 444-6106
**ITC Electronics**
Los Angeles, CA
(800) 225-5482
**Mitchell Instrument Co.**
San Marcos, CA
(619) 744-2690
**RAG**
Canoga Park, CA
(800) 732-3457
**Ward Davis Associates**
Redondo Beach, CA
(310) 643-6977
**Zack Electronics**
Milpitas, CA
(408) 942-5432

**Connecticut**
**Contact East**
Wallingford, CT
(203) 265-9333
**Lincoln Controls**
West Hartford, CT
(203) 953-3999

**Florida**
**EMSCO**
Orlando, FL
(800) 275-3554

**Georgia**
**Dow Electronics, Inc.**
Norcross, GA
(800) 627-2910
**Tycom Electronics**
Decatur, GA
(404) 378-6160

**Illinois**
**Joseph Electronics**
Niles, IL
(800) 323-5925
**Klaus Radio, Inc.**
Peoria, IL
(800) 545-5287
**McMaster-Carr Supply**
Elmhurst, IL
(708) 834-9600
**W. W. Grainger**
North Suburban, IL
(708) 913-7400
Ext. 75

**Indiana**
**Allied Broadcast**
Richmond, IN
(800) 622-0022
**Great Lakes Electronic**
Indianapolis, IN
(800) 968-2004

**Maryland**
**HARCO**
Aberdeen, MD
(800) 638-7616
**TESSCO**
Sparks, MD
(800) 638-7666

**Massachusetts**
**Contact East**
North Andover, MA
(800) 225-5334

**Michigan**
**Great Lakes**
Battle Creek, MI
(800) 321-8434
**Kent-Moore SPX Corp.**
Warren, MI
(313) 578-7324
**R.S. Electronics**
Livonia, MI
(313) 525-1155
(800) 366-7750

**Minnesota**
**Instrumentation Services, Inc.**
Minneapolis, MN
(612) 544-8916
**Stark Electronics Supply**
Minneapolis, MN
(800) 334-6154

**Missouri**
**RS Electronics/Olive**
Maryland Heights, MO
(314) 997-7709
**Electronics Supply Co.**
Kansas City, MO
(816) 931-0250

**New Hampshire**
**Zorn Industries**
Salem, NH
(800) 828-4950

**New Jersey**
**Beta Lambda, Inc.**
Freehold, NJ
(800) 282-5632
**Brownell Electro, Inc.**
Edison, NJ
(800) 828-1552

**New Mexico**
**Electronic Parts Co.**
Albuquerque, NM
(800) 456-0057

**New York**
**Advanced Automotive Training Services**
Webster, NY
(716) 671-0320
**Northern Technical Sales**
Liverpool, NY
(315) 451-1091
**W.E.I.**
Syracuse, NY
(315) 437-4281

**Ohio**
**WKM Associates**
Dayton, OH
(513) 434-7500

**Oregon**
**Northwest Test and Measurement**
Beaverton, OR
(503) 645-9000

**Pennsylvania**
**Leff Electronics**
Braddock, PA
(412) 351-5000
**Sunshine Scientific Instruments, Inc.**
Philadelphia, PA
(800) 343-1199

**South Carolina**
**Resource Electronics/Dixie**
Columbia, SC
(803) 779-5332

**Texas**
**ENTEST**
Dallas, TX
(800) 955-0077
**INOTEK**
Dallas, TX
(800) 492-6767

**Washington**
**Radar Electric**
Seattle, WA
(206) 282-2511

**Wisconsin**
**Dist-Tron, Inc.**
Menomonee Falls, WI
(608) 835-5527

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**Arizona**
**Jenson Tools**
Phoenix, AZ
(602) 968-6231

**California**
**Fibertron**
Fullerton, CA
(714) 871-3344
(Fiber optic specialists)

**Colorado**
**ANTEC**
Englewood, CO
(800) 841-1531
(CATV)

**Illinois**
**Anixter Brothers, Inc**
Skokie, IL
(800) 221-5217
(LAN/WAN)
**ANTEC**
Rolling Meadows, IL
(800) 252-CATV
(CATV)

**Kansas**
**North Supply Company**
Industrial Airport, KS
(800) 755-1975
(Telephone companies)

**Utah**
**Campbell Scientific, Inc**
Logan, UT
(801) 753-2342
(Soil moisture/ data logging)

**Washington**
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Seattle, WA
(206) 282-2511
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**Puerto Rico & Caribbean Countries**
**TeleNetworks**
San Juan, Puerto Rico
(809) 766-2829

### SECURITY INDUSTRY DISTRIBUTORS

**Connecticut**
**R.J. Heffernan Associates**
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**Oklahoma**
**Jarvis International**
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(918) 437-1100

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# Distributors, Representatives, and Rental/Leasing Companies

## Representatives

### TEST & MEASUREMENT PRODUCTS

**Alaska**
**Frigid North**
Anchorage, AK
(907) 561-4633

**Arkansas, Louisiana, and Mississippi, Oklahoma**
Served by:
**EnTest**
Dallas, TX
(800) 955-0077

**California (San Diego County)**
Served by:
**Ward Davis Associates**
Redondo Beach, CA
(310) 643-6977

**Florida (North)**
**EMSCO**
Orlando, FL
(800) 275-3554

**Hawaii**
**ComTest Technologies, Inc.**
Honolulu, HI
(808) 831-0600

**Idaho, Montana, Utah**
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Beaverton, OR
(503) 643-9202

**Kansas, Missouri, Nebraska**
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(816) 931-0250

**Maine, Vermont**
Served by:
**Beta Lambda**
Freehold, NJ
(800) 282-5632

**Nevada (North)**
Served by:
**Ward Davis Associates**
Santa Clara, CA
(408) 245-3700

**Nevada (South)**
Served by:
**Ward Davis Associates**
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(310) 643-6977

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Birmingham, AL
(205) 822-1326

**Delaware, New Jersey, Pennsylvania**
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Philadelphia, PA
(800) 343-1199

**Massachusetts**
**Technical Education Products**
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(413) 566-3808

**North and South Carolina**
Served by:
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Newberry, SC
(803) 276-3136

**Connecticut, Massachusetts, Maine, New Hampshire, New York, Pennsylvania (East), Rhode Island, Vermont**
Served by:
**Beta Lambda**
Freehold, NJ
(800) 282-5632

**Oregon**
**Northwest Test and Measurement**
Beaverton, OR
(503) 645-9000

**Pennsylvania**
**Leff Electronics**
Braddock, PA
(412) 351-5000

**Texas**
**EnTest**
Dallas, TX
(800) 955-0077

**Virginia**
**Ronald A. Williams, Ltd.**
Richmond, VA
(804) 282-8239

**Washington**
**Radar Electric**
Seattle, WA
(206) 282-2511

### DATACOM REPS LAN/WAN

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Anchorage, AK
(907) 561-4633

**Florida**
**Col-Ins-Co**
Orlando, FL
(407) 423-7615

**Hawaii**
**ComTest Technologies, Inc.**
Honolulu, HI
(808) 831-0600

**Illinois**
**Network Technologies**
Indianapolis, IN
(317) 861-6613

**Maryland**
**CLC Associates**
Rockville, MD
(301) 340-1175

**Massachusetts**
**FICO**
Chelmsford, MA
(508) 250-4445

**New Jersey**
**ATM**
Wayne, NJ
(201) 633-7070

**Ohio**
**Mecom, Inc.**
Risingsun, OH
(419) 457-3231

**Pennsylvania**
**Data Plus**
Kennett Square, PA
(215) 388-2008

### TELEPHONE INDUSTRY REPS

**Alaska**
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Anchorage, AK
(907) 561-4633

**Georgia**
**Southeast Datacom**
Roswell, GA
(404) 998-5083

**Hawaii**
**ComTest Technologies, Inc.**
Honolulu, HI
(808) 831-0600

**Maryland**
**CLC Associates**
Rockville, MD
(301) 340-1175

**New Jersey**
**ATM**
Wayne, NJ
(201) 633-7070

**Ohio**
**Mecom, Inc.**
Risingsun, OH
(419) 457-3231

**Pennsylvania**
**Data Plus**
Kennett Square, PA
(215) 388-2008

**Massachusetts**
**FICO**
Chelmsford, MA
(508) 250-4445

**Washington**
**RJM Company**
Renton, WA
(206) 255-8918

### CATV REPS

**California**
**TVC**
San Clemente, CA
(800) 755-1415

**Colorado**
**Mega Hertz**
Englewood, CO
(800) 525-8386

**Hawaii**
**ComTest Technologies, Inc.**
Honolulu, HI
(808) 831-0600

**Indiana**
**R Alan Communications**
Indianapolis, IN
(317) 849-7572

**New York**
**RF Technologies**
Rockville Center, NY
(516) 678-7200

**Pennsylvania**
**Jerry Conn Associates**
Chambersburg, PA
(800) 233-7600

**South Dakota**
**TSB, Inc.**
Yankton, SD
(605) 665-1393

**Texas**
**Spectrum**
Bedford, TX
(817) 267-2288

**Washington**
**Comm/Net Systems**
Seattle, WA
(206) 623-8670

## Rental/Leasing Companies

**AT&T Capital Corporation Instrument Services**
Dallas, TX
(214) 456-4600
(800) 874-7123

**Continental Resources, Inc.**
Bedford, MA
(617) 275-0850
(800) 937-4688

**Electro Rent Corporation**
Van Nuys, CA
(800) 688-1111

**G.E. Rental/Lease**
Norcross, GA
(404) 246-6200
(800) GE-RENTS

**Genstar Rental Electronics, Inc.**
Palo Alto, CA
(800) 422-3300

**McGrath RentCorp**
San Lorenzo, CA
(510) 276-2626
(800) 352-2900

**McGrath RenTelco**
Richardson, TX
(214) 234-2422
(800) 233-5807

**Telogy, Inc.**
Redwood City, CA
(415) 594-1700
(800) TELOGY-I

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Name _____

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Address _____

City _____ State _____ Zip _____

Z7A-284207-01

Also, please send:

- ❑ GSA Price List 11185
- ❑ Logistics Data Book 11238
- ❑ TekDirect Catalog 11070
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Name _____

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Dept./Mail Station _____

Company _____

Address _____

City _____ State _____ Zip _____

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Also, please send:

- ❑ GSA Price List 11185
- ❑ Logistics Data Book 11238
- ❑ TekDirect Catalog 11070
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Phone (_____) _____ Ext. _____

Name _____

Title _____

Dept./Mail Station _____

Company _____

Address _____

City _____ State _____ Zip _____

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- ❑ GSA Price List 11185
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- ❑ VXI/CDS Products Catalog 11095
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Tektronix

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PITTSFIELD MA 01202-9865

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PITTSFIELD MA 01202-9865