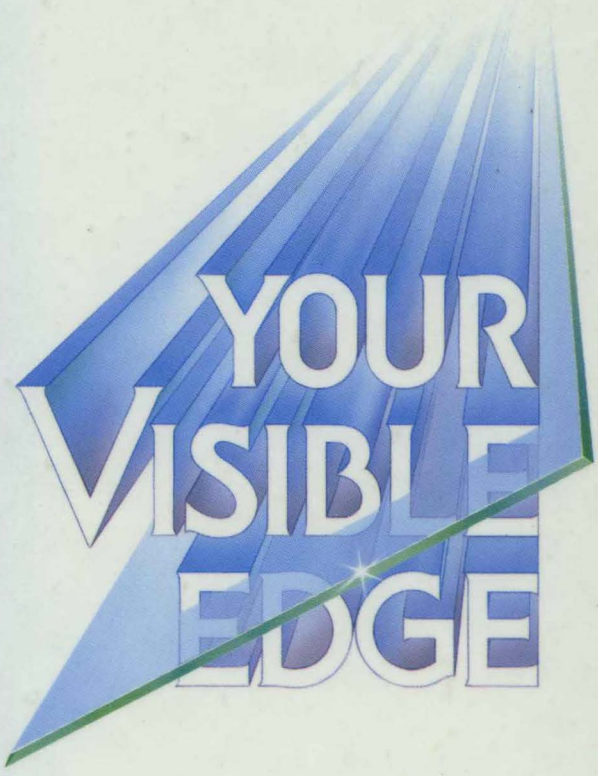
Tektronix

1990 CATALOG



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November 1, 1989

Providing solutions is what Tektronix is all about. Sure, we make and sell test & measurement, graphics, and communications equipment, and there are close to 3,000 products featured here, but that's really only a small part of our purpose.

Understanding your needs is the first part. When we do our homework, understanding what features you need, making the products easy to use and affordable, we've done our job. And in the process, we've given you an edge over your competition.

Providing the right instruction materials and applications information is another part of our job. Just getting you to buy our products isn't our objective...showing you how to use our products to solve your specific needs is. By providing you this information, you can do your job faster, more efficiently, and more effectively. And by so doing, you have an edge over your competition.

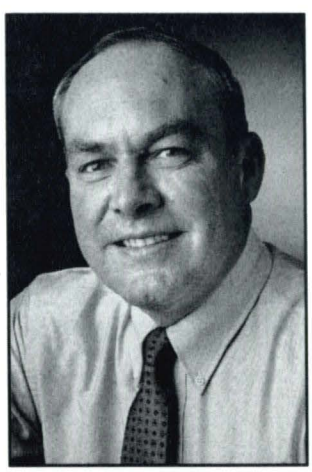
Developing technology to meet your future needs in the areas of generation, acquisition, processing and display of signals and images is also part of our job. Guaranteeing the next generation of capabilities such as the XD88 Superworkstation, the DSA 600 Series Digitizing Signal Analyzer, the Prism 3000 Logic Analyzer and the VM700 Video Measurement Set, provides an edge for your needs of the future.

Product reliability is also important. Our reliability track record is among the best in the industry. But frankly, unless the products you buy from us work like they're supposed to - right out of the box - you don't care what our record states. It's another part of our job to prove our reliability over and over again in each Tektronix product you buy. And that reliability is backed by a worldwide service and support organization guaranteeing someone is there to help you long after the "shine" is gone from you new Tektronix product. We're still supporting some of the earliest Tek products, so you can rest assured we'll stand behind the product you buy today. Having the assurance your instrument will be ready when needed keeps you on the edge.

When you buy from Tektronix, you get more than a product. Our people, technology, products, quality, reliability, engineering service, support...all provide an edge. We don't want you to have to guess at what edge we provide. We want that edge to be obvious. As your partner, we want to become part of - your competitive advantage.

Tektronix - Your Visible Edge!

David P. Friedley
President, Tektronix, Inc.



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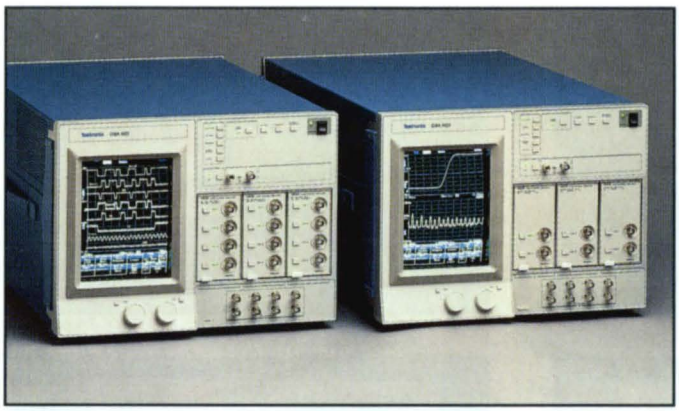
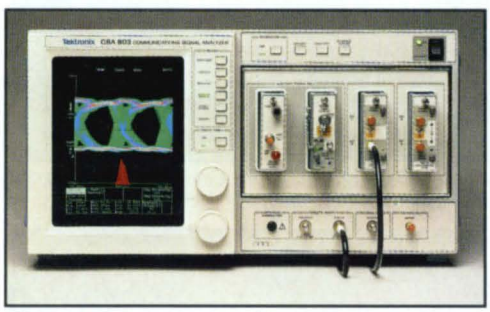
NEW PRODUCTS OSCILLOSCOPES

NEW

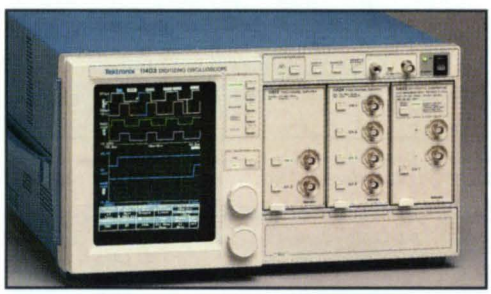


DSA 601 and DSA 602 Digitizing Signal Analyzers (DSA) provide Phenomenal Signal Acquisition and Analysis at your fingertips – see page 40.

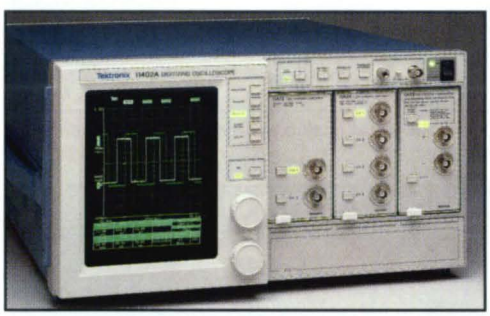
The SD-20 Loopthrough Sampling Head and SD-22 Low-Noise Sampling Head were added to the 11800 Series products - see page 48.



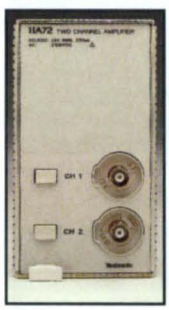
CSA 803 Communications Signal Analyzers offer capabilities to acquire and display high-speed digital communication signals - see page 44.



11403, 1 GHz Color Digitizing Oscilloscope – see page 37.

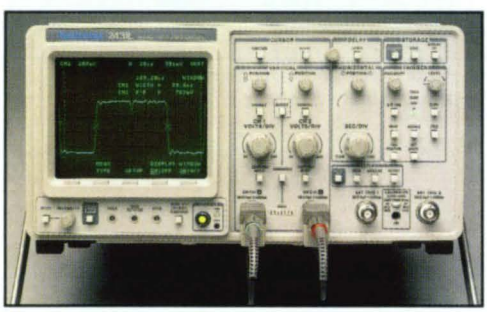


11402A, 1 GHz Digitizing Oscilloscope – see page 37.

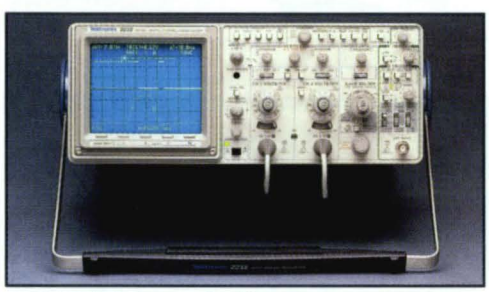


11A72, 1 GHz bandwidth two-channel amplifier - see page 64.

222 Hand Held Digital Storage Oscilloscope - see page 148.



2431L 250 MS/S, 300 MHZ Digitizing Oscilloscope – see page 115.



2232 Digital Storage Oscilloscope – see page 124.

DSA 601/DSA 602

- *Transient Capture*
- *High Measurement Accuracy*
- *Extended Triggering*
- *Comprehensive Signal Analysis*
- *Live FFT Capabilities*

CSA 803

- *10 GHz Trigger Bandwidth*
- *Histograms and Mask Testing*
- *Constellation Diagrams*
- *Automatic Measurement System*

SD 20

- *Low Loss Signal Acquisition*
- *20 GHz Bandwidth*

SD 22

- *450 µV Typical Noise*
- *12.5 GHz Bandwidth*

11403

- *24 Automated Measurements*
- *High Resolution Color Display*
- *On-Board Statistics*

11402A

- *10 Bit Vertical Resolution*
- *10 ps Horizontal Resolution*
- *On-Board Statistics*

11A72

- *1 GHz Bandwidth (in 11400 and DSA 600)*
- *Two Channel Amplifier*

2431L

- *Low-cost*
- *Automated*
- *Compatible with 2400-Series Digitizing Oscilloscopes*

2232

- *100 MHz Analog and Digital Storage Bandwidth*
- *100 MS/s Sampling Per Channel*
- *1K, 4K Selectable Record Length*
- *Extended Memory - Store Up to 29 Waveform Sets.*
- *10 ns Glitch Capture at Any Speed.*

222

- *Handheld*
- *10 MHz, 10 MS/s*
- *Fully Programmable*
- *Battery Operated*
- *Floatable to 800V*
- *Std. RS-232 Interface*

NEW

NEW PRODUCTS OSCILLOSCOPES/DIGITIZERS

2224
- 60 MHz Analog Bandwidth
- 10 MHz Digital Bandwidth
- 100 MS/s Sample Rate
- 10 ns Glitch Capture

2221
- 100 MHz Analog and Digital Storage Bandwidth
- 20 MS/s Sampling Rate
- 4k Record Length
- 100 ns Glitch Capture

2211
- 50 MHz Analog Bandwidth
- 20 MS/s Sample Rate
- 4k Record Length
- RS-232-C Hard Copy Output
- Waveform-Based Cursors
- Trigger Level Voltage Readout

2236A/2235A
- 100 MHz Bandwidth
- Graticule Illumination
- HF & LF Reject Trigger Coupling
- Versatile, 4-in-1 Scope

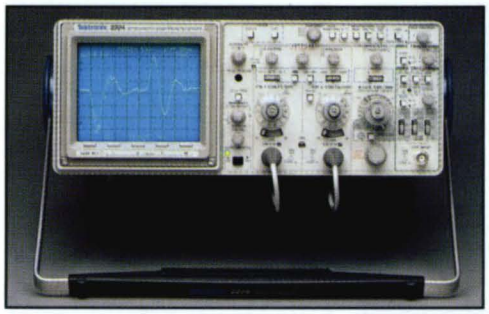
2247A
- 4 Channels, 100 MHz + C/T
- Automatic Measurements
- Front Panel Store/Recall

RTD720
- 2 GS/s Sample Rate
- Record Lengths to Over 1 Million Data Points
- Four 500 MHz Channels with 8 Bits Vertical Resolution
- Address Wide Range of High Frequency Transient Event Capture Requirements

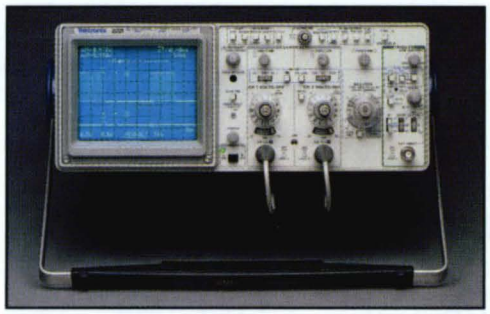
9503/9504
- Provide Longer Record Length Memory for RTD 710A
- 4 Mwords of 16 Bit Memory at 100 MW/sec (9503)
- Up to 32 Mwords of 16 Bit Memory at 100 MW/sec (9504)
- Use for Contiguous Waveform Data or Large Numbers of Smaller Records with High Throughput Capability

SCD1000/SCD5000
- High Analog Bandwidth 4.5 GHz w/SCD 5000 1 GHz w/SCD1000
- 5 Picosecond Time Resolution
- 200 Giga Samples Per Second Sample Rate
- Address Ultra High Frequency Transient Event Acquisition Requirements

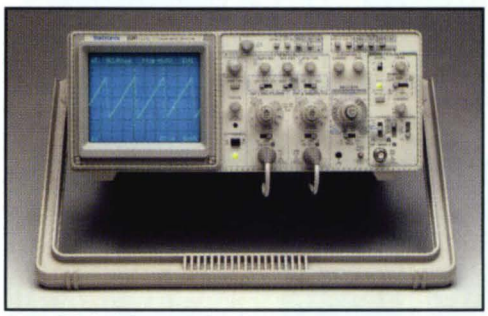
ANALYTEK SERIES 2000
- High Channel Density
- High Speed Transient Capture
- Up to 2 GS/s Sampling Rate
- Expandable VME Based System



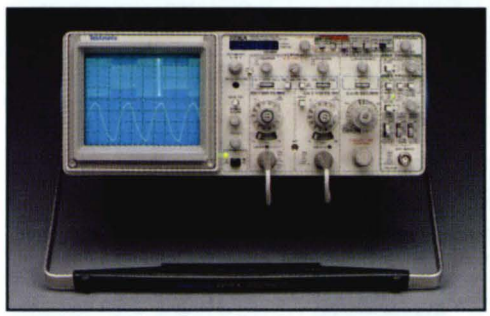
2224 Digital Storage Oscilloscope – see page 126.



2221 Digital Storage Oscilloscope – see page 128.

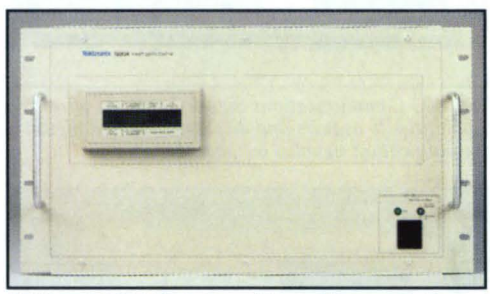


2211 Digital Storage Oscilloscope – see page 130.



2236A Dual Time Base Plus Counter, Timer and Digital Multimeter – see page 136.

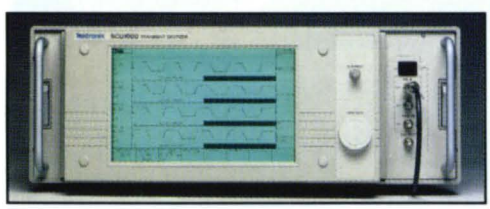
2247A Analog Oscilloscope with Voltmeter/Counter/ Timer has several new features - see page 133.



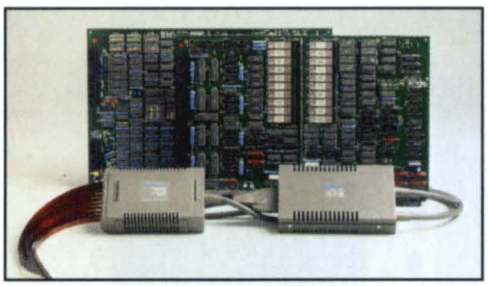
9503 and 9504 High Speed Large Memory Buffers – see page 160.

RTD 720 Transient Event Digitizer – see page 154.

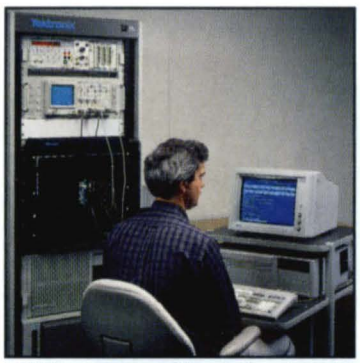
AnalyTek Series 2000 Digitizers High Channel Density Digitizer – see page 169.



SCD1000 and SCD5000 Transient Event Digitizers – see page 166.



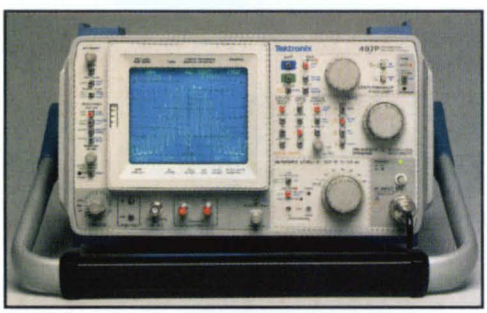
92SX109 and 92SX118 Digital Stimulus That Establishes a New Performance Level – see page 190.



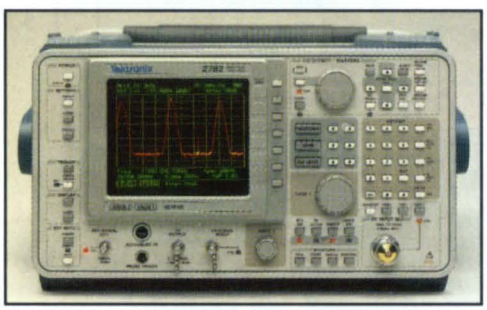
92BV400 Printed Circuit Board Verification Systems – see page 197.

Prism 3000 Series Breaking the Logic Analysis Barriers – see page 198.

1230 DSM – Digitizing Oscilloscope and Logic Analyzer Combined – see page 204.

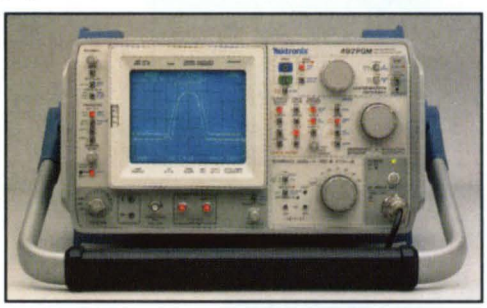


497P Portable Spectrum Analyzer Digital Communications System Maintenance – see page 220.

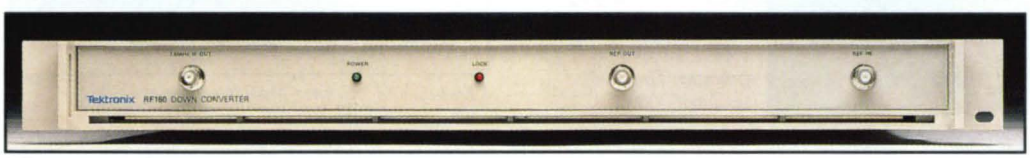


2782 Highest Performance Microwave Spectrum Analyzer Microwave System R/D/T & E – see page 210.

Waveguide Mixers 18 GHz to 325 GHz Individually Calibrated – see page 226.



492PGM Microwave System Maintenance – see page 220.



RF 160 Down Converter – see page 240.

92SX109/92SX118

- *Add to Any DAS 9200 System*
- *100 MHz Data Rates*
- *>500 Channels of High Speed Digital Stimulus*
- *Up to 16 k Vectors/Channel*

92BV400

- *Instrument and Fixturing Environment*
- *Patterns Up to 50 MHz*
- *Flexible Test Generation Tools*

PRISM 3000 SERIES

- *Tailored to Specific Logic Analyzer Applications*
- *Support for 8/16/32-bit Microprocessor System Integration*
- *High Speed Digital Timing Analysis*
- *Software/Firmware Debug and Optimization*
- *Waveform Analysis*

1230DSM

- *Dual-trace Digitizing Scope, Plus*
- *16-48 Channels of Logic Analysis*
- *Both in One Low-Cost Package*

2782

- *33 GHz Coaxial Input*
- *0 to 33 GHz Full Span*
- *100 dB Dynamic Range*

497P

- *100 Hz to 7.1 GHz Frequency Range*

492PGM

- *10 kHz to 21 GHz Frequency Range*

WM780 SERIES

- *Individual Frequency Characterization Curves Attached to Housing*
- *Custom Characterization Available*

RF160

- *Down Converts IF Signals for Rigorous 3D Modulation Analysis on the Tektronix 3052 Digital Spectrum Analyzer*
- *Works with Tektronix 2782, 49X, and 275X Series Spectrum Analyzers*
- *Effective Component in Complex Processing Systems*

NEW

NEW PRODUCTS
VXI CARD INSTRUMENTATION

VX4530/VX4535/ VX5530/VX5535

- *C-size (VX4530/VX4535)*
- *D-size (VX5530/VX5535)*
- *Implement the Slot 0, Resource Manager, Message Manager Functions*

VX5260

- *Compact, High Performance*
- *Message-Based, Dual Channel Waveform Digitizer*
- *200 MS/s Real Time Acquisition Rate*
- *8-bit Vertical Resolution*

VX5790

- *10-bit Vertical Resolution*
- *100 MHz max. Clock Rate*
- *3 Selectable Filters*
- *Selectable Waveform Package Size–24 to 2048 Data Points (in Increments of 8)*

VX4236

- *C-Size*
- *Up to 1,000 Measurement Stored in Buffer*
- *100 mV to 300 VDC and AC Voltage Measurements Made in 6.5 and 5.5 Digit Resolution, Respectively*
- *Resistance Measurements Made from 100 Ω to 10 MΩ with 5.5 Digit Resolution*

VX4223

- *C-size*
- *14 Measurement Functions*
- *Measurements from DC to 160 MHz (first input); DC to 100 MHz (second input) with DC Coupling*

VX4440

- *C-size, Message-Based*
- *6 Ports to Control 6 Switch Cards or 12 RF Modules*
- *Programmable to Execute Prestored Switch Settings by Command or Internal TTL*

VX1400

- *Supports all PI and P2 Functionality*
- *600 W Power Supply*
- *50 W of Cooling Per Slot*

VX1405

- *Supports All P1 and P2 Functionality*
- *400 W Power Supply*
- *45 W of Cooling Per Slot*

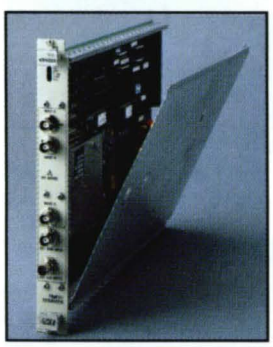
VX1505

- *Supports All P1 and P2 Functionality*
- *600 W Power Supply*
- *100 W of Cooling Per Slot*

VX1405 VXI C Size 5 slot Mainframe – see page 304.

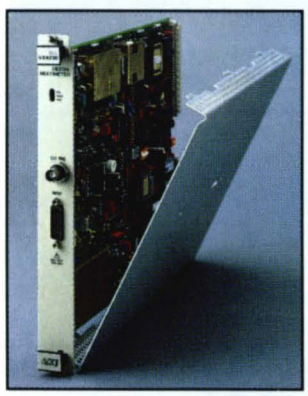
VX5260 VXI Waveform Digitizer – see page 307.

VX5790 VXI Arbitrary Waveform Generator – see page 307.

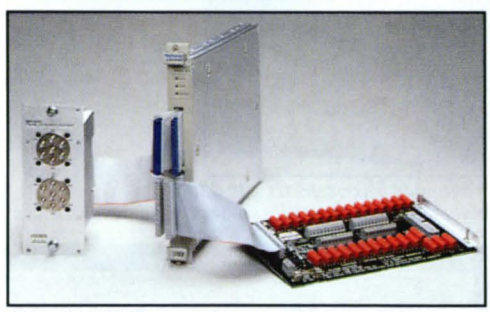


VX4223 VXI Counter/Timer – see page 308.

VX5530/VX5535 and VX4530/VX4535 – see page 306.



VX4236 VXI Digital Multimeter – see page 308.



VX4440 VXI Scanner Master – see page 308.

DM 5110 & DM 511 Digital Multimeters – see page 265.

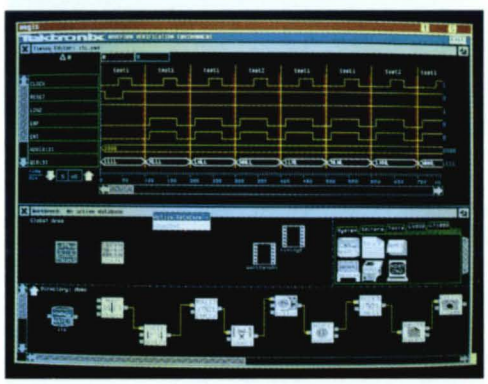
Automated Impedance Test Systems – see page 326.

571 Digital Curve Tracer – see page 333.

CG5010/CG5011 Calibration Generators – see page 296.

PEP 201 Instrument Controller – see page 319.

TDR 200 Semiautomated Impedance Test System – see page 326.



TekWAVES Design to Test Link Software for the LV500 – see page 339.

LV500 – ASIC Verification Tester – see page 340.

DM5110/DM511

- *Programmable*
- *Compact*
- *Competitive Price*
- *dBv, dBm, Rear Interfacing (DM511)*

PEP 201

- *Small, Low-Cost*
- *Benchtop ATE Controller*
- *Runs at 12 or 8 MHz*
- *High Resolution, Monochrome Monitor*

AUTOMATED IMPEDANCE TEST SYSTEMS

- *Labor Cost Savings, Error Reduction, Improved Accuracy*
- *Cable Testing*
- *Wire Harness Testing*
- *Bare Circuit Board Testing*
- *Backplane Testing*

LV500

- *Benchtop ASIC Verification*
- *Powerful*
- *Easy to Use*
- *Affordable*

TekWAVES

- *Waveform Editing*
- *Tester Capabilities Checking*
- *Simulation of Tester Resources*
- *Automatic Test Program Generation*
- *Graphical Iconic User Interface*

571

- *Digital Curve Tracer*
- *Easy to Operate*
- *Large Display*
- *All Functions Menu Driven and Selected from Keypad*
- *Dot Matrix Printer Output*

CG5010/CG5011

- *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*

NEW PRODUCTS
TEST AND MEASUREMENT SOFTWARE

TekTMS
- *Integrated Test Software Development & Execution System*
- *VXI and GPIB Environment*

WaveWriter™
- *Create/Modify Arbitrary Waveforms for Tek AFG5101/ AFG5501/VX5790 Arbitrary Waveform Generators*
- *Create Exact Tolerance or Templates for 2400 Series Digital Storage Scopes*

i-PATTERN™
- *Statistically Measure and Visually Examine Signal Noise and Signal Timing Jitter*
- *Real Time Display*
- *User Definable Mask Testing*

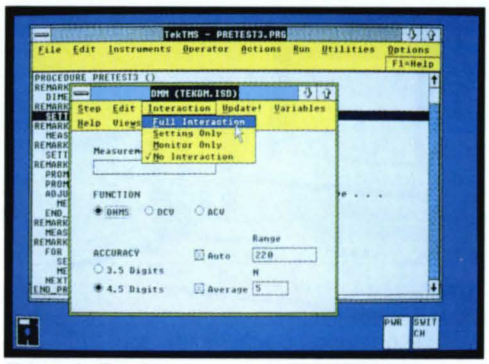
TEMPLATE WAVEFORM
- *Waveform Template Editing*
- *Act-on-Delta Processing – see page 355*

TELESERVICING
- *Data Management*
- *Waveform Graphics*
- *Modem Communications*

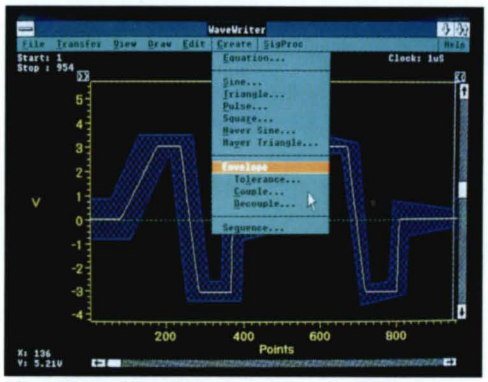
ASYSTANT™ GPIB
- *PC Software for Data Acquisition, Analysis, and Graphics*
- *Designed for Scientific and Engineering Applications*
- *Menu-Driven Interface*

LabWindows®
- *Group of Software Tools for Microsoft QuickBASIC and C Programmers*
- *Instrument Control, Data Acquisition and Analysis Applications*

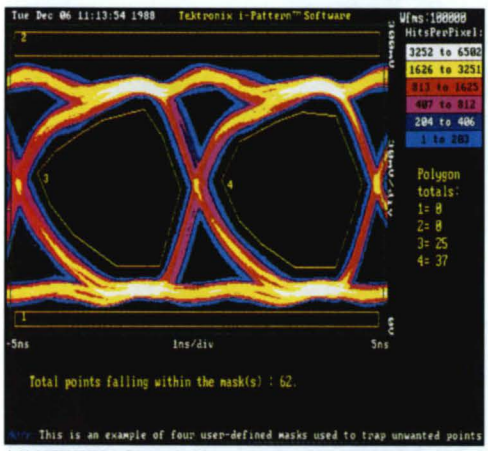
DADiSP™
- *Analytical Graphics Package*
- *Designed Exclusively for Scientific and Technical Data Analysis Applications*
- *Unique Spreadsheet-like, Menu-Driven Environment*



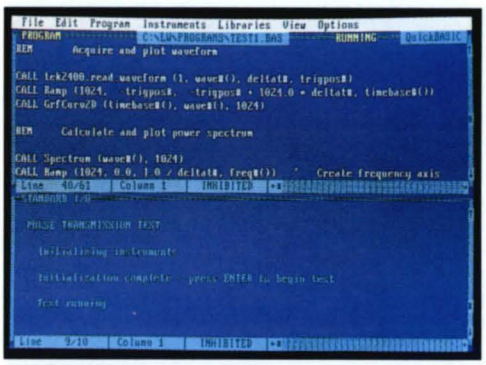
Tektronix Test Management System (TekTMS) – see page 347.



WaveWriter Waveform Generation Software – see page 348.

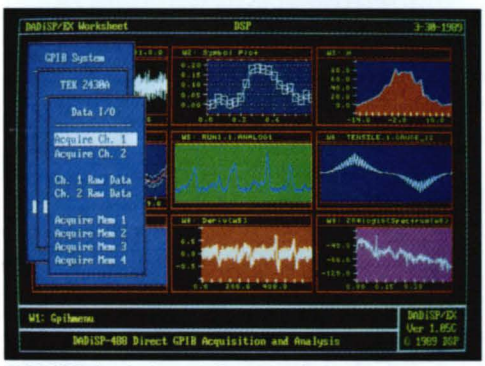


i-PATTERN Signal Characterization and Mask Testing Software – see page 355.



ASYSTANT GPIB Acquisition and Analysis Software – see page 350.

LabWindows Analysis and Data Acquisition Software – see page 351.



DADiSP Analysis and Graphics Software – see page 352.

TeleServicing Software – see page 357.

2510/20 TestLab Multichannel Waveform Analyzers
TestLab – see page 365.

2622 Personal Fourier Analyzer
Realtime Signal Acquisition and Analysis – see page 368.

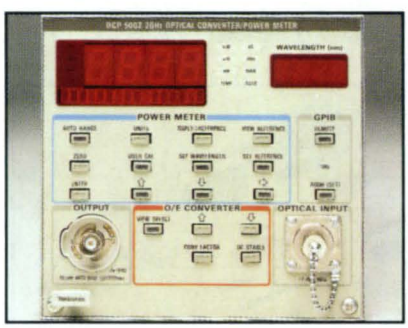
SA-42 Optical to Electrical Converters
Optical to Electrical Conversion from DC to 20 GHz– see page 372.

LTS2000 Laser Diode Test System – see page 377.

2630MS Modal Analysis System
Analyze the Dynamic Properties of Structures with a Complete Four Channel Modal Analysis System – see page 368.

2640 Personal Fourier Analyzer
200 kHz Fourier Analyzer – see page 368.

SD-46/SD-42 Optical to Electrical Converters – see page 372.



OCP 5002 – see page 376.

2510/20

- *Multi-Channel, Long Record, High Resolution Waveform Analyzer*
- *Applications in Power, Process, Telephony and Biomedical*
- *Environments in R & D Prototype Testing, Service, and Manufacturing*

2630MS

- *Four Channels*
- *Creates Analytical Model with Animated Graphics of Structural Measurements*

2622

- *Spectrum, Network, Waveform Analysis*
- *Mechanical, Electromechanical, Acoustic Electronic Applications*

2640

- *Fourier Analysis to Applications Beyond 100 kHz*
- *Up to 4 Channels, 200 kHz Performance Each*
- *Control Systems, Ultra-Sonic Devices, Sonar Applications*

SD-46/SD-42

- *Accepts Optical Input from 1000 to 1700 nm, Bandwidths from DC to 20 GHz*
- *Designed to Work with Tek 11800 Series Sampling Oscilloscopes*

SA-42

- *Accepts Optical Input from 1000 to 1700 nm, Bandwidth from dc to 7 GHz (-3dB)/dc to 15 GHz (-25dB)*
- *Battery Powered, Rechargeable Standalone O/E Converter*

LTS2000

- *Fully Automated PC-based*
- *Display Results in Graphics or Tabular Format*
- *Delivers Comprehensive Characterization of Laser Diode Module*

OCP 5502/5002

- *2GHz Optical Converter/Power Meter*
- *1100 to 1700 nm, dc to 2 GHz*

OIG 502

- *Optical Impulse Generator*
- *1300 nm*
- *40 ps Laser Impulse Source*

NEW

NEW PRODUCTS TEST AND MEASUREMENT PRINTERS, DIGITIZERS/IMAGER, CARTS, PROBES

HC200

- *Compact, 9-Pin Dot Matrix*
- *232 cps (dRaft Mode), 40 cps (Near Letter Quality)*
- *Dual Paper Path*

DCS02

- *Waveform Analysis, Image Capture*
- *High Speed Transient Capture*
- *Waveform Analysis*

K636

- *Mobile, Rackmount Workstation*
- *36 Inches High, 28 Inches Maximum Rack Depth*

K332WH/K335BN/ K336BN

- *Anthro Modular Workstations*
- *Variety of Configurations*

P6119/P6127

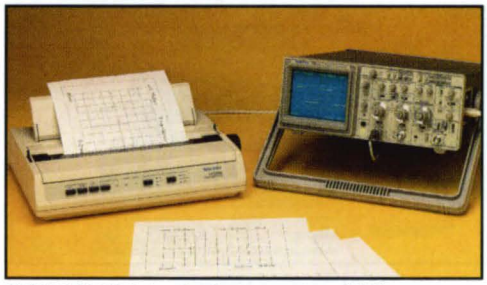
- *1X/10X Switchable*
- *300 MHz (P6127), 100 MHz (P6119)*
- *Ground Reference, Different Cable Lengths*

ACCELEROMETER KITS

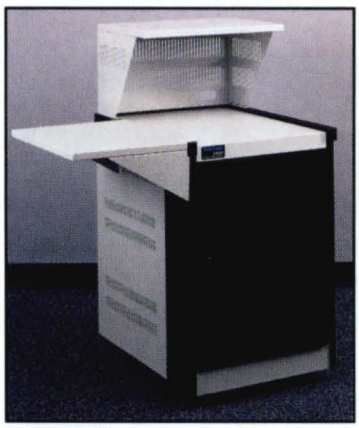
- *Shock and Vibration Analysis*
- *Measure 0.005 to 500 g over a Wide Frequency Range*

ANTHRO TECHNOLOGY FURNITURE

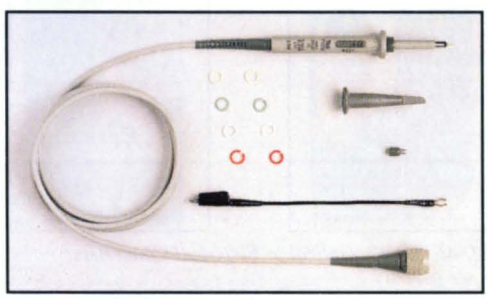
- *Configurable in a Variety of Ways to Support High Tech Hardware, Increase Work Surface and Provide Privacy and Noise Reduction*



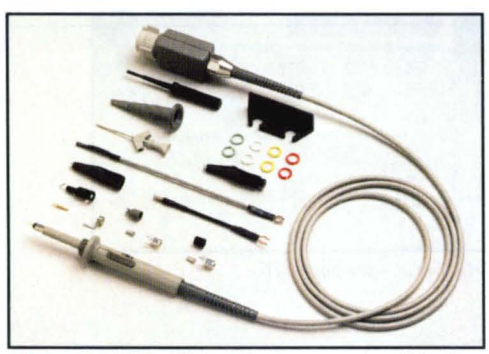
HC200 TekPrinter for Instrument and PC Documentation – see page 385.



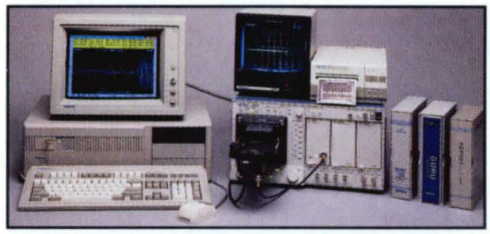
K636 Mobile Rackmount Work Station – see page 400.



P6119 100 MHz, 1X/10X Switchable Probe Best Value in 1X/10X Switchable Probes – see page 411.

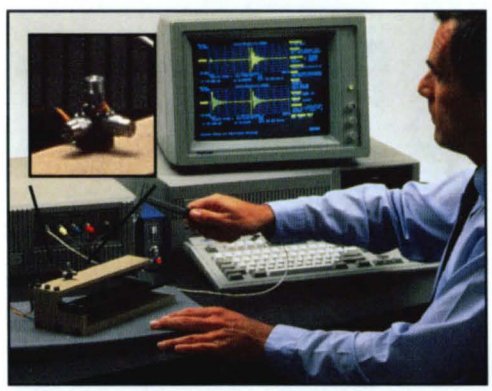


P6127 300 MHz, Highest Performance in 1X/10X Switchable Probe – see page 411.



DCS02 Digitizer/Imager – see pages 172-176.

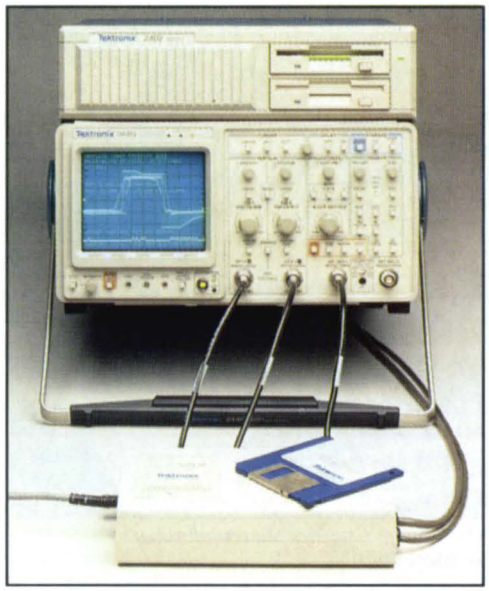
K335BN Workstation Furniture – see page 402.



Accelerometer Kits – see page 430.

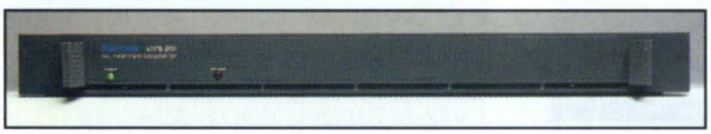
Anthro Technology Furniture – see page 483.

TC 1000 Portable, High Performance, Single Function Test Set – see page 453.



2410 Digital Interface Test System– see page 455.

VM700A Automatic Video Measurement Set – see page 456.



VITS201 PAL Insertion Generator – see page 459.

WFM300A Component/Composite Monitor – see page 457

TSG-1000 Family High Definition Television Signal Generators – see page 458.

TSG-370 Component/NTSC Television Generator – see page 458.

TC1000

- *Single-Function Test Set Offers One of the Following:*
  - *T1/PCM/BERT Analyzer*
  - *Protocol Analyzer*
  - *ISDN-BR Analyzer*
  - *LAN Protocol Analyzer (Ethernet or Token Ring)*
  - *TIMS*

2410

- *Test Telecommunications Signals at the Digital Signal Interface*
- *Fully-Integrated Hardware and Software Package*
- *Test Digital Carrier to ANSI or CCITT Specifications*

VM700A

- *Automatic, Video Measurement Including Those Specified in CCIR REP.624-1, Rec. 567, Rec. 569*
- *3 Input Channels*
- *Remote Control Operation*

VITS201

- *CCIR, EBU UK National*
- *5 External ITS Inputs*
- *Source Identification*

WFM300A

- *Component and Composite Waveform Display*
- *Lighting Display for Equipment Setup and Monitoring*
- *Bowtie Display for System Timing*
- *Menu Selectable Component Format Options*
- *Menu Selectable 625/50 or 525/60 Configuration*
- *Separate GBR and Composite Picture Monitor Outputs*
- *Front Panel User Recalls for Fast Operation*

TSG-1000 FAMILY

- *Supports the Major Proposed HDTV Production Standards*
- *Comprehensive Test Signal Complement Including Moving Patterns*
- *GBR and Y, P_B, P_R Formats*
- *30 MHz Bandwidth*
- *10 Bit Signal Generation*

TSG-370

- *Component/NTSC Signal Generator*
- *Simultaneous and Independent Component and Composite Test Signal Outputs*
- *High Stability, Correctly SCH Phased Internal Sync Generator*
- *Black Burst (6 Outputs), Comp Sync, and Comp Blanking Outputs*
- *Full Color Genlock*

NEW PRODUCTS
DISPLAY

XD88 SERIES
- *Motorola 88000 RISC-Based Superworkstation*
- *Brilliant Graphics, Outstanding Compute Speed*
- *Adherence to Industry Standards*

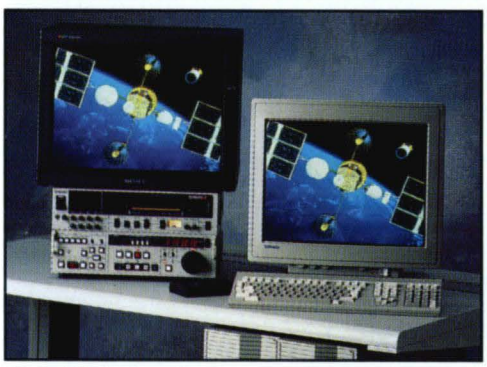
X STATIONS
- *Full Color or Monochrome High-Resolution Network Displays with X Support*
- *CAD, CAE, Mapping & GIS, Manufacturing, Automation, Data Analysis, CASE Applications*

DIGITAL VIDEO INTERFACE
- *Converts Full-Screen, High-Resolution Graphics to Broadcast Quality Video*
- *Real-Time Down-Conversion and Frame-by-Frame Rendering*

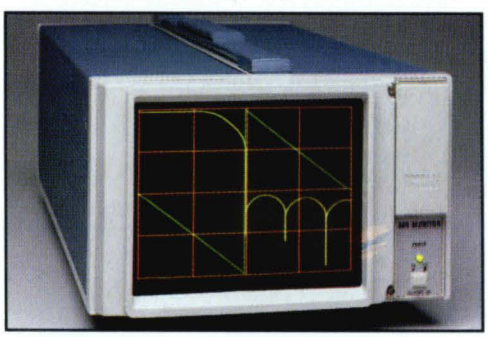
GMA213S/GMA263S
- *High Resolution, High Brightness, Stereoscopic Display*
- *Liquid Crystal Shutter Technology and Passive Stereo Viewing Glasses*
- *Wide Angle View*
- *Remote Sensing, Photogrammetry, Nondestructive Testing Applications*

609
- *Bi-Primary Colors (Red/Green)*
- *High Contrast*
- *High Resolution*
- *Medical, Simulators Applications*

XD88 Series Graphics Superworkstations – see pages 462-463.



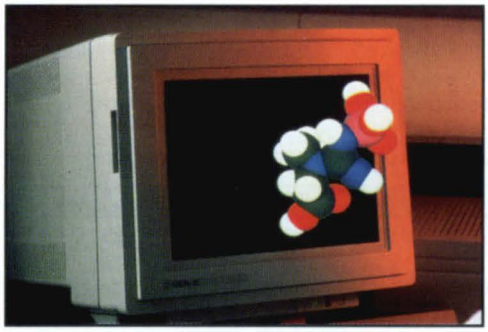
Digital Video Interface – see page 463.



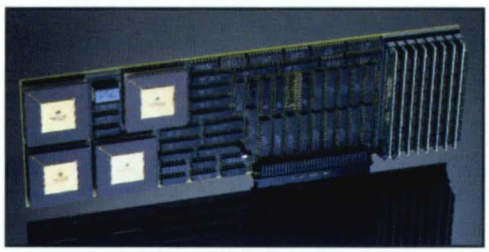
609 Color Display – see page 470.

New High-Performance X Stations – see page 464.

GMA213S/GMA263S High Resolution, High Brightness Steroscopic Displays – see page 472-473.

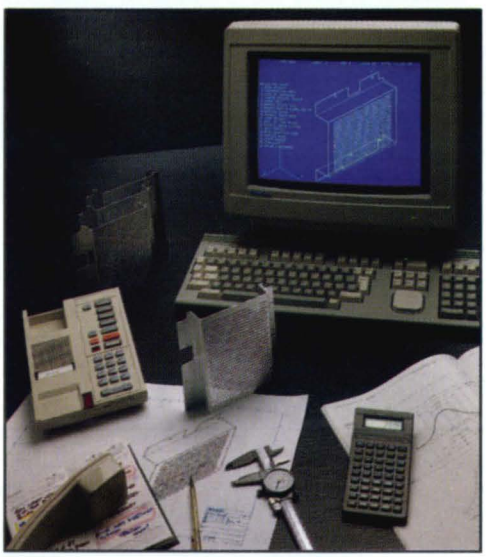


SG 625, SGS 421 Steroscopic Displays
Excellent Viewability in Stereoscopic 3D Color –
see page 476.



RP88 Coprocessor
Mainframe Power in a Macintosh™ Environment –
see page 474.

CACHE™ Worksystem
A window into the world of chemistry – see page 474.



Metal Components – see page 482.

SG625/SGS421

- *Stereoscopic, 3D Color Display*
- *Liquid Crystal Technology, Passive 3D Viewing Glasses*
- *Multimode*
- *Easily Adaptable to Workstations and Imaging Card Sets*

CACHE

- *Design, Edit, Manipulate Chemical Compound in a Computer*
- *Molecular Modeling with a Macintosh II*

RP88

- *Compute Power Equal to a VAX8800*
- *17 MIPS*
- *Engineering CAD, Scientific Visualization, Image Processing, Simulation, Modeling Applications*

METAL COMPONENTS, CASTINGS, ASSEMBLIES

- *Sheet Metal Fabrication*
- *Precision Machining*
- *Custom Finishing*

Contents

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11000 Series 37
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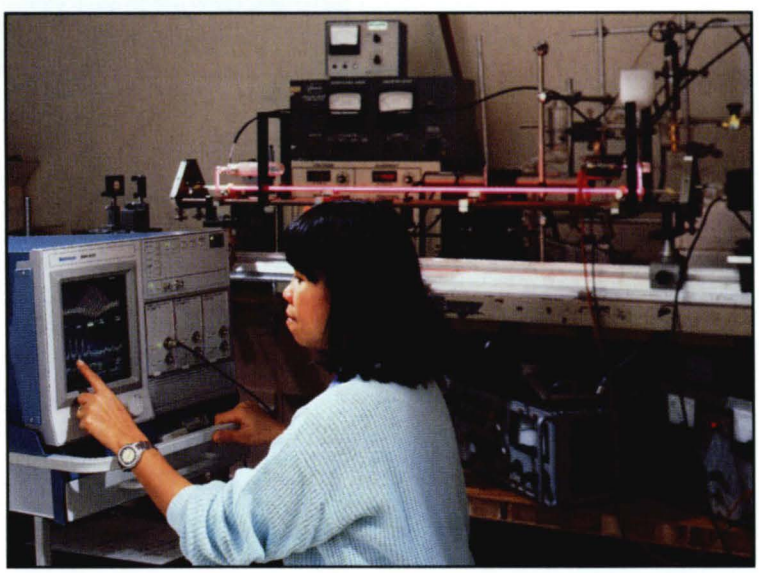
INTRODUCTION

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.

Tektronix has pioneered and patented several industry firsts that separate our instruments from the competition:

Industry Firsts	Benefit
• Glitch Capture Mode	Ensures that instabilities and transients don't escape your notice with the 2200, 2400, and DSA 600 Series.
• Microchannel Plate (MCP) CRT	Lets you see transients that are impossible to detect with conventional CRTs using high performance analog scopes, like the 7104, the 11302A, and the 2467B.
• High-Performance Analog Front-End	Guarantees the most accurate capture of your signal in all our scopes.
• Variable-Persistence & Bistable CRT Storage	Displays low repetition rate or slowly varying signals in our 11000, 7000, and 5000 Series.
• Scan Conversion Instrument	Transforms analog acquisitions into digital data for waveform processing, storage, and analysis in the DCS02, 7912HB, and 7250 with single-shot bandwidths up to 6 GHz.
• Advanced, On-Board Waveform Processing	Reduces the need for external computations, and gives you real time results in the 11000 Series.
• Analog/Digital	Provides analog, digital plus analog, and digital storage scopes in both portable and benchtop models.
• Modularity	Allows flexible instrument configurations with bandwidths beyond 1 GHz.
• Multiple-Channel Acquisition	Acquires up to 136 channels with the 11800 Series.
• Digitizing Signal Analyzers	Delivers fast sampling rates and comprehensive on-board processing and analysis systems.
• Programmability	Provides IEEE Standard 488 and RS-232-C programmable instruments.
• Variety of Probes	Optimizes signal integrity when connected to your device under test (DUT) with FET, differential, high voltage, current, bias/offset, and spring contact probes.
• Accessories	Complete your system with the widest selection of cameras, printers, plotters, cables, probe tips, and scope carts.

And with Tektronix you know that you're backed by the most respected service and support organization in the industry.



Product	Technology *1	Configuration	BW (Max.)	Sample Rate	Sweep (Max.)	Weight (lb/kg)	Page	Prices*3 Begin at
CSA 803	Digital Sampling	Modular	20GHz	200kS/s	1ps/div	49/22.3	44	$23,950
11802	Digital Sampling	Modular	20GHz	200kS/s	1ps/div	53/ 24.1	45	$22,000
11801	Digital Sampling	Modular	20GHz	200kS/s	1ps/div	49/22.3	45	$23,500
DSA 601	Real-Time DSO	Modular	1GHz	1GS/s	200ps/div	67/30.4	40	$21,025
DSA 602	Real-Time DSO	Modular	1GHz	2GS/s	200ps/div	71/32.2	40	$28,500
11403	Random ET DSO	Modular	1GHz	20MS/s	500ps/div	41.6/19	54	$16,950
11402A	Random ET DSO	Modular	1GHz	20MS/s	500ps/div	41.6/19	54	*4
11302A	BrightEye™	Modular	500MHz	N/A	500ps/div	44/20	60	$14,500
11201A	Random ET DSO	Modular	400MHz	20MS/s	500ps/div	41.6/19	58	*4
7934	CRT Storage	Modular	500MHz	N/A	500ps/div	37.8/17.2	74	$15,100
7904A	Analog	Modular	500MHz	N/A	500ps/div	37.8/17.2	76	$12,750
7854	A and D Sampling	Modular	400MHz	200kS/s	500ps/div	45/20.4	78	$17,000
7633	CRT Storage	Modular	100MHz	N/A	5ns/div	30/13.6	80	$10,500
7623A	CRT Storage	Modular	100MHz	N/A	5ns/div	30/13.6	80	$8,900
7613	CRT Storage	Modular	100MHz	N/A	5ns/div	30/13.6	80	$8,600
7603	Analog Sampling	Modular	100MHz	N/A	5ns/div	30/13.6	82	$4,235
7104	BrightEye™	Modular	1GHz	N/A	200ps/div	45/20.4	72	$29,995
5441	CRT Storage	Modular	50MHz	N/A	10ns/div	23/10.4	100	$6,875
5440	Analog	Modular	50MHz	N/A	10ns/div	23/10.4	100	$4,430
5113	CRT Storage	Modular	2MHz	N/A	100ns/div	23/10.4	102	$5,055
5111A	CRT Storage	Modular	2MHz	N/A	100ns/div	23/10.4	102	$3,610
5110	Analog	Modular	2MHz	N/A	100ns/div	23/10.4	102	$2,420
2467B	BrightEye™	Portable	400MHz	N/A	500ps/div	20.5/9.3	108	$13,045
2465B *2	Analog	Portable	400MHz	N/A	500ps/div	20.5/9.3	110	$6,060
2445B	Analog	Portable	150MHz	N/A	1ns/div	20.5/9.3	110	$3,995
2440	Real-Time DSO	Portable	300MHz	500MS/s	2ns/div	23.9/10.9	115	$12,390
2432A	Real-Time DSO	Portable	300MHz	250MS/s	2ns/div	23.9/10.9	115	$10,335
2431L	Real-Time DSO	Portable	300MHz	250MS/s	2ns/div	23.9/10.9	119	$7,250
2430A *2	Real-Time DSO	Portable	150MHz	100MS/s	5ns/div	23.9/10.9	115	$8,235
2247A	Analog	Portable	100MHz	N/A	2ns/div	17.3/7.9	133	$2,995
2246A *2	Analog	Portable	100MHz	N/A	2ns/div	17.3/7.9	133	$2,595
2245A	Analog	Portable	100MHz	N/A	2ns/div	17.3/7.9	133	$1,995
2236A	Analog	Portable	100MHz	N/A	5ns/div	16.2/7.3	136	$3,195
2235A	Analog	Portable	100MHz	N/A	5ns/div	13.5/6.1	136	$1,795
2232	Analog/ET DSO	Portable	100MHz	100MS/s	5ns/div	18/8.2	124	$5,495
2225	Analog	Portable	50MHz	N/A	5ns/div	15.2/6.9	138	$1,095
2224	Analog/RT DSO	Portable	60MHz	100MS/s	5ns/div	18/8.2	126	$4,495
2221	Analog/ET DSO	Portable	100MHz	20MS/s	5ns/div	18/8.2	128	$3,495
2211	Analog/RT DSO	Portable	50MHz	20MS/s	5ns/div	16.8/7.6	130	$2,495
2205	Analog	Portable	20MHz	N/A	10ns/div	14.8/6.7	139	$695
2201	Analog/RT DSO	Portable	20MHz	10MS/s	10ns/div	16.8/7.6	132	$1,495
2335/6/7	Analog	Ruggedized	100MHz	N/A	5ns/div	27.8/12.6	141	$4,450
336A	Analog/ET DSO	Handheld	50MHz	20MS/s	10ns/div	11.1/5	144	$5,745
314	CRT Storage	Handheld	10MHz	N/A	100ns/div	10.5/4.7	146	$5,340
305	Analog (w/DMM)	Handheld	5MHz	N/A	500ms/div	13.1/6	147	$3,310
222	ET DSO	Handheld	10MHz	10MS/s	5ns/div	4.4/2	148	$2,450
221	Analog	Handheld	5MHz	N/A	500ms/div	3.8/1.9	150	$2,950
214	CRT Storage	Handheld	500kHz	N/A	500ms/div	3.8/1.9	150	$3,100
212	Analog	Handheld	500kHz	N./A	200ms/div	3.8/1.9	150	$2,450
T202	ET DSO	Handheld	5MHz	20MS/s	50ns/div	2.0/1	152	$1,995
T201	ET DSO	Handheld	5MHz	20MS/s	50ns/div	2.0/1	152	$1,295

*1 *Refer to pages 32 and 33 for a more detailed look at these technologies.*

*2 *Military and Special Service Versions of these Scopes are on page 143.*

*3 *The prices listed for modular instruments do not include the cost of plug-ins or sampling heads.*

*4 *Contact your local sales representative.*

MAKING AN EDUCATED CHOICE – A GUIDE TO OSCILLOSCOPE SELECTION

Here you will find a complete listing, in decreasing numerical order, of all Tektronix instruments – from the DSA 600 and CSA 803 benchtops to the T200 Series handhelds. Instruments numbered 5000 and above are designated as benchtop scopes. Portable scopes are numbered 2400 and below.

Selection Checklist

- ❑ **Step 1:** Characterize Your Signal
- ❑ **Step 2:** Identify Basic Requirements
- ❑ **Step 3:** Determine the Appropriate Scope Technology
- ❑ **Step 4:** Select a Scope Based On Appropriate Specs and Features
- ❑ **Step 5:** Select A Probe

STEP 1:

SIGNAL CHARACTERISTICS

Each type of signal imposes a different set of requirements for optimal signal capture. Therefore, the most critical step of the selection process is to describe and understand certain basic characteristics of the signal you expect to see.

Signal Characteristics Checklist

- Repetition Rate
  - ❑ Single Shot
  - ❑ Repetitive
- Frequency
  - ❑ _____
- Rise Time
  - ❑ _____
- Vertical Requirements

  Min. Voltage Resolution:
  - ❑ _____

  Max. Voltage Signal:
  - ❑ _____
- Dynamic Range
  - ❑ _____
- DC Offset
  - ❑ _____
- Horizontal Requirements

  Max. Time Window:
  - ❑ _____

  Min. Time Resolution:
  - ❑ _____

Signal Characteristics	Selection Considerations
What is your signal's repetition rate?	**Repetition Rate –** *Is your signal a one-time, single-shot event, like lightning, or ESD? Or, does your signal have a low rep rate, like laser pulses?* A fast waveform update rate and high visual writing rate are required to capture single-shot and low repetition rate events. Tektronix instruments offer the fastest update and visual writing rates available. *Or, is your signal a highly repetitive signal, such as a carrier signal, a digital clock signal, or a repeating sequence of events?* When dealing with repetitive signals, be careful not to assume that there is no other information present. Repetitive signals can be a mixture of a periodic component and low-repetition rate aberrations – such as glitches, metastability, power supply coupling, or cross talk. Tektronix instruments provide a number of methods of glitch capture – peak detection in the 2200 Series, peak detection and envelope mode in the 2400 Series, and time-qualified triggering in the DSA 600 Series.
What are your signal's frequency and rise time characteristics?	**Frequency and Rise Time –** *What is the highest frequency component of interest to you? Or, what is the fastest risetime you want to capture?* Characterize your signal in either of these terms using the following approximation: Bandwidth ≈ 0.35/Rise Time
What is the smallest increment of voltage you need to discern from your signal?	**Vertical Requirements –** *What is the smallest change in voltage that you will need to see?* You may be interested in signal noise as low as 1 mV, or possibly signal ripple as low as 50 mV – By defining the smallest voltage you need to discern, you will be able to determine the vertical sensitivity and resolution you'll need from your scope.
What is the largest voltage swing of your signal?	**Dynamic Range –** *Is your signal zero to 50 volts? Or just zero to five volts?* This will determine the dynamic range that your scope will need.
How far is your signal from ground?	**DC Offset –** Be sure that the scope you select can handle the offset you expect to see. Dynamic range and offset capabilities are critical to making accurate measurements. Tektronix scopes offer several times the dynamic and offset range of competitive scopes.
What are your signal's timing requirements?	**Horizontal Requirements –** When considering your horizontal requirements you'll want to know the largest time window you need to view, and the smallest increment of time you need to view it in. This is the timing resolution you'll need. If you want to use a digital scope, the timing resolution divided by the time window will determine the record length of your scope.

Basic Requirements	Selection Considerations
How accurate do your measurements need to be?	**Overall Accuracy –** *In the most general terms, how accurate do your measurements need to be? Do you just need to see that the signal is there? Or, do you need to make very precise waveform measurements?* Tektronix has consistently developed the most accurate instruments since 1946.
How many signals do you need to acquire simultaneously?	**Number of Signals –** *Do you need to examine more than one signal on-screen at once?* Multiple inputs provide a convenient method of comparing events, whether on our handheld, dual channel 222; portable, four channels 2247A; benchtop, twelve channel; the 11801 with expansion option to 136 channels; or the Digitizing Camera MUX16 option with 256 channels.
What are your storage requirements?	**Signal Storage Requirements –** *Do you just need to view the data, as is often the case with repetitive signals? Do you need to hold the trace on-screen – often true of single shot and low repetition-rate events? Or do you need to capture the data in digital form for measurement, waveform processing, or hard copy output?* Traditional non-storage analog scope capabilities may meet your requirements quite effectively and economically. However, many measurements require, or can benefit from, the unique advantages of digital storage. When signals are especially slow, for example, or when you need to see pretrigger data, a digital storage scope may be the answer. Documenting a waveform, or comparing it to a stored version for pass/fail testing also calls for digital storage.
What are your transportability requirements?	**Transportability –** Tektronix portable instruments fit into almost any test and measurement environment – large and small businesses; educational and research facilities; design departments; manufacturing assembly lines; field service operations; and, repair depots. From handheld to rackmount, or mobile cart stations, such as the K212 cart , Tektronix fits your transportability needs.
What are your packaging and environmental constraints?	**Packaging and Environmental –** In some applications, a scope's packaging can be as important as its performance. Field applications require that an instrument be lightweight, rugged and able to withstand environmental extremes. Some laboratory environments, such as laser labs, require EMI shielding of both portable and benchtop scopes in order to meet electromagnetic compatibility (EMC) standards.

STEP 2:

BASIC REQUIREMENTS

After determining your signal characteristics and basic requirements, you can begin to qualify which instrument best fits your particular application. From overalll accuracy to environmental requirements, Tek has an instrument to meet your needs.

Basic Requirements Checklist

- ■ Accuracy
  - ❑ Basic
  - ❑ Precise
- ■ Number of signals
  - ❑ _____
- ■ Signal Storage Requirements
  - ❑ Basic
  - ❑ Hold Trace On-Screen
  - ❑ Digitally Capture
- ■ Transportability
  - ❑ Handheld
  - ❑ Benchtop
  - ❑ Cart
  - ❑ Racks/Rackmounts
- ■ Packaging and Environmental
  - ❑ Lightweight
  - ❑ Rugged
  - ❑ Withstand Environmental Extremes
  - ❑ EMI Shielding

STEP 3:

CHOOSING THE APPROPRIATE SCOPE TECHNOLOGY

Many of today's modern scopes are not simply analog or digital, but offer the benefits of both technologies. Because each application imposes a different set of requirements, Tektronix has developed more techniques than any other vendor for solving your measurement needs.

Once you have identified the fundamental characteristics of your signal and know your basic performance requirements, you can use the chart on page 33 as a guide to selecting the scope technology, or combination of technologies, that best fits your application.

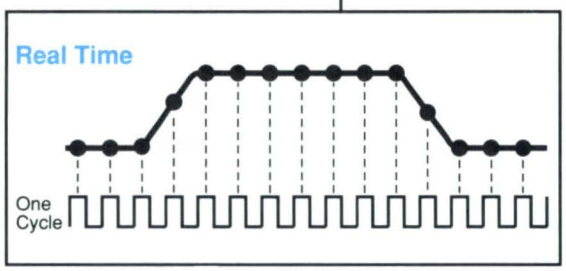


Figure 1. Real-time sampling captures a complete waveform with a single trigger event.

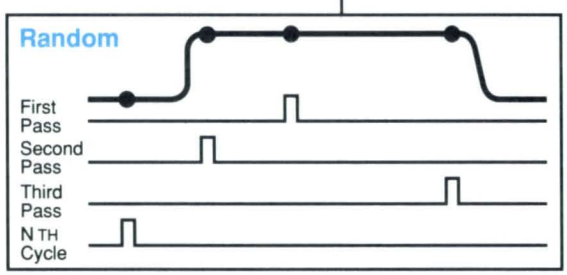


Figure 2. Random-equivalent time sampling digitally reconstructs a waveform using several trigger events.

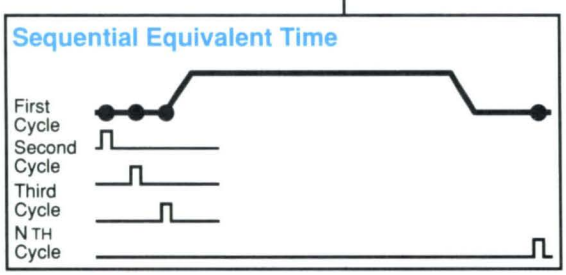


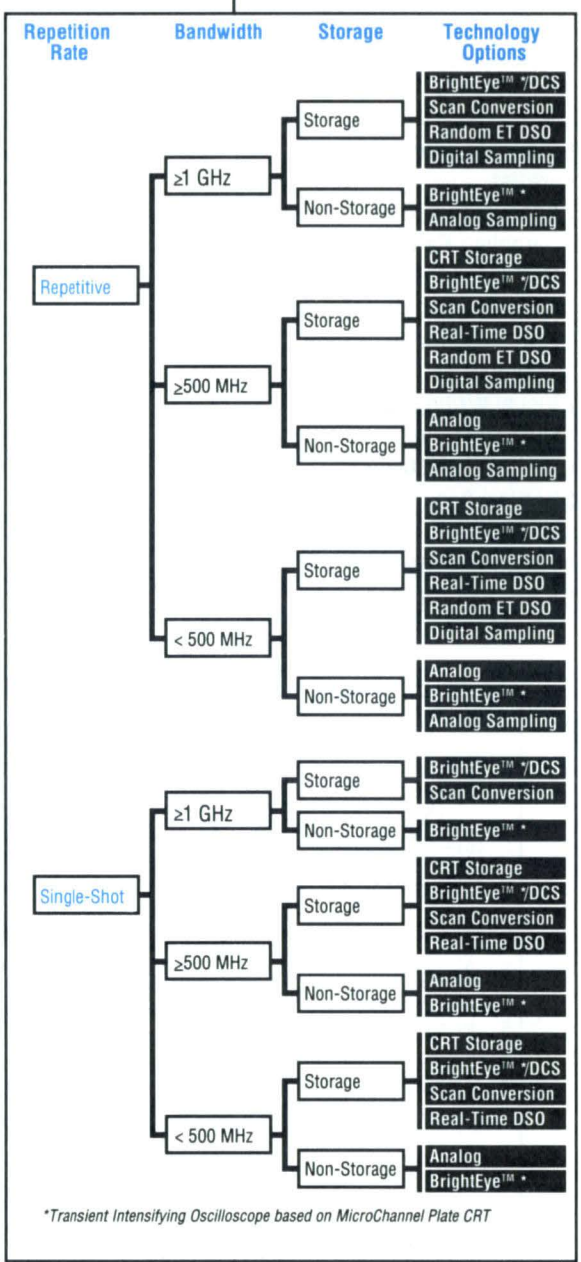
Figure 3. Sequential sampling digitally reconstructs a waveform at a rate of one point per trigger event.

Technology	Description
Real-Time DSO	In real-time digital scopes the digitizer samples the entire input waveform in one pass – with a single trigger. It's called "real time" because acquisition and display always occurs in the same time frame (Figure 1). This makes real time digital scopes – such as the 1 GHz, 2 GS/s DSA 602 Digitizing Signal Analyzers – ideal for single-shot applications. Some real-time instruments, like the DSA 600 Series, also include random equivalent time sampling capabilities, at faster sweep speeds, for capturing repetitive signals.
Random Equivalent Time DSO	Equivalent time sampling takes advantage of the nature of a truly repetitive signal, which gives you a virtually limitless number of repetitions that can be sampled. In random equivalent time sampling, several samples are taken for each trigger, over a large number of trigger events. The samples are random with respect to the trigger – hence the term "random" equivalent time – but equally spaced for any given pass (Figure 2). Sampling occurs on both sides of the trigger point, so you have very flexible pretrigger capability. And because you're sampling repetitive signals, the bandwidth of the random equivalent time scope can far exceed its sample rate. The 2221 portable scope has a maximum sample rate of 20 MS/s, but a repetitive signal bandwidth of 100 MHz.
Analog & Digital Sequential Sampling	As with random equivalent time, a repetitive signal is required for sequential sampling. The difference is that only one sample is acquired for each trigger – at some constant delay after the trigger. For each subsequent sample, the trigger-to-sample interval is increased by a fixed time. This fixed time interval can be made as small as femtoseconds – providing phenomenal timing resolution (Figure 3). In sequential equivalent time sampling instruments, the input is sampled prior to any attenuation or amplification. This permits very high bandwidth signal acquisitions – as in the 7000 Series analog sequential sampling scopes, which offer bandwidths to 14 GHz; or the 20 GHz, CSA 803 and 11800 Series instruments.
Scan Conversion	In monolithic scan conversion, an analog and a digitizing system are built into the same package – for example, our 6 GHz 7250 Transient Digitizing Oscilloscope and 750 MHz 7912HB Programmable Digitizer.

Whether you choose analog or digital technologies, each have benefits and tradeoffs. Analog scopes display the actual signal, letting you see the waveform's shape directly – as it occurs.

Digital scopes offer a digitally-derived representation of the signal, allowing flexible pretrigger and long record lengths; along with all the waveform processing, automeasure, and hard copy capabilities of digital storage.

Technology	Description
Analog	One of the major advantages of all analog scopes is that they provide a direct representation of your signal, and the fastest update rate possible. Even the most basic analog scopes provide extremely fast update rates, because only a beam retrace and trigger rearm are required between sweeps. This happens thousands of times faster than transferring data in and out of memory, as required by digital technology. Consequently, analog scopes provide a much higher probability of capturing the events you want to see than any other technology.
CRT Storage	CRT storage oscilloscopes have the ability to store events on the face of the screen itself. And, because the writing rate is faster than with basic analog, CRT storage is ideal for capturing fast transient events. It's an excellent choice for viewing slowly changing signals, too. Tektronix offers both variable persistence and bistable CRT storage scopes in the 7000 and 5000 Series.
BrightEye ™	Tektronix's proprietary microchannel plate (MCP), transient-intensifying analog scopes – such as the portable 2467B, the 500 MHz 11302A, or the 1 GHz 7104 – are superb for viewing all signal types at all sweep speeds and at all repetition rates. You get the fast update rate of basic analog and the highest writing rate available (6 cm/ns with the 11302A; 4 cm/ns with the 2467B and the 7104). With such fast writing rates, single-shot events can be captured up to each scope's full bandwidth on an extremely sharp display.
BrightEye ™/DCS	The CCD-based DCS02 digitizing camera system, mounted on the front of a BrightEye™ analog scope , utilizes scan conversion technology to provide both analog and digital technologies. A signal can be written very fast on an microchannel plate (MCP) CRT, and then scanned and digitized by the CCD camera at a much slower rate. The result is very high vertical resolution, high oversampling, plus the automatic measurements, waveform processing, and hard copy features made possible with digital storage.



*Transient Intensifying Oscilloscope based on MicroChannel Plate CRT

Combining Technologies

Many Tektronix oscilloscopes use a combination of the technologies described above. One example is Tek's low-cost 2200 Series which combines **Analog PLUS Digital** technologies. You benefit from simplified setup in analog mode PLUS Tek's powerful digital mode gives you a visible edge in measurement confidence.

STEP 4:

SELECT A SCOPE BASED ON SPECS AND FEATURES

Now you're ready to evaluate individual scopes based on how well their specifications and features fit your application. This section will help you relate your signal characteristics from Step 1 to specifications and features used to describe oscilloscopes.

Specs and Features Checklist

- ❑ Bandwidth & Rise Time
- ❑ Sampling Rate
- ❑ Horizontal Resolution & Record Length
- ❑ Horizontal Magnification
- ❑ Update Rate
- ❑ Visual Writing Rate
- ❑ Dual Time Base
- ❑ Vertical Sensitivity
- ❑ Vertical Accuracy and Resolution
- ❑ Triggering Capabilities
- ❑ Pretrigger Viewing

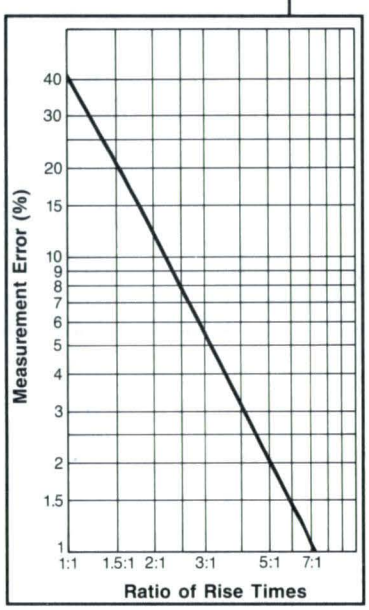


Figure 4. Relates the % Error incurred given the ratio of the signal's rise time to the instrument's rise time.

Key Specifications & Features	Selection Considerations
Bandwidth & Rise Time	These are the key characteristics to consider when choosing any oscilloscope, or probe. Appropriate ratings ensure that your scope will accurately reproduce the range and type of signals you measure with the accuracy you need. The chart below describes the relationship between your signal bandwidth and the desired bandwidth of your oscilloscope. For example, if you have a 100 MHz signal and are using a 100 MHz oscilloscope [or any such combination producing a 1:1 ratio] the resultant displayed waveform will have 40% error (see Figure 4). As a rule, select a scope with a bandwidth three to five times greater than the highest frequency you expect to measure. A 5:1 ratio gives you a rise time measurement with less than 2% error.
Sampling Rate	When choosing a digital scope you must consider both the necessary bandwidth, as described above, and the appropriate sample rate. For single-shot acquisition, your signal must be sampled at greater than twice the frequency of its highest frequency component. While for repetitive signals a much lower sample rate can be used. So, for digital scopes there are two critical specifications. Bandwidth is related to the scopes analog front end and is specified in hertz. And, sample rate, which is related to the digitizing process and is specified in samples per second.
Horizontal Resolution & Record Length	These two specifications are important when choosing digital instruments. A contribution to horizontal resolution is the number of points that can be displayed on screen — the more points, the better the resolution. Record length can be expressed as time window divided by time resolution. Many Tektronix digital instruments offer selectable record lengths. The DSA 600 Series Digitizing Signal Analyzers, for example, provides user-selectable record lengths from 512 to 32,000 points.
Horizontal Magnification	Many instruments offer some means of horizontally magnifying waveforms on the screen, a useful feature when you want to see details that occur very close together. For example, the 11000 Series digital instruments include pan and zoom features that let you see the details of your signal.
Update Rate	The rate at which a scope will get ready for a triggered event after an acquisition is complete. Analog scopes provide extremely fast update rates, because only a beam retrace and trigger rearm are required. This happens thousands of times faster than transferring data in to and out of memory, as required in digitizing instruments. Advanced Tek digital instruments such as the DSA 600 Series, however, update the display so fast that they have the look and feel of real time analog systems.
Visual Writing Rate	The amount of time required to sweep a beam across the screen – the visual writing rate – varies widely among manufacturers. Be sure that the analog scope you select has the writing rate necessary to capture the signal you want to see.
Dual Time Base	When a scope is equipped with delayed sweep, you can make more accurate timing measurements. Tektronix offers delayed sweep in dual time base instruments like the 11000, 2400 and 2200 Series. These instruments provide all of the measurement capabilities of single time base instruments plus convenient comparisons of a portion of a signal at two different sweep speeds, jitter-free triggering of delayed sweeps, and timing measurement accuracy of 1.0% or better.

Key Specifications & Features	Selection Considerations
Vertical Sensitivity	It's important that the scope you choose has sufficient volts/div range to display the signals you measure, large or small. But be aware that sensitivity and bandwidth can be trade-offs. Higher bandwidth lets you capture high frequency signals, and sometimes unwanted high frequency noise. That's why many higher-sensitivity scopes provide bandwidth-limiting controls for showing cleaner low-level signals at moderate frequencies.
Vertical Accuracy & Vertical Resolution	Accuracy, resolution and the difference between the two are important concepts to understand, especially when you are selecting a digital scope. Accuracy and resolution are not synonymous. Resolution determines your ability to see fine detail or small changes in measurements, while accuracy indicates the degree to which your measurement conforms to a true and accepted standard value. Resolution will greatly impact the accuracy of your acquisitions. Generally, settling for less than 8 bits of resolution is not advisable , while more than 10 bits is probably overkill if the instrument's accuracy is 1% (see Figure 5). All Tektronix digital instruments have a minimum of 8 bits of resolution.
Triggering Capability	The triggering flexibility you choose can make your job substantially easier and enhance your measurement confidence. Tektronix instruments offer a number of triggering features that fit a wide range of applications. These include: ***Auto level triggering*** for virtually "hands-off" triggering. ***Peak-to-peak auto triggering*** for quick, convenient triggering with automatic level limits. ***Vertical mode triggering*** for simultaneous, stable viewing of two or more signals unrelated in time. ***Single-sweep operation*** for applications such as baby-sitting a transient pulse and for CRT photography. ***Television (video) triggering*** for triggering on either TV lines or fields at any sweep speed. ***High and low frequency reject coupling*** for stable triggering on noisy signals. ***Boolean triggering,*** offered on the most advanced instruments, for qualifying a trigger based on user selected levels of two independent trigger circuits. ***Time, level, and event qualified triggering*** for capturing any signal that is too high, too low, too wide, too narrow, too soon, too late, missing, or extra.
Pretrigger Viewing	Pretrigger viewing is standard to most Tektronix digital scopes; however the amount of time viewed before the trigger may vary and could be important in your application. In most cases, at least 1/8, 1/2, or 7/8 of a record can be displayed prior to the trigger point. Tektronix offers instruments that can vary the trigger point throughout the entire record.

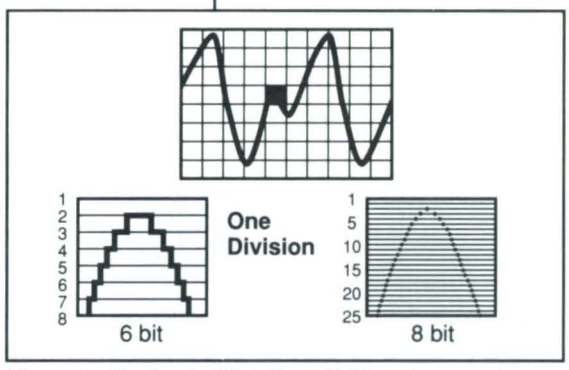


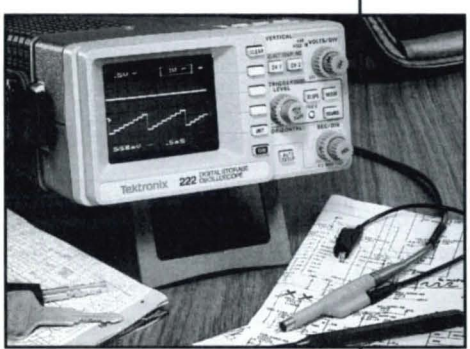
Figure 5. The level of detail available using a scope with 6-bit resolution is shown in the close-up on the left. By comparison, a scope with 8-bit resolution lets you see more waveform details (right).

STEP 4 CONTINUED:

SELECT A SCOPE BASED ON SPECS AND FEATURES

Specs and Features Checklist Continued

- ❑ Glitch Capture
- ❑ Automatic Setup
- ❑ Store/Recall
- ❑ On-Board Counter-Timer/ DMM
- ❑ On-Board Waveform Processing



Key Specifications & Features	Selection Considerations
Glitch Capture	Glitches by nature are random events which are short and fast relative to the signal you need to see. The sampling nature of digital scopes makes it possible to miss glitches between samples. Glitch capture functions in Tektronix portable and benchtop instruments ensure that instabilities and transients don't escape your notice.
Automatic Setup	With an automatic setup feature, a single button can control the entire front panel and optimize settings to acquire and display a signal. Tektronix instruments with this feature automatically calculate and set the proper sweep speed, vertical deflection, trigger level, position, and intensity required to produce a useable on-screen display. Automatic setup is especially useful for troubleshooting – you don't need to readjust front-panel controls for every acquisition.
Store/Recall	For applications requiring repetitive or pre-established measurements, some Tektronix scopes provide a Store/Recall feature that lets you save front-panel setups for later recall. For example, you can avoid resetting front-panel controls every time you measure a test routine that is performed repeatedly throughout the day.
On-Board Counter-Timer/DMM	Some scopes feature a counter-timer integrated into their vertical, horizontal, and triggering systems. A digital voltmeter or multimeter (DVM or DMM) may also be built-in. Integrated counter-timers, as in the 11302A, 2400 Series, and 2247A let you make measurements such as frequency, period, width, rise/fall time and propagation delay at the touch of a button, while viewing the signal you are measuring.
On-Board Waveform Calculations	Some scopes provide on-board waveform processing capabilities that allow sophisticated waveform calculations. The waveform calculations included with the 11000 Series digital instruments, for example, include differentiation, integration, interpolation, smoothing, averaging, envelope, square root, and logarithm. The 2400 Series Digitizing Oscilloscopes provide envelope mode, signal averaging, and standard waveform math. The new DSA 600 Series Digitizing Signal Analyzers also includes dejitter, fast Fourier transform, and Act on Delta functions. On-board processing capability reduces the need for external processing, and allows you to see waveform manipulations in real time.

STEP 5:

SELECTING A PROBE

Probe Requirements Checklist

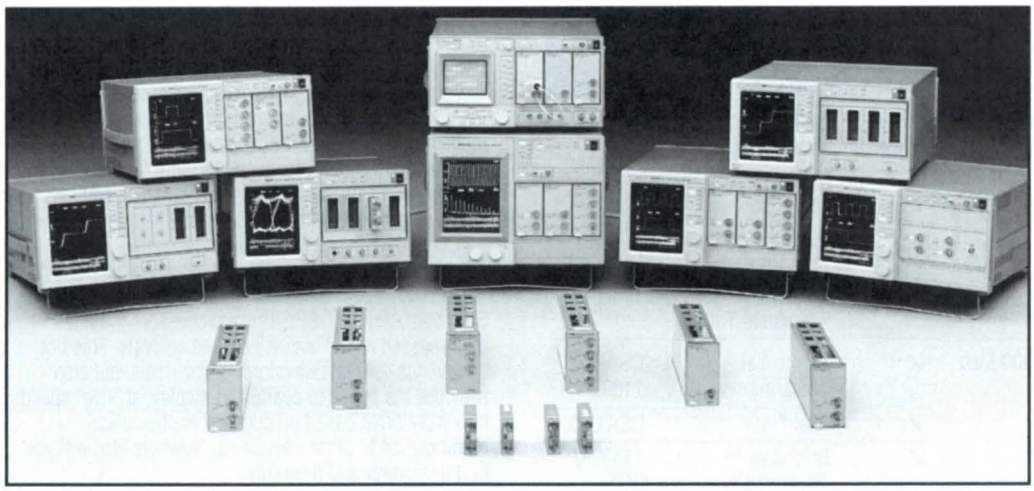
- ■ **Probe Type**
  - ❑ High Impedance
  - ❑ Low-Loading FET
  - ❑ High Voltage
  - ❑ Current
  - ❑ Differential
  - ❑ Others Available

Your probe is the critical path to your scope. It's not just a wire - it's a transmission line. Its purpose is to pass all the frequency components of the signal to the scope.

When a probe touches a circuit it becomes a part of that circuit, and the effects of its loading capacitance and resistance must be taken into account. Using the right probe is just as important as using the right scope for the job. A probe that is not designed to meet the requirements of your application can erode signal fidelity at the probe tip and negate your investment in high-performance signal acquisition instrumentation.

Furthermore, improperly compensated probes can distort the waveforms you see on the screen of your scope. Failing to compensate your probe to its input channel can cause up to 85 percent error in measurements.

Tektronix offers the most complete line of high-performance probes available, including: high-impedance, low-loading FET probes, high-voltage probes, current probes, and differential probes. Optional probe cable lengths allow you to easily reach the DUT from your measurement instrument.

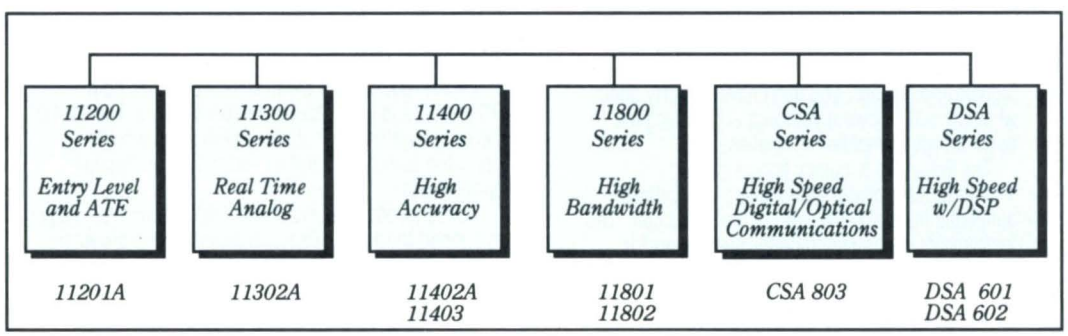


11000 SERIES

The Tektronix 11000-Series is a new generation 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, high sensitivity, bandwidth, filtering, 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-232-C or GPIB interfaces.

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.

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



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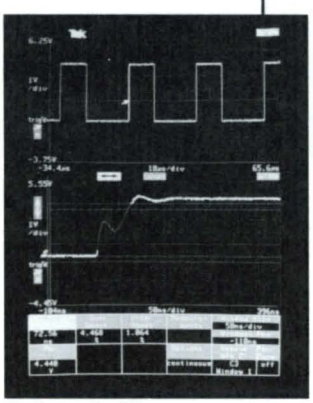
Signal Characteristics vs Oscilloscope/ CSA/DSA Technology

Signal Type to Measure	Bandwidth	Storage Capability	Instrument Technology	Instrument(s)
Repetitive	≥ 1 GHz	✓	Sequential Sampling	CSA 803, 11800
		✓	Real Time	DSA 600
		✓	Random Equivalent Time	11400
	≤ 500 MHz	✓	Sequential Sampling	CSA 803, 11800
		✓	Real Time	DSA 600
		✓	BrightEye ™ Analog/DCS	11302A/ DCS
		✓	Random Equivalent Time	11400, 11201A
			BrightEye ™ Analog	11302A
Single-Shot	≥ 1 GHz	✓	Real Time	DSA 600
	≤ 500 MHz	✓	Real Time	DSA 600
		✓	BrightEye ™ Analog/DCS	11302A/ DCS
			Brighteye ™ Analog	11302A



Automatic Measurements using the 11403 Digitizing Oscilloscope.

ACCURACY

Measurement accuracy sets the 11000 Series apart from all other oscilloscopes. The analog front end 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.

FLEXIBILITY AND POWER

The 11000 Series continues the plug-in versatility of the Tektronix 7000 Series. Five plug-in amplifiers, six 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) 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 11000-Series architecture uses three 16-bit microprocessors and additional processors as needed.

The DSA 600 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 803 offers histograms and mask testing to specifically perform the measurements on signals that are typical in communication applications. Histograms are powerful measurement tools for measuring jitter and noise. Mask testing is a very beneficial tool in ATE applications for measuring noise margin and jitter tolerance.

DIGITAL SIGNAL PROCESSING

The 11000 Series provides capability far beyond the basic four math functions of +, −, ×, 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 600 Series with its TriStar Digital Signal Processor provides 14 different options; including averaging at 180 waveforms per second, signal dejitter, real-time 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-232-C and IEEE Standard 488 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 printers, Centronics printers, HP Inkjet/Laserjet printers, or HPGL plotters.

Hard copy support for the 11302A is provided by the Digitizing Camera Systems (DCS).

11000 SERIES SELECTION GUIDE

Instrument	Bandwidth	Maximum # of Channels	Sample Rate	Maximum Record Length	Vertical Resolution	Technology
DSA 601	1 GHz	12	1 GS/s	20 K	8 bits	Real Time
DSA 602	1 GHz	12	2 GS/s	32 K	8 Bits	Real Time
CSA 803, 11802	20 GHz	4	200 KS/s	5 K	8 bits	Sequential Equivalent Time
11801	20 GHz	136	200 KS/s	5 K	8 bits	Sequential Equivalent Time
11400	1 GHz	12	20 MS/s	10 K	10 bits	Random Equivalent Time
11302A	500 MHz	8	100 GS/s w/DCS	512 w/DCS	8 bits w/DCS	BrightEye Analog
11201A	400 MHz	4	20 MS/s	10 K	9 bits	Random Equivalent Time

MEASUREMENT SYSTEM

No measurement system on any other oscilloscope compares with the power and flexibility of the 11000 Series. Key capabilities offered by these oscilloscopes are:

- Up to 28 pre-defined measurements are available
- Up to six measurements can be displayed simultaneously and updated continuously
- Six different measurements can be defined for each waveform
- The measurement region can be specified
- Measurement annotation shows where the measurement is being made
- Measurement tracking follows topline and baseline as the signal changes
- Measurement statistics provide a powerful analysis tool

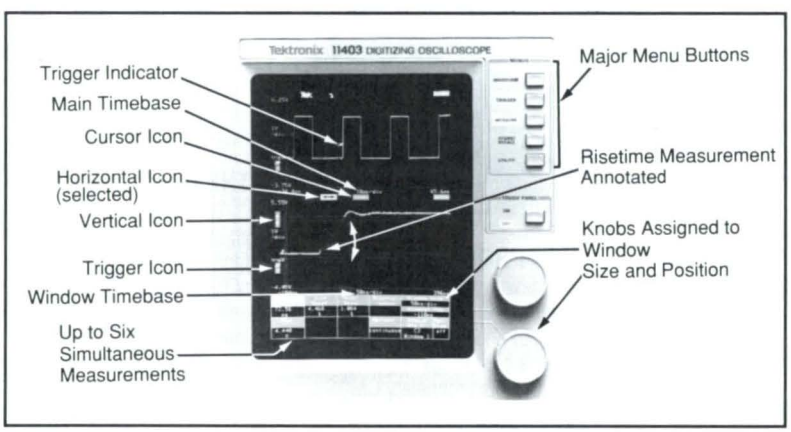
Four cursor modes provide the most flexible method of measuring ΔV and Δt. In addition to horizontal and vertical bar cursors, the 11000 Series offers dot and split dot cursors which track one or two waveforms.

A TOUCH OF POWER

Large displays, touch screen control, pop-up menus, and built-in intelligence combine to make operating the 11000 Series simple. Menu options are limited to two levels, so that you can perform any operation with a minimum of touches. And, similar operations are grouped together.

Operators of the 11000 Series need not be conversant with traditional oscilloscopes, and their myriad of knobs and buttons, to quickly learn and become productive with the 11000-Series instruments. Often, achieving a stable display of a signal simply means connecting the probe and touching the Autoset button.

Basic oscilloscope operations which are often used (vertical size and position, horizontal size and position, trigger level and holdoff, and dual time base control) are available as icons on the screen. Touching one of these icons assigns the knobs to those functions. Since vertical size and position controls are normally used together, they are both available at the same time using the two front-panel knobs. So, there is no need to continually select a button to redefine a knob between vertical size and position, as is the case with a single-knob instrument.



Powerful measurement functions of the 11000 Series.

A Technology for Every Application

DSA 600 Series

- Providing real-time digitizing at 2Gs/s, the Digitizing Signal Analyzers are the newest and most powerful members of the 11000 Series. These instruments contain a dedicated digital signal processor that processes waveforms at unprecedented speeds.
- The DSA offers real-time 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 803

- The CSA 803 Communications Signal Analyzer uses sequential sampling for viewing communication signals up to 20 GHz.
- Histogram, mask testing, and a color graded display are included to form an ideal tool for analyzing eye diagrams.

11800 Series

- The 11800-Series uses Sequential Equivalent-Time sampling technology to achieve bandwidths of up to 20 GHz. Sampling head modularity provides a variety of acquisition methods including TDR, optical coupling, loopthrough sampling, low-noise sampling, and triggering.
- Up to 136 channels of acquisition and TDR measurements can be achieved with an 11801. The 11800 Series provides the highest timing resolution and measurement repeatability of any of the 11000 Series.

11400 Series/11201A

- The 11400-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.
- The high update rate of the 11400 Series provides the throughput needed for challenging ATE applications. Continuously updated measurements and statistics provide the confidence required in automated test environments.

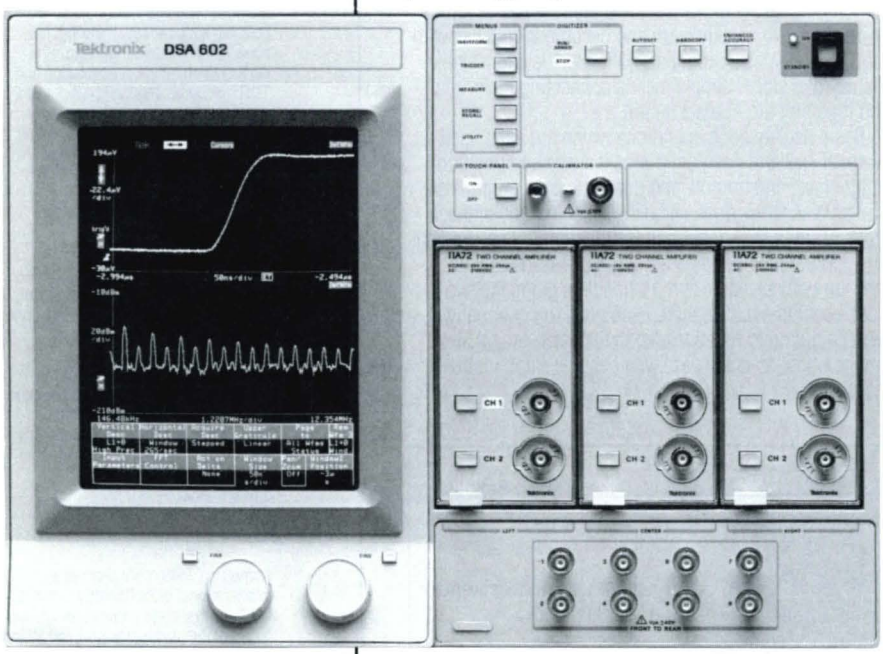
11302A

- Combining Tektronix's proprietary micro-channel plate BrightEye™/MPC CRT, the fast update rate of an analog oscilloscope, and an integral 750 MHz, 10-digit counter-timer, the 500 MHz 11302A lets you see otherwise invisible events and measure otherwise unknown quantities — proving again how indispensable analog technology remains for many applications.

NEW
DSA 601/DSA 602

Digitizing Signal Analyzers contain powerful internal digital signal processors that can process digitized signals up to 180 times per second.

- *2-GSamples/s Sampling Rate*
- *8-Bit Vertical Resolution*
- *1% Vertical Accuracy at the Probe Tip*
- *1-GHz System Bandwidth*
- *12 Channels of Acquisition, Display of 8 Waveforms*
- *Up to 4 Channels of Concurrent Single-Shot Capability*
- *Time, Event, Level, and Boolean Qualified Triggering*
- *2-ns Glitch Capture*



GPIB IEEE-488 *

** The DSA 601/DSA 602 comply with IEEE Standard 488.1-1987, RS-232C and Tektronix Standard Codes and Formats.*

DSA 601/DSA 602 DIGITIZING SIGNAL ANALYZERS

With standard waveform acquisition features such as a sampling rate of up to 2 GS/s, a bandwidth of 1 GHz, and record lengths selectable up to 32K points, the DSA 601 and DSA 602 Digitizing Signal Analyzers surpass any other digitizing acquisition system available. Add to this a multiple-microprocessor control platform and a dedicated TriStar Digital Signal Processor (DSP) and you get waveform processing and analysis capabilities in real time, that previously required "offline" processing by an external computer.

Equipped with three plug-in compartments and true dual time bases, the DSA 600 Series can acquire signals from up to 12 input channels – any combination of these 12 channels can display 8 waveforms on-screen simultaneously. In addition, true dual time bases permit simultaneous, single-shot capture and display of a main record and up to two window records for each channel. The eight-color display eases comparison of waveforms and parameters in the main and window areas.

Selectable triggering capabilities of the DSA 600 Series include basic and extended triggering functions. In the DSA 600 Series, basic triggering simply initiates main and window record acquisition. Extended triggering functions include time, event, level, and Boolean qualified triggering.

ADVANCED WAVEFORM PROCESSING

The dedicated TriStar DSP provides waveform capture, processing, and analysis features that place the DSA 600-Series Digitizing Signal Analyzers in a class of their own. Optimized for analysis of high-speed, single-shot, or repetitive signals, this proprietary CMOS processor makes possible comprehensive waveform analysis features such as real-time integer and floating point math operations, FFT magnitude and phase computations, Act on Delta, and signal dejitter. Advanced waveform calculations such as area and energy; eleven timing measurements, including propagation delay; amplitude measurements, including gain and true RMS; and live updating of waveform parameters are also included as part of the DSA 600-Series processing package.

Dedicated digital signal processing provides acquisition enhancement functions such as averaging and smoothing to selectively remove noise from the display. For example, averaging rates of up to 180 waveforms/second for repetitive integer waveforms and up to 90 waveforms/second for repetitive floating point waveforms are possible.

FFT (FAST FOURIER TRANSFORM)

If you need to examine the frequency spectrum of a waveform, the FFT function provides a means to automatically transform time-domain data into frequency-do-main data for spectral analysis.

Both time-domain and frequency-domain versions of the same signal can be simultaneously displayed "live" on the screen (see Figure 1). The FFT function is available for binary record lengths from 512 to 16K points. The information in the frequency domain can be expanded to provide a closer look at magnitude and phase plots.

ACT ON DELTA (PASS/FAIL TESTING)

The Act on Delta function detects when a user-specified number of points on a selected waveform fall outside the bounds of a reference waveform template, and executes one or more of five user-defined actions when this event occurs. These actions are save, repeat, chime, SRQ over IEEE-488, and hardcopy. The Act on Delta function is automatic, so an operator need not be present to detect and act on an event.

The template waveform may be a displayed or stored-envelope waveform. The stored-envelope waveform may be externally generated with an appropriate software package, such as the Tektronix Template Waveform Processing Program.

DEJITTER

The Dejitter function reduces the effect of time jitter caused by a noisy input signal; or it may be used to stabilize trigger holdoff by time. When used in conjunction with signal averaging, the Dejitter function maintains high frequency components that would otherwise be "averaged away", resulting in a better preserved signal.

THE USER INTERFACE

These comprehensive analysis functions, plus virtually all of the manual controls of the instrument – including plug-ins and probes – are accessible through a minimum of front panel buttons, two user-definable control knobs, and an easy-to-operate, eight-color, touch-screen interface. Operator menus are presented on the screen in an intuitive format that guides you through instrument setup and measurement acquisition. Selections are made by simply touching the designated areas of the CRT.

Control of variable functions, such as vertical sensitivity or position, time base, trigger level, delay time, and cursor position is accomplished with the two control knobs located below the screen. In addition, all information needed to completely configure the DSA 600 Series and perform detailed analysis of waveforms is never more than two menus deep.

CONCURRENT, REAL-TIME ACQUISITION

Two, 8-bit digitizers in *the DSA 601* allow simultaneous, 500 MS/s, single-shot acquisition from two channels; or, you can elect to interleave the digitizers in order to obtain a 1 GS/s sample rate from one channel (see Figure 2 on page 42).

Interleaving can be enabled from the "Horizontal Description" touch-screen menu. When interleaving is active, the input signal path is internally shared between the digitizers. The clock for each digitizer is skewed by one-half the sample rate so that the input signal can be sampled every nanosecond.

The DSA 602 has four, 8-bit digitizers capable of 500-MS/s, simultaneous, single-shot acquisition from four channels; 1 GS/s from two channels; or, with digitizer interleaving enabled, 2 GS/s from one channel (see Figure 2 on page 42).

For each channel being acquired, one main and two window records may be acquired (main and window records in the DSA 600 Series are similar to main sweep and delayed sweep acquisitions in analog oscilloscopes). Window records provide enhanced detail in areas of interest on the main waveform.

1 GHz system bandwidth (available with the 11A72 Plug-in) captures frequency content up to Nyquist. And both mainframes are equipped with an anti-alias filter to prevent the inclusion of high-frequency information into low-frequency data.

RECORD LENGTH

Record length is selectable from 512 to 32,768 points, providing the ability to capture and analyze long, single-shot or repetitive events in detail.

The DSA 600 Series comes standard with more than 230,000 points of volatile memory which is shared between acquired and stored waveforms. Also standard is sufficient non-volatile memory for approximately ten settings.

To make the most of the capabilities of the DSA 600 Series, Option 4C, Non-Volatile RAM, provides more than 450,000 points of storage – enough memory for the most demanding applications. NVRAM stores waveform data when the instrument is turned off.

TRIGGERING

Trigger capability within the instrument is divided into two general categories: basic trigger and extended trigger. (Basic triggering is similar to standard level and slope triggering in analog oscilloscopes.) For basic trigger operation, TRIGA is associated with the main record and is referred to as the main trigger, while TRIGB is associated with the window record(s) and is referred to as the window trigger.

In extended trigger operation each trigger source is compared to its trigger level or threshold, and is

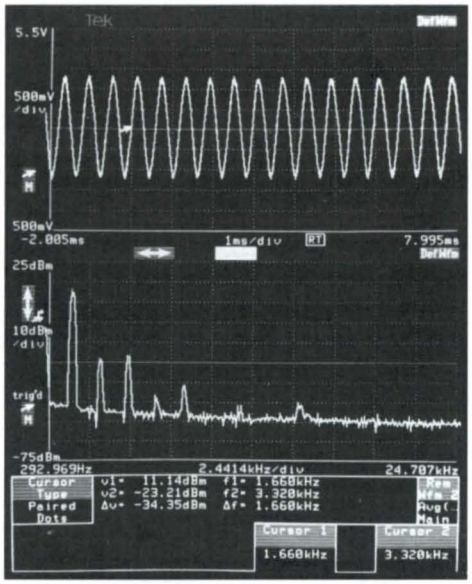


Figure 1. The TriStar Digital Signal Processor allows simultaneous display of "live" frequency-domain data concurrent with the real-time, time-domain signal.

determined to be either a high or low logic level. You may then choose to combine the trigger sources with Boolean algebra, qualify one with a level of the other (LEVEL QUALIFIED), qualify one or both by time (TIME QUALIFIED), or qualify the window by an event count (EVENT TRIGGERED), to form the main and window triggers. These extended trigger operations may be used alone or in combination for added flexibility in defining trigger events.

TIME QUALIFIED TRIGGERING CONFIGURATIONS

Time-Qualified Triggering can be set in one of six possible configurations:

- True Duration < Time Interval
- True Duration > Time Interval
- True Duration Within Time Bracket
- True Duration Outside Time Bracket
- Comparison Timing < Time Interval
- Comparison Timing > Time Interval

Time qualified triggering provides the capability to trigger on and capture glitches as narrow as 2 nanoseconds.

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, video, workbook, board reference, and power plug; and is included in the purchase price of the instrument.

NEW DSA 601/DSA 602

- *Simultaneous Display of Time and Frequency Domains*
- *Live FFT Magnitude and Phase Display*
- *Act on Delta (Pass/Fail Testing)*
- *32K-Point Record Length*
- *Labeling of Waveforms/ Settings*
- *Color Display*
- *Printer/Plotter Support*
- *Fully Programmable via GPIB and RS-232-C*
- *True Differential Capability*

NEW
DSA 601/DSA 602

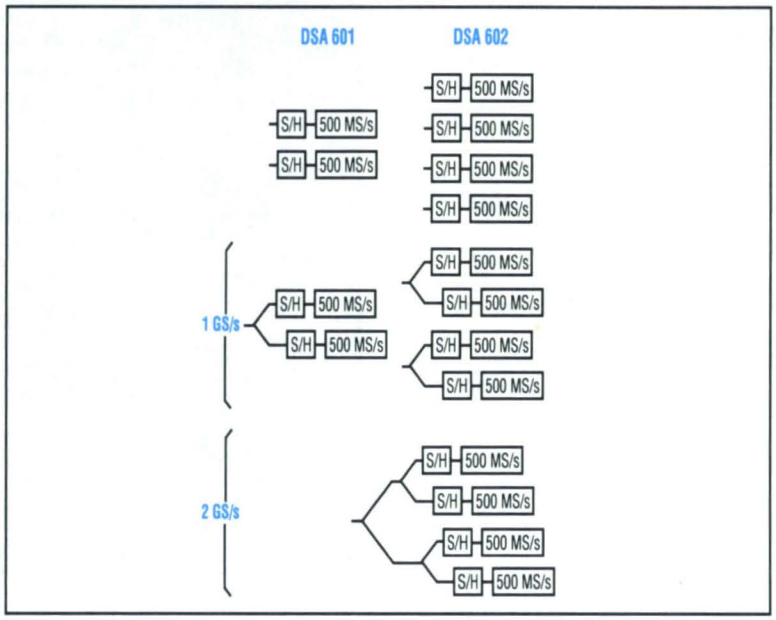


Figure 2. Digitizer interleaving allows for 1 GS/s maximum sample rate in the DSA 601 and 2 GS/s in the DSA 602.

REPETITIVE SINGLE-SHOT ACQUISITION

Repetitive Single-Shot Acquisition lets you automatically capture, store, label, and time and date stamp a waveform; re-arm the trigger; and then repeat this process up to 918 times. *1

Any number of repetitions, from 1 to 918 can be selected, depending on the record length.

The maximum repetition rate is 60 waveforms/s for a 512-point record length. The repetition rate is reduced for longer record lengths and slower sample rates.

Coupled with the DSA 600 Series extended trigger capabilities, the Repetitive Single-Shot Acquisition feature is a powerful tool for selectively capturing anomalous events within repetitive signals. This feature also makes it easy to store acquired waveforms for later examination using the Stored Waveform Scan capability.

STORED WAVEFORM SCAN

Stored Waveform Scan is a feature designed to allow rapid viewing of stored waveforms acquired during Repetitive Single-Shot Acquisition or Act on Delta. This feature lets you scan through a sequence of stored waveforms, recalling them one at a time, and displaying them at a user-selectable rate. The scan rate can be set to any value from 0.1 to 10 waveforms/s using the control knobs on the front panel. It lets you rapidly "flip through" a set of waveforms to see at a glance how the acquisitions change with time.

Stored Waveform Scan simplifies the process of viewing a large set of stored waveforms. It displays the waveforms without requiring the recall and deletion of each one separately. It may also be used to search for particular characteristic waveforms.

COLOR DISPLAY

The DSA 600 Series color display lets you easily distinguish superimposed waveforms and, if desired, adjust the color set to suit your particular needs. You can select up to eight colors from a palette of 4096. The high resolution screen results in a crisp display for viewing comfort. Color-keyed waveform names can be attached to the traces to further enhance waveform clarity and documentation.

*1 *Option 4C is required to obtain the maximum number of waveforms in the Repetitive Single-Shot Acquisition mode.*

Single-Shot Acquisitions —

	DSA 601		DSA 602		
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

CHARACTERISTICS

VERTICAL SYSTEM

Accuracy With Enhanced Accuracy – ≤1% for an 8-division signal.

Vertical Resolution – 8 bits. Resolution can be increased to 14 bits with signal averaging or smoothing.

Equivalent-Time Bandwidth – Determined by the plug-in used. See page 63.

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

HORIZONTAL SYSTEM

Time Bases

Sweep Speeds – 200 ps/div to 100 s/div.

Record duration – 2.04 ns to 1024 s in 1-2-5 sequence.

Time Base Accuracy – +0.005%, -0.015%: 0 to 45°C.

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

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

Main Record Positioning – The main record is positioned with respect to the main trigger point. The maximum pretrigger is the last point in the main record. The maximum post trigger is the first point in the main record.

Windows – 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.

Extended Pan and Zoom – A trace may be magnified to 1 pt/div.

Waveform Memory – More than 230K points of volatile memory shared between acquired and stored waveforms.

Settings Memory – Nonvolatile memory for approximately ten 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 – Differentiate, integrate, interpolate, smooth, average, envelope, square root, logarithm, natural log, absolute value, exponential, signum, and dejitter.

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

FFT – Magnitude and phase; six window functions; noise floor: -60 dB; -70 dB with averaging.

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

MEASUREMENT SYSTEM

Amplitude – Min, max, mid, mean, p-p, gain, and RMS.

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

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

Cursors – Single or dual dots, split or paired mode, horizontal and vertical bars, and measurement-zone delimiters.

CRT AND DISPLAY FEATURES

Standard 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 601: 465 W max; DSA 602: 585 W max.

ENVIRONMENTAL AND SAFETY

Temperature – Operating: 0 to +45°C. Nonoperating: -40 to +75°C

Humidity – Operating and Nonoperating: Up to 95% relative humidity; up to +45°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; CSA Bulletin 556B, Sept. 1973; Tektronix self-certification to comply with IEC 348 recommendations.

NEW DSA 601/DSA 602

ORDERING INFORMATION

DSA 601 Digitizing Signal Analyzer **$21,025**
Includes: Tutorial Manual (070-7249-00); User Reference (070-7250-00); Programmer Ref. (070-7251-00); Command Ref. (070-7252-00); Service Reference (070-7254-00); Sub-miniature Probe Tip-to-BNC Adapter (013-0195-00); Power Cord, U.S., 120 V (161-0066-00).

DSA 602 Digitizing Signal Analyzer **$28,500**
Includes: Same as DSA 601.

INSTRUMENT OPTIONS

Opt.1C – Cable Feedthrough Connectors. **+$200**
Opt.1R – Rackmount **+$300**
Opt.3C – Acquisition Memory External Power Input. Provides plug for external power to acquisition memory. **+$150**
Opt.4C – Non-Volatile RAM. Adds over 450,000 points of nonvolatile storage **+$1,000**
Opt.25 – PEP 301 Instrument/System Controller **+$7,995**
Opt.1P – HC100 Four-Color Plotter **+$965**
Opt.3P – 4693DX Color Image Printer **+$8,995**
See page 67 for additional option information.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1-A5 Available **NC**
See page 488.

WARRANTY-PLUS **SERVICE PLAN OPTIONS**

See page 490.
DSA 601:
Opt.Q0 – On-site Product Installation and Setup **+$475**
Opt.Q1 – 1-Year On-Site Service **+$630**
Opt.Q2 – 2-Year On-Site Service **+$2,315**
Opt.Q3 – 3-Year On-Site Service **+$3,575**
DSA 602:
Opt.Q0 – On-site Product Installation and Setup **+$475**
Opt.Q1 – 1-Year On-Site Service **+$815**
Opt.Q2 – 2-Year On-Site Service **+$2,985**
Opt.Q3 – 3-Year On-Site Service **+$4,610**

ACCESSORIES

Blank Panel – See page 67.
Cables – See page 67.
Hard Copy Units – See page 67.
Recommended Cart – K217S.
Recommended Probes – See page 67.
Recommended Software – See page 67.

PHYSICAL CHARACTERISTICS

	Cabinet		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 601	30.4	67.0	36.3	80.0
DSA 602	32.2	71.0	38.1	84.0
Shipping (Domestic)	43.6	96.0	38.1	84.0

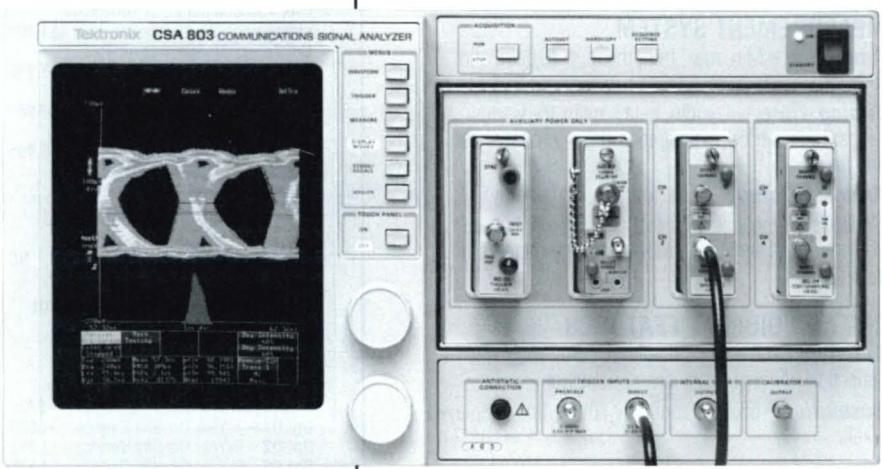
NEW

CSA 803 COMMUNICATIONS SIGNAL ANALYZER

NEW CSA 803

- *Communication Applications*
- *Up to 10-GHz of Built-in Trigger Bandwidth*
- *200-kHz Sample Rate*
- *"Real-Time" Feel*
- *High-Speed Statistical Data Capture*
- *Optical-to-Electrical (O/E) Capability*
- *Automatic Measurements with Statistics*
- *Statistical Analysis (Histograms)*
- *Comprehensive Waveform Processing*
- *Fully Programmable*
- *Mask Testing*
- *Constellation Diagrams*
- *Hardcopy*
- *Color Display*

GPIB* IEEE-488



ORDERING INFORMATION

CSA 803 Communications Signal Analyzer **$23,950**
Includes:
Tutorial manual (070-7718-00);
User Reference (070-7719-00);
Command Reference (070-7720-00);
Programmer Reference (070-7738-00);Service Reference (070-7721-00);
Power Cord, U.S., 120 V (161-0066-00).

See page 47 for additional ordering information.

PHYSICAL CHARACTERISTICS

	Cabinet		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	448	17.6	483	19.0
Height	238	9.4	222	8.8
Depth	599	23.6	550	21.6
Weights ≈	**kg**	**lb**	**kg**	**lb**
Net	22.3	49	23.2	51
Shipping	25.9	57	26.8	59

CSA 803 COMMUNICATIONS SIGNAL ANALYZER

With state-of-the-art technology, histograms, persistence, mask testing, and constellation diagrams, the CSA 803 is specifically designed to meet the needs of the communication industry. The modular architecture of the instrument allows the choice of several sampling heads including a low noise head, O/E converter, and TDR heads. The high sample rate, the highest in the industry for any sampling oscilloscopes, brings a real-time feel to the control and display of waveforms.

TRIGGER BANDWIDTH

The CSA 803 provides a built-in, full function, DC coupled, 2.5-GHz trigger that has slope and level control to provide a versatile, flexible, and stable trigger. It also has a built in, AC coupled, 10-GHz prescaler trigger that divides and randomizes the input signal for a very stable trigger on high speed signals. By using an external delay line, the trigger point can also be viewed.

HISTOGRAMS

Time and Voltage histograms are a powerful statistical tool for measuring noise and jitter in communication signals. The CSA 803 offers both Time and Voltage histograms with a set of useful information such as the mean, RMS deviation, and p-p that are displayed and continuously updated at a user-selectable rate. In addition, the fast sample rate of the CSA 803 (200 kHz) makes the data collection much faster than other instruments.

PERSISTENCE

In addition to the normal persistence mode, the CSA 803 has variable persistence, infinite persistence, and color-graded infinite persistence. While variable persistence is useful to view signals that are "aged" over a finite amount of time (300 ms to 20 s), the infinite and color-graded infinite persistence are useful to accumulate the waveforms indefinitely. Color-graded persistence provides visual feedback on the density of the samples.

MASK TESTING

For ATE applications requiring Pass/Fail testing, the CSA 803 provides mask testing. You can define and edit up to 10 polygons (i.e., masks), each with up to 50 vertices, and count the samples that fall in each of the defined masks. The defined masks can be stored as part of the 10 instrument settings and can be recalled at a later time.

STATISTICAL DATA BASE

256 x 512 x 16 bit data array accumulates data indifinitely. The data is available over the GPIB and can be viewed in the color-graded display mode.

MEASUREMENTS

The CSA 803 provides automatic measurements including; phase, duty cycle, overshoot, and undershoot measurements; along with other measurements such as mean, RMS, rise, fall, frequency, and period. All the measurements are updated continuously and have built-in statistics and compare function.

CHARACTERISTICS

HORIZONTAL SYSTEM

Main and Window Time Base – 1 ps/div to 5 ms/div, settable to 1-2-5 sequence or in 1 ps increments.

Time Base Accuracy *[1] –

Time interval	Accuracy
≥ 10 ns	0.05% x time interval + 10 ps
1 ns	10 ps
100 ps	5 ps
10 ps	2 ps

*[1] *Interpolate linearly between cardinal points.*

TRIGGER SYSTEM

Trigger Bandwidth – 2.5 GHz (direct), 2 to 10 GHz (Prescaled).

Trigger Sensitivity *[2] – Direct: DC coupled, 30 mV p-p, dc -200 MHz; 200 MHz to 2.5 GHz increasing linearly to 250 mV; Prescaled: AC coupled, 600 mV p-p.

Delay Jitter – 4 ps +20 ppm of selected delay (RMS).

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

Trigger Level Range – ±1.0 V (direct)

Trigger Input Range – ±1.5 V (direct), ±2.5 V (Prescaled).

MEASUREMENT SYSTEM

Measurement Set – Max, min, mid, p-p, mean, RMS, overshoot, undershoot, rise, fall, frequency, period, prop delay, cross, width, phase, duty cycle, area +, area -, and energy. Measurements are constantly updated; mean and standard deviations available on all measurements.

The 11800-Series features and characteristics are common to the CSA 803 unless otherwise noted. See pages 45-47 for details.

*[2] *CSA 803 has external trigger only; requires < 40-ns pretrigger or use DL-11 Delay Lines.*

*The CSA 803 complies with IEEE Standard 488.1-1987, RS-232C and Tektronix Standard Codes and Formats

11800 SERIES

The 11800 Series of digital sampling oscilloscopes 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 11800 adds single-ended and differential TDR and TDT, timing resolution to 0.01 picoseconds, and up to 20-GHz bandwidth (depending on the sampling head used). This unmatched performance and feature set makes the 11800 ideal for semiconductor device testing; TDR characterization of circuit boards, IC packages, and cables; and high-speed digital, data-communication measurements.

The 11800 Series includes two mainframes:

- The 11801 accepts up to four, dual-channel SD-Series sampling heads and is expandable to 136 channels of acquisition and TDR using SM-11 Multi-Channel Units.
- The 11802 offers dual, built-in compensated delay lines that display the trigger event. It accepts two, dual-channel SD-Series Sampling Heads.

RESOLUTION AND REPEATABILITY

The state-of-the-art digital time base in the 11800 Series 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 μV/div range and beyond.

FASTEST ACQUISITION

The 11800 Series, with its multiprocessor 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 11800 the "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 11800 Series 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 SD Series of sampling heads currently includes six heads, with more to come.

AUTOMATED MEASUREMENTS MAKE IT EASY

The 11800 Series 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-232-C interfaces.

All 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: 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.

In addition, measurements can be compared to a reference value stored in the 11800. Turning the compare mode on, causes the 11800 to display the difference between a stored reference value and the current measurement results; making comparison measurements simple. For example, the compare function can be used to eliminate cable and fixture delays from propagation delay measurements. You can measure the delay in a cable without even disconnecting it, using TDR with the SD-24.

For large channel count applications where throughput is a prime consideration, dedicated time measurement hardware can be used to make precise timing measurements on many channels in parallel – over 50 measurements per second. This hardware is duplicated for each sampling head in the mainframe and SM-11, providing maximum throughput even in large channel-count applications.

ON-BOARD WAVEFORM PROCESSING

The extensive on-board waveform processing capability of the 11800 Series 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, including the basic operators (+, -, x, ÷), as well as specialized math functions such as square root, differentiate, log, envelope, and filter. Calculations can include acquired waveforms, stored waveforms, and constants, such as attenuation factors.

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 11800 Series 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 particular section of the waveform on a second trace.

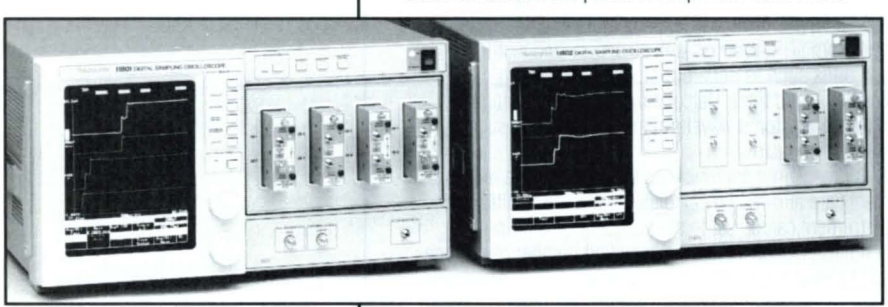
High resolution instruments capable of viewing very fast digital signals.

- *High Resolution and Repeatability*
- *17.5-ps Rise Time*
- *Highest Sample Rate (200-kHz) among Sampling Oscilloscopes*
- *Modularity through Sampling Heads*
- *Powerful, Comprehensive Automatic Measurements with Statistics*
- *TDR/TDT Capability on Every Channel*
- *Dual Time Base allows Multiple Windows*
- *Extensive Waveform Processing*
- *High Resolution Display*
- *Ease of Use*
- *Complete Programmability for ATE Applications (both GPIB and RS-232-C)*

11801/11802

- *DC to 20-GHz Bandwidth*
- *10-femtosecond Equivalent-Time Sampling Interval*
- *Modular Architecture*
- *200 kHz Sampling Rate*
- *"Real-Time" Feel for Waveform Control*
- *TDR and Differential TDR*
- *Optical-to-Electrical (O/E) Capability*
- *Automatic Measurements with Statistics*
- *Comprehensive Waveform Processing*
- *Fully Programmable*
- *Easy to Use*
- *Hardcopy*
- *Internal Trigger Pickoff (11802)*
- *Eight Channels, Expandable to 136 (with an 11801 and SM-11 Multi-Channel Units)*

GPIB* IEEE-488



**The 11800 Series complies with IEEE Standard 488.1-1987, RS-232-C and Tektronix Standard Codes and Formats.*

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 11800 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.

TIME DOMAIN REFLECTOMETRY (TDR)

With the SD-24 Dual-Channel TDR/Sampling Head, the CSA 803/11800 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, differential microstrips, or differential inputs in active devices.

The step generator of the SD-24 also represents state-of-the-art technology, offering unmatched 35-ps reflected risetime (the rise time of a reflection from a short circuit, including the acquisition rise time of 17.5 ps) with the flattest step in the industry. 11800 TDR is also simple to use with one-touch preset functions for both single-ended and differential TDR. There is direct readout of impedance in rho and ohms as well as readout of one-way or two-way distance in meters, feet, or inches.

The 11800 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 11800 displays a live trace that shows the response at that 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.

HARNESSING THE POWER

Virtually all operation of the 11800 is through the touch-sensitive front-panel. A simple two-level menu structure with pop-up menus and two control knobs provide simple interaction with all functions. In addition, common functions, such as volts/division and time/division are always selectable through on-screen icons – so these functions are never buried in menus. The two multi-function knobs allow controlling two related parameters, such as volts/division and offset, for less button pushing.

Autoset provides a convenient, fast method for displaying a signal on the 11800. Just select a channel and press autoset. Usually autoset is complete in less than 2 seconds.

ATE APPLICATIONS

All 11800 functions are completely programmable through the IEEE Standard 488 (GPIB) and RS-232-C interfaces. In addition, up to 10 complete instrument settings may be stored in nonvolatile memory on board for quick recall over the external interfaces or though the front-panel. Documentation is simple using the flexible hardcopy features of the CSA 803/11800. Full screen printouts, including waveforms, measurement results, and time/date stamp can be printed on a variety of devices including dot matrix or laser printers and pen plotters.

SOFTWARE SUPPORT

All the 11000-Series software products are compatible with the 11800, including the advanced i-Pattern™ statistical analysis software, Template Waveform Processing Program, Utility software, and EZ Test II. See page 67 for more information on software for the 11000 Series.

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, video, workbook, board reference, and power plug; and is included in the purchase price of the instrument.

The 11800-Series features and characteristics are common to the CSA 803 unless otherwise noted.

11801 DIGITAL SAMPLING OSCILLOSCOPE

The 11801 has up to eight acquisition channels in the mainframe and expansion capability for up to 136 channels using four SM-11 Multi-Channel Units. This large number of channels allows parallel acquisition for very fast pulse parametric testing of high-speed integrated circuits or for supplementing a functional test system while performing AC parametric testing.

Up to half of the channels can be acquired and measured simultaneously – in a single acquisition cycle. This measurement power is made possible by the multiprocessor architecture used in the 11800 Series.

The highly parallel acquisition and measurement architecture not only eliminates the need for relay multiplexers, which degrade signal quality and system reliability, but it also makes acquisition and measurement of many channels practical in a production ATE environment. Signal acquisition and TDR measurements can be done with a simple command, with no disconnecting and reconnecting of cables or probes required before acquiring data.

In today's high-speed circuits, testing controlled impedances of circuit board runs, removing cable delays from the device under test, and other transmission-line integrity measurements are critical. In addition, multichannel TDR allows crosstalk testing on ribbon cables and circuit boards, as well as high throughput single-ended TDR for traditional cable and connector applications. The 11801 with the SD-24 TDR/Sampling head, moves TDR from the position of an occasional tool to an integral part of your measurement strategy.

11802 DIGITAL SAMPLING OSCILLOSCOPE

For those applications where four channels are sufficient, the 11802 offers a built-in, dual compensated, delay line with trigger pickoff. The delay line allows you to pick off a trigger from the input signal and provides up to 5 ns of pretrigger viewing. This is especially useful in applications involving low repetition rate signals, where it may be impractical to trigger on one event and look at the next repetition of that event.

CHARACTERISTICS (CSA 803/11800)

The 11800-Series characteristics are common to the CSA 803 unless otherwise noted.

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 – ±2V.

*[1] *See Sampling Head Characteristics on page 52. The 11800-Series mainframes have no acquisition bandwidth limits; except when delay lines are used in the 11802. Using delay lines in the 11802 limit bandwidth to 5 GHz and attenuate the signal by 50%.*

HORIZONTAL SYSTEM

Main and Window Time Base – 1 ps/div to 5 ms/div, settable to 1-2-5 sequence or in 1 ps increments.

Time Base Accuracy *[2]

Time interval	Accuracy
≥ 20 ns	0.01% x time interval + 20 ps
1 ns	20 ps
100 ps	10 ps
10 ps	2.5 ps

*[2] *Interpolate linearly between cardinal points.*

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. Window may be set to automatically track a moving edge on the main record.

Maximum Sample Rate – 200 kHz.

TRIGGER SYSTEM (11801 and 11802)

Trigger Bandwidth – 1 GHz.

Trigger Sensitivity *[3] –

DC Coupled: 50 mV p-p, DC to 100 MHz, 150 mV p-p to 800 MHz; increasing to 250 mV at 1 GHz;

AC Coupled: Attenuates signals below 10 kHz, 50 mV p-p from 10 kHz to 100 MHz; 150 mV p-p at 1 GHz.

Delay Jitter – 5 ps +20 ppm of selected delay (RMS).

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

Trigger Level Range – ±1.0 V (±5.0 V with 10X trigger attenuator activated).

*[3] *11801 has external trigger only; requires 50-ns pretrigger or use DL-11 delay lines; 11802 provides internal pretrigger pickoff in both delay lines.*

MEASUREMENT SYSTEM

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

Measurement Set – Max, min, mid, p-p, mean, RMS, rise, fall, frequency, period, prop delay, cross, width, 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

See page 52.

ORDERING INFORMATION

11801 Digital Sampling Oscilloscope **$23,500**
Includes:
Introduction manual (070-7036-01); User Reference (070-7037-01); Programmer Reference (070-7038-01); Pocket Reference (070-7039-01); Service Reference (070-7041-01); Power Cord, U.S., 120 V (016-0066-00).

11802 Digital Sampling Oscilloscope **$22,000**
Includes:
Introduction manual (070-7042-01); User Reference (070-7043-01); Programmer Reference (070-7044-01); Pocket Reference (070-7045-01); Service Reference (070-7047-01). Power Cord, U.S., 120 V (016-0066-00).

INSTRUMENT OPTIONS

Opt. 1R – Rackmount. **+$250**
Opt. 1M – Multi-Channel Conversion (11801 only). **+$1,000**
Opt. 25 – PEP 301 Instrument / System Controller. **+$7,995**
For additional option information see page 67.

WARRANTY-PLUS **SERVICE PLAN OPTIONS**

See page 490.
Opt. Q0 – On-Site Product Installation and Setup **+$440**
Opt. Q1 – 1-Year On-Site Service **+$640**
Opt. Q2 – 2-Year On-Site Service **+$1,915**
Opt. Q3 – 3-Year On-Site Service **+$3,155**

ACCESSORIES

See pages 52 and 383.

PHYSICAL CHARACTERISTICS

Dimensions	Cabinet mm	Cabinet in.	Rackmount mm	Rackmount in.
Width	448	17.6	483	19.0
Height	238	9.4	222	8.8
Depth	599	23.6	550	21.6
Weights ≈	**kg**	**lb**	**kg**	**lb**
11801				
Net	22.3	49	23.2	51
Shipping	25.9	57	26.8	59
11802				
Net	24.1	53	25.0	55
Shipping	27.7	61	28.6	63

NEW SD-20
NEW SD-22
SD-24/SD-26

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

SD-20

- *Loopthrough Sampling Head*
- *Non-Terminated Applications and General-Purpose TDR*

SD-24

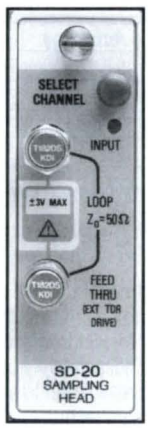
- *TDR/Sampling Head*
- *TDR, True Differential TDR Measurements, and High Bandwidth Sampling Acquisition*

SD-26

- *20-GHz Sampling Head*
- *Dual-Channel Sampling in High Bandwidth Applications*

SD-22

- *12.5-GHz Sampling Head*
- *Low-Noise Digital Communication and Device Characterization Applications*



SD-20 Loopthrough Sampling Head

SD-24 TDR/Sampling Head

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, therefore it can be used in applications where terminating 50 Ω to ground would cause problems in the circuit. It allows in-line signal verification, floating source/termination signal characterization, and general-purpose time domain reflectometry (TDR). The SD-20 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 pulse generator, to tailor the TDR pulse to fit a particular situation. Slower slew rates or higher amplitude may be utilized, for instance; or you may perform half-sine or impulse testing. The SD-20 may be operated as a terminated sampler by installing a precision, 50-Ω termination (included with the sampling head).

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 TDR pulse. The TDR pulse is a fast-rising step that is activated when the SD-24 is in TDR mode. Each TDR pulse is applied to the input signal path for that channel. The acquisition portion of the sampling head is still functional for monitoring the incident pulse and its reflected components. The polarity of each channel's TDR pulse can be selected independently of the other channel. This allows for differential or common-mode testing of two coupled lines, in addition to the independent testing of isolated lines. The *reflected* rise time of the TDR pulse is 35 ps or less.

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 pulse. Both of these sampling heads are useful for very fast logic testing applications (e.g., GaAs and ECL).

SD-22 LOW-NOISE SAMPLING HEAD

The SD-22 is a dual channel, 12.5 GHz sampling head specifically designed for low-noise test and measurement in digital communications, digital design and debug, and high-throughput ATE 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.

Whenever the input signal amplitude is on the order of tens of millivolts, as is characteristic of telecommunications devices, the noise introduced by the test system becomes critical. 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 can meet this criteria, and so it is the ideal instrument for these applications.

SD-20 SD-24 SD-26 SD-22 NEW

NEW SD-20
NEW SD-22

SD-26 20-GHz Sampling Head

SD-22 12.5 GHz Sampling Head

CHARACTERISTICS

Acquisition System – SD-22, SD-24, SD-26: dual channel; SD-20: Single channel.

Rise Time – SD-20, SD-24, SD-26: 17.5 ps, 10% to 90%; SD-22: 28 ps, 10% to 90%

Bandwidth – 20 GHz for the SD-20, SD-24, and SD-26; 12.5 GHz for the SD-22.

Dynamic Range – 1 V p-p within a ±1.6 V range.

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-20 is not terminated and not rated.

Displayed Noise –

With unity dot response:	Maximum	Typical
SD-20,SD-24,SD-26	1.2 mV	750 µV
SD-22	800 µV	450 µV
With smoothing:		
SD-20,SD-24,SD-26	550 µV	350 µV
SD-22	400 µV	180 µV

Aberrations (typical) –

10 ns to 20 ps before step: ±3% or less.
< 300 ps after step: + 10%, -5% or less.
300 ps to 5 ns after step: ±3% or less.
300 ps to 5 ns after step: ±4 or less (SD-20 only).
5 ns to 100 ns after step: ±1% or less.
Elsewhere: ±0.5% or less.

Maximum Input Voltage – ±3 volts.

Isolation Between Channels – 1% p-p voltage transmission from the channel driven by the 067-1338-00, to the quiescent channel (see page 52).

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 Pulse Amplitude – Adjustable to ±250 mV (polarity of either pulse may be inverted).

Time Coincidence Between TDR pulses – 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.
Elsewhere: ±1% or less.

ENVIRONMENTAL AND SAFETY

See page 52.

ORDERING INFORMATION

SD-20 Loopthrough Sampling Head **$3,350**
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/SamplingHead **$5,000**
Includes: Installation/User Reference (070-7052-00); Service Reference (070-7053-00); SMA short-circuit terminations (015-1021-00).

SD-26 Dual Sampling Head **$3,600**
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 **$3,600**
Includes: Same as SD-26.

WARRANTY-PLUS SERVICE PLAN OPTIONS

See page 490.

Opt. Q1 – 1-Year On-Site Service.
SD20 *1
SD24 **+$225**
SD26 **+$158**
SD22 **+$158**

Opt. Q2 – 2-Year On-Site Service.
SD20 *1
SD24 **+$725**
SD26 **+$508**
SD22 **+$508**

Opt. Q3 – 3-Year On-Site Service.
SD20 *1
SD24 **+$1,200**
SD26 **+$840**
SD22 **+$840**

ACCESSORIES

See pages 52, 383.

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

*1 *Contact your local sales representative.*

CSA 803/11800 SERIES SAMPLING HEADS

SD-42

- *Characterizing and Manufacturing of Electro-Optic Devices, Components, and Systems*

SD-51

- *Triggers on Signals Up to 20 GHz*

ORDERING INFORMATION

SD-42 Optical-to-Electrical Converter Head **$3,400**
Includes: See the Opto-Electronics Instruments section, page 370.
SD-51 Trigger Head **$3,000**
Includes:
Installation/User manual (070-7338-00);
Service Reference (070-7339-00);
12" SMA male-to-male (174-1364-00).

ACCESSORIES

2X Attenuator – SMA Male-to-Female (015-1001-00) **$150**
5X Attenuator – SMA Male-to-Female (015-1002-00) **$155**
Power Divider – (015-1014-00) **$280**

For additional accessories, see page 52.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width	25.3	1
Height	75.9	3
Depth	101.2	4
Weight	**kg**	**lb**
Net	0.205	0.69
Shipping (Domestic)	0.441	2.0

SD-42 Optical-to-Electrical Converter Head

SD-51 Trigger Head

SD-42 OPTICAL-TO-ELECTRICAL CONVERTER HEAD

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 SD-42 fits directly adjacent to an SD-22, SD-24, or SD-26 Sampling Head. The electrical output on the front panel SD-42 converter head is coupled to the adjacent sampling head via the semi-rigid coaxial link provided.

MEAN OPTICAL POWER METER

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. The voltage outputs of the SD-42 can be connected to any voltmeter with the supplied cables. A selector button on the front panel of the SD-42 switches the sensitivity of the power meter to one of two ranges for optical signals at the μW or mW power levels. Powers from 5 nW to 5 mW can be measured.

CHARACTERISTICS

See the Opto-Electronics Instruments section, page 370.

SD-46 OPTICAL-TO-ELECTRICAL CONVERTER HEAD

The SD-46 is an optical-to-electrical converter for use with the CSA 803/11800-Series Oscilloscopes equipped with an SD-22, SD-24, or SD-26 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 instrument, see the Opto-Electronics Instruments section, page 372.

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 803/11800-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.

CHARACTERISTICS

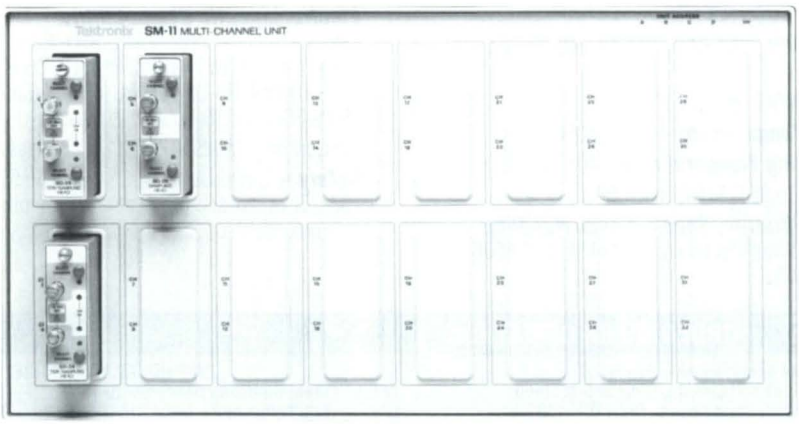
Input Signal – Frequency range is 1 to 20 GHz. Stable synchronization on signals of at least 100 mV p-p, as measured separately into 50 Ω, 5 V p-p max.

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.

ENVIRONMENTAL AND SAFETY

See page 52.



SM-11 Multi-Channel Unit can accept up to sixteen SD-Series Sampling Heads.

SM-11 MULTI-CHANNEL UNIT

The SM-11 Multi-Channel Units expand the 11801 Digital Sampling Oscilloscope to 136 channels. Each SM-11 accepts up to 16 of the SD-Series Sampling Heads; an 11801 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 11801/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 11800 system allows timing measurements to be taken in a single acquisition cycle. This greatly increases the throughput of a large multi-channel system over that of a system where the signals must be multiplexed through a small number of acquisition channels and then processed in software to determine measurement results.

CHARACTERISTICS

POWER REQUIREMENTS

See page 52.

ENVIRONMENTAL AND SAFETY

See page 52.

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 11801 or CSA 803. 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.

CHARACTERISTICS

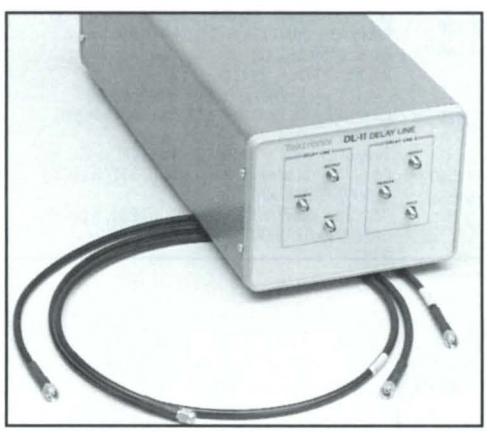
ENVIRONMENTAL AND SAFETY

Temperature – Operating: 0 to +50°C; Non-operating: -40 to +75°C.

Humidity – Operating and Non-operating: Up to 95% relative humidity; up to 50°C.

Altitude, Vibration, Shock, Bench Handling – Meets MIL-T-28800C, Type III, Class 5.

Safety – Listed UL 1244, CSA Bulletin 556B September 1973, Tektronix self-certification to comply with IEC 348 recommendation.



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 11801 or a CSA 803.

SM-11

- *Multi-Channel TDR and Simultaneous Acquisition*
- *Up to 136 Acquisition Channels when Connected to the 11801 Digital Sampling Oscilloscope*

DL-11

- *5-GHz Bandwidth*
- *47.5-ns Compensated Dual Delay Line*

ORDERING INFORMATION

SM-11 Multi-Channel Unit **$18,000**
Includes: Installation/User manual (070-7048-00); Service Reference (070-7049-00); Power Cord, U.S., 120 V (161-0066-00).

INSTRUMENT OPTIONS

Opt. 1R – Rackmount. **+$250**
See page 67 for additional option information.

WARRANTY-PLUS **SERVICE PLAN OPTIONS**

See page 490.
Opt. Q0 – On-Site Product Installation and Setup. **+$95**
Opt. Q1 – 1-Year On-Site Service **+$300**
Opt. Q2 – 2-Year On-Site Service **+$750**
Opt. Q3 – 3-Year On-Site Service **+$1,200**

ACCESSORIES

See pages 52 and 383.

PHYSICAL CHARACTERISTICS

Dimensions	Cabinet mm	Cabinet in.	Rackmount mm	Rackmount in.
Width	448	17.6	483	19.0
Height	238	9.4	222	8.8
Depth	558	22	550	21.6
Weights	**kg**	**lb**	**kg**	**lb**
Net	20.0	44	20.9	46
Shipping	23.6	52	24.5	54

DL-11 Delay Line. **$4,000**
Includes: Installation/User manual (070-7050-00); Instruction sheet (070-7051-00); 20" coaxial cable, RF 50 Ω (174-1427-00); 60" coaxial cable, RF 50 Ω (174-1428-00).

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

CHARACTERISTICS AND ACCESSORIES

CHARACTERISTICS

(11801, 11802, CSA 803, SM-11, SD-Series Heads)

ENVIRONMENTAL AND SAFETY

Operating Temperature – 0°C to 50°C.

Non-Operating Temperature – -40°C to +75°C.

Humidity – To 95% RH at up to 50°C.

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

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.

Safety – Listed UL 1244, CSA Bulletin 556B September 1973, Tektronix self-certification to comply with IEC 348 recommendation.

ORDERING INFORMATION

The following are accessories for the CSA 803, 11800, SD-Series heads, and SM-11, unless specified otherwise.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – A5 Available — **NC**
See page 488.

RECOMMENDED ACCESSORIES

Calibration Step Generator – Order 067-1338-00 — **$4,990**
Includes: Instruction sheet (070-7056-00); SMA-female, short-circuit termination (015-1021-00); International power supply options, see below.

The Calibration Step Generator is a very fast rise time, 250 mV step generator that verifies specifications of SD-Series 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 803/ 11800-Series mainframe.

INTERNATIONAL POWER SUPPLY OPTIONS

Universal European – (240 V, 50 Hz)
Order 067-1338-01 — **$3,120**
UK – (240 V, 50 Hz) Order 067-1338-02 — **$3,120**
Australian – (240 V, 50 Hz) Order 067-1338-03 — **$2,500**
Switzerland – (240 V, 50 Hz) Order 067-1338-05 — **$3,120**
Japanese – (100 V, 50-60 Hz) Order 067-1338-06 — **$3,120**

SAMPLING HEAD ACCESSORIES WITH SMA (3 MM) CONNECTORS

SMA Accessory Kit – Order 020-1693-00 — **$1,995**
Includes the following:
50-Ω Attenuators – 2 each
(2X) Order 015-1001-00 — **$150**
(5X) Order 015-1002-00 — **$155**
SMA Terminations – 2 each
(Male Short Circuit). Order 015-1020-00 — **$27**
(Female Short Circuit). Order 015-1021-00 — **$29**
(Male 50 Ω). Order 015-1022-00 — **$41**
(Female 50 Ω). Order 015-1004-00 — **$75**
50-Ω Signal Cables – 2 each (2 ns).
Order 015-0560-00 — **$290**
500-ps, 50-Ω Semi-Rigid Cable – 2 each.
Order 015-1015-00 — **$30**
Adapters – 2 each, (Male-to-Male).
Order 015-1011-00 — **$28**
(SMA Male-to-BNC Female). Order 015-0554-00 — **$27**
(Female-to-Female). Order 015-1012-00 — **$12**
50-Ω Power Divider T – 1 each (Female).
Order 015-0565-00 — **$230**
Combination Wrench – 1 each.
(0.312, 6 point). Order 003-0247-00 — **$9.00**
3.5 MM Accessory Kit – (020-1692-00) — **$5,995**
Includes the following:
50-Ω Reference Air Line – 1 each (017-0056-00). — *2
Adapters – 1 each
(Male-to-Male). Order 015-0551-00 — *2
(Female-to-Female). Order 015-0550-00 — *2
26.5 GHz, 50-Ω Terminations – 1 each
(Male 50 Ω). Order 011-0148-00 — *2
(Female 50 Ω). Order 011-0149-00 — *2
26.5 GHz Short Circuits – 1 each
(Male). Order 011-0151-00 — *2
(Female). Order 011-0150-00) — **$250**
50-Ω Attenuators – 2 each
(6 db 26.5 GHz, 2.9 mm). Order 011-0152-00 — *2
(20 db 26.5 GHz, 2.9 mm). Order 011-0153-00 — *2
Power Divider – (26.5 GHz, 2.9 mm), 1 each.
Order 015-0557-00 — *2
Signal Cables – 2 each
(2 ns, Male-to-Male). Order 015-0563-00 — *2
(500 ps, Male-to-Male), (2.9 mm, Semi-Rigid).
Order 015-0564-00 — *2
Torque Wrench – Order 003-1437-00 — *2
Combination Wrench – 1 each. (0.312, 6 point).
Order 003-0247-00 — **$9.00**
Combination Wrench – 1 each. (0.281, 6 point).
Order 003-0245-00 — **$9.00**

INDIVIDUAL ACCESSORIES

Blank Sampling Head –See page 67.
ECL Terminator – Order 015-0558-00 — **$600**
The ECL terminator provides the bias and termination for your device output. 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.
DC Block (Coupling Capacitor) – Order 015-1013-00 — **$235**
Slip on Connector – Order 015-0553-00 — **$34**
Connector Savers –
SMA. Order 015-0549-00 — **$150**
APC. Order 015-0552-00 — *2

CABLES/EXTENDERS

Sampling Head Extender Cables –
(1 m) Order 012-1220-00 — **$585**
(2 m) Order 012-1221-00 — **$665**
See page 67 for additional cables.
Acquisition Extender – Order 067-1324-00 — **$95**
Acquisition System Extender – Order 067-1323-00 — **$745**
Card Cage Extender – Order 067-1267-00 — **$810**

RECOMMENDED PROBES

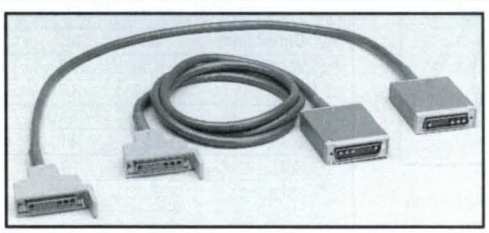
P6150 – See page 67. *1 — **$1,260**
P6156 – See page 67. — **$240**

RECOMMENDED SOFTWARE

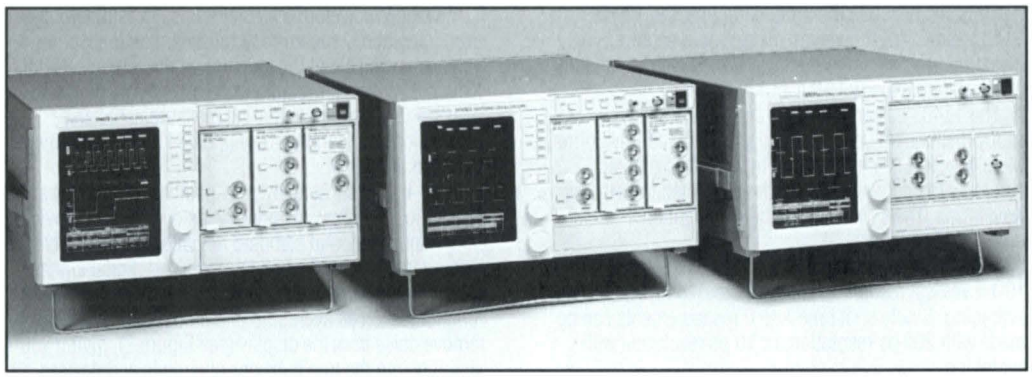
For more information on utility and application software, see page 67.

*1 *Requires SMA male-to-BNC female adapter when attached to SMA-type inputs. Order 015-0554-00.*

*2 *Contact your local sales office*



Sampling Head Extender Cables, 1 and 2 meters, can be used for placing a sampling head closer to a circuit of interest. One end attaches to a sampling head; the other end can be inserted into an 11801, 11802, CSA 803, or SM-11.



The 11400 Series are the first oscilloscopes to combine high bandwidth and exceptional accuracy with excellent vertical and horizontal resolution.

- *1-GHz Bandwidth*
- *Acquire Up to Six Channels of Data at 1-GHz Concurrently*
- *10-bit Vertical Resolution – 14-bit with Averaging – and 10-ps Horizontal Resolution*
- *Time Base Accuracy of 100 ps Plus 0.002% of the Measured Interval*
- *Deskew Nulls Out Channel Timing Differences – Including Probes*
- *Enhanced Accuracy Mode*
- *Internal Calibration Capability for a Vertical Error of 1% or Less*

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.

The 11400 Series approach to user interfaces promises more thorough analysis in fewer steps. 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.

The few controls that remain are grouped around the display screen.

All other 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 types of measurement change, 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 multiple cycles 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.

11400 AND 11201A APPLICATIONS

Oscilloscope	Applications
11403 and 11402A	**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.
	Optical Waveform Acquisition – With the P6701/P6702/P6703, you can characterize, calibrate, or troubleshoot electro-optic devices such as diode lasers, LEDs, electro-optic modulators, and optical waveguides.
	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.
11201A	**Power Supply Testing –** With advanced waveform processing functions and a powerful measurement set, you can define both power and energy waveforms and make critical measurements automatically.
	Telecommunications – With Tektronix EyePattern™ software, the 11201A can perform a variety of tests on communication signals.
	Digital Measurements – With 400 MHz bandwidth, 9-bit vertical performance,10 k record lengths, and the ability to select the point in the digital signal to trigger on, the 11201A is a very useful tool for digial measurements.

NEW

11403 11402A 1-GHz DIGITIZING OSCILLOSCOPES

- *Color Display (11403 only)*
- *1-GHz Bandwidth*
- *1-GHz Trigger Bandwidth*
- *10-bit Vertical Resolution, 14-bits with Averaging*
- *Powerful Measurement Set*
- *On-Board Measurement Statistics*
- *Advanced Waveform Processing*
- *8 Channels of Acquisition*
- *Dual Independent Time Bases*
- *Selectable 512 to 10k Point Record Lengths*
- *Menu-Based, Touch-Screen Front Panel*
- *Fully Programmable Over GPIB and RS-232-C Interfaces*
- *HPGL Plotter Output*

From the bench to the production line, the 1 GHz 11403 and 11402A give you the power to acquire, measure, process and output waveforms with a standard of accuracy exclusive to the 11400 Series.

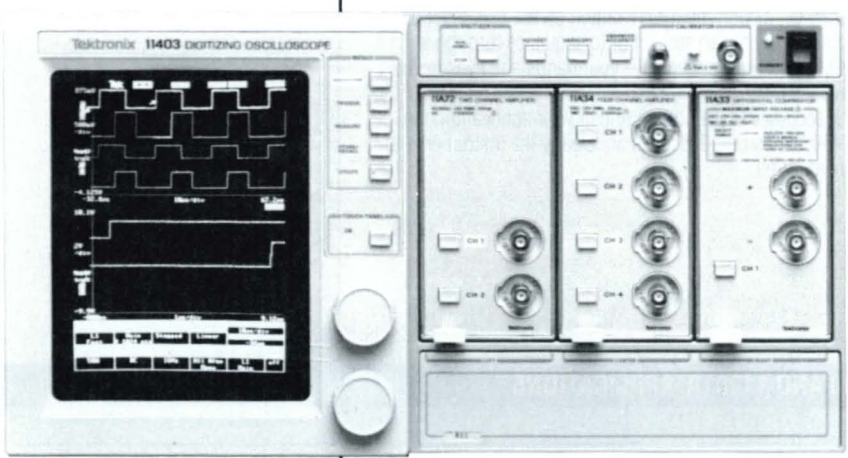
The 11403 has an full-color display that lets you easily distinguish between multiple displayed waveforms. Main waveforms are displayed in up to four different colors, with one additional color designated for window waveforms. The 11402A has a high-resolution monochrome display.

For critical applications, the 11403 and 11402A's 10-bit vertical resolution can be increased to 14-bits with averaging. Single shot time A to B measurements can be made with 200 ps resolution, or 10 ps resolution with averaging.

Equipped with three plug-in compartments, and dual time bases, the 11403 and 11402A can continuously acquire 8 signals from up to 12 input channels. Eight waveforms can be displayed simultaneously on the nine-inch vertical, raster scanned CRT.

The 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 digital oscilloscopes are analogous to main sweep and delayed sweep acquisitions in analog oscilloscopes.

Window acquisitions can be positioned anywhere within the main record and can be used for detailed analysis of critical areas of the main waveform.



GPIB* IEEE-488

The 11403 and 11402A incorporate extensive triggering capabilities including selectable AC or DC coupling, AC noise reject, as well as high and low frequency reject. Pretrigger or posttrigger details can be viewed on the main trace. And a 1 GHz trigger bandwidth lets you trigger on the fastest signals.

ADVANCED ANALYSIS WITHOUT DELAY

Live updating of the display and of all 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 processor 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 (see Figure 1). Dedicated digital signal processing hardware provides acquisition enhancement functions such as averaging and smoothing to selectively remove noise from the display (see Figure 2), giving you visibility into the true behavior of circuits and devices never before seen without extensive delayed signal processing.

MEASUREMENT SYSTEM

All measurements can be programmed over the GPIB or RS-232-C interfaces, eliminating operator error and enhancing test repeatability.

The 11403 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.

ANNOTATIONS

All of the 11403 and 11402A measurements are fully annotated in order to clearly identify the portion of the waveform being measured, and to show the locations of the measurement thresholds (see Figure 4 on page 56). 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% and 90% values.

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

THE USER INTERFACE

The 11403 and 11402A's comprehensive analysis functions, plus virtually all of the manual controls of the instrument – 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 (see Figure 5 on page 56).

COLOR DISPLAY

The 11403's color display lets you easily isolate and focus on related items. A high-resolution raster-scan CRT results in a crisp display, and allows simultaneous presentation of up to eight waveforms.

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

Four colors are dedicated for the display of main records, with one additional color designated for window records. This makes the differentiation of acquisition channels a simple task, and lets the user easily distinguish superimposed waveforms. In addition, the default color set can be adjusted to suit particular needs, with over 260,000 gradations to choose from.

The 11402A offers the same resolution and waveform display capabilities in a sharp monochrome display.

PLUG-IN MODULARITY

The 11403 and 11402A Digitizing Oscilloscopes are equipped to handle up to three 11000-Series plug-ins. (For a list of plug-ins and characteristics, see page 63.) Several plug-ins are available, offering a range of bandwidths, channels, and input impedances to choose from. Installation is a simple matter of sliding each unit into place. The plug-ins are controlled through the mainframe, either through the touch screen interface, or via the IEEE Standard 488 or RS-232-C bus.

WINDOWS

The 11403 and 11402A allow acquisition of two window records in addition to the main time base record (main and window records in the 11403 and 11402A are similar to main sweep and delayed sweep acquisitions in analog oscilloscopes). Areas of interest on the main waveform can be expanded in Window records to provide a more thorough or detailed analysis.

RECORD LENGTH

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

WAVEFORM MEMORY AND NONVOLATILE STORAGE

The standard 11403 and 11402A are equipped with 512 kbytes of volatile waveform acquisition and display memory and 128 kbytes of non-volatile memory for storage of waveforms and settings. These memories are independent; that is, the number of stored waveforms and settings has no impact on the memory available for acquisition.

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

DOCUMENTATION

Documenting your results with the 11403 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-232-C, or GPIB port to any compatible printer or plotter – including the Tektronix 4696 and 4693D color printers, and HC100 color plotter (see Figure 3).

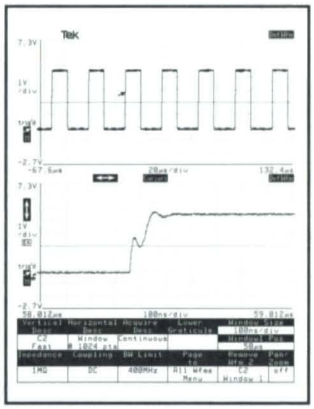


Figure 3. 11400 hardcopy output.

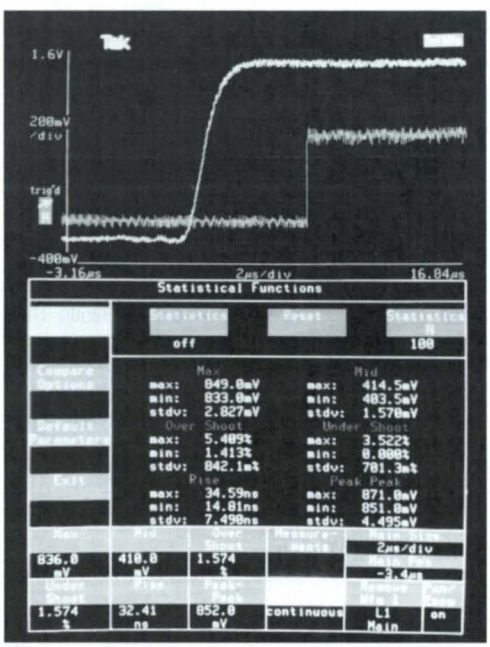


Figure 1. Statistical analysis of measurements provides maximum, minimum, mean, and standard deviation for up to six measurements at once. This feature is useful for statistical quality control, ATE test development, and device characterization.

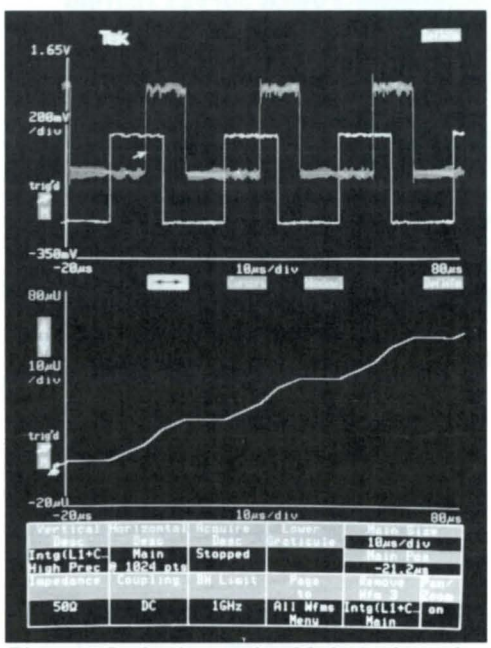


Figure 2. In the Annotation Mode, horizontal cursor bars and highlighting serve to focus your attention on the portion of the waveform being measured.

APPLICATIONS

DEVICE CHARACTERIZATION

The 11403 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. Multiple signal acquisition and display eliminates the need to multiplex channels, and allows you to see cause and effect relationships on the same screen. And the color display of the 11403 lets you easily distinguish among multiple waveforms.

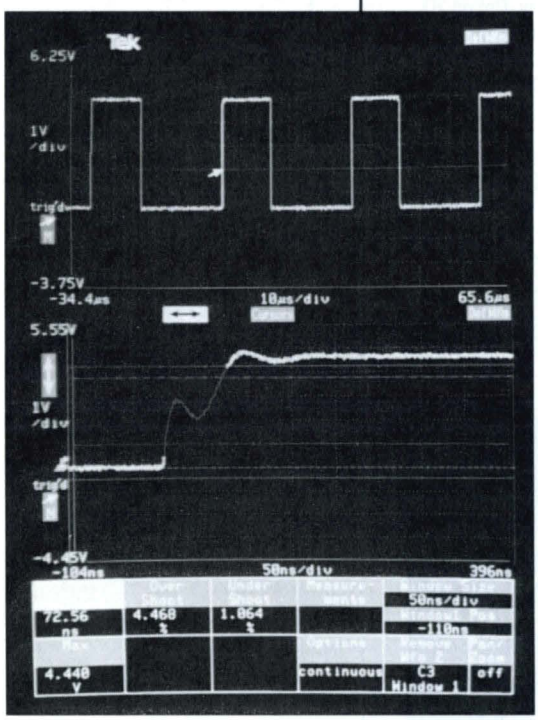


Figure 4. Averaging selectively removes random noise at a rate of up to 30 waveforms/second.

OPTICAL WAVEFORM ACQUISITION AND ANALYSIS

With the P6701/P6702/P6703 Optical-to-Electrical Converters you can transform your 11403 or 11402A into a powerful tool for characterizing, calibrating, or process troubleshooting of electro-optic devices such as diode lasers, LEDs, electro-optic modulators, and optical waveguides. Network designers can use P6701, P6702, or P6703 with the 11403 or 11402A to develop fiber optic control networks, LANs, and optical disk storage systems.

POWER SUPPLY TESTING

The 11403 and 11402A/11000-Series plug-in combination provide AC coupling, fast overdrive recovery, high vertical resolution, and one-touch energy measurements; making this combination an ideal tool for power testing. 11000-Series plug-in amplifiers have a wide range of calibrated offset, and are unsurpassed in their ability to recover quickly from up to 1000 divisions of overdrive.

The 11403 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. For more information on power supply testing, see the product literature listed on page 68.

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, video, workbook, board reference, and power plug; and is included in the purchase price of the instrument.

Figure 5. With the intuitively designed touch screen, instrument and acquisition set-up is a simple matter of making a few touch screen selections.

CHARACTERISTICS

VERTICAL SYSTEM WITH ENHANCED ACCURACY:

ΔV DC 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 11403 or 11402A 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 – 1 GHz max, (determined by the plug-in used). See page 63.

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.

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

Window Record Positioning – The window records are positioned relative to a window trigger point which may 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

DC Coupled – 0.55 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 at 1 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 – 0.7 div from DC to 30 kHz.

LF Reject Coupled – 0.7 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 at 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 80 kHz.

LF Reject Coupled – 0.65 div from 80 kHz; 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.

*1 *At minimum holdoff setting.*

MEASUREMENT SYSTEM

Waveform Processing Functions

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

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

Measurement Set

Amplitude – Min, max, mid, mean, gain, p-p, undershoot, overshoot, and RMS.

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

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

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

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

Input/Output System – Centronics, GPIB, and RS-232-C ports standard. Fully GPIB and RS-232-C programmable.

CRT AND DISPLAY FEATURES

CRT – 9-in. diagonal, magnetic defection. Vertical raster-scan orientation. Color CRT in 11403, monochrome display in the 11402A.

Colors (11403 only) – Eight-color default; or the user can select 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.
Non-operating:– 40 to +75 °C.

Humidity – Operating and Non-operating: Up to 95% relative humidity, up to + 50 °C.

Altitude – Operating and Non-operating: meets MIL-T-28800C, Type Class S.

Vibration – Operating: meets MIL-T-28800C, Section 4.5.5.3.1, Type Class S.

Shock – Non-operating: meets MIL-T-28800C, Section 4.5.5.4.1, Type Class S.

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

Safety – Listed UL 1244; CSA Bulletin 556B, September 1973; Tektronix self-certification to comply with IEC 348 recommendations.

ORDERING INFORMATION

11403 1-GHz Color Digitizing Oscilloscope **$16,950**
Includes: Tutorial (070-7418-01); User Reference (070-7419-01); Programmer Reference (070-7420-01); Command Reference (070-7421-01); Service Reference (070-7422-01); Quick Reference (070-7734-01); Power Cord, U.S., 120 V (161-0066-00).

11402A 1-GHz Monochrome Digitizing Oscilloscope. **$14,950**
Includes: Same as 11403.

INSTRUMENT OPTIONS

Opt. 1C – Cable Feedthrough Connectors. **+$200**
Opt. 1R – Rackmount. **+$250**
Opt. 2D – Memory Expansion Adds 768 kbytes of nonvolatile memory for storage of waveforms and settings. **+$1,500**
Opt. 4D – DMA Controller Increases transfer speed over GPIB. **+$400**
Opt. 25 – PEP 301 Instrument/System Controller. **+$7,995**
See page 67 for additional option information.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – A5 Available **NC**
See page 488.

WARRANTY-PLUS SERVICE PLAN OPTIONS

See page 490.
Opt. Q0 – On-Site Product Installation and Set-up. **+$475**
Opt. Q1 – 1-Year On-Site Service **+$465**
Opt. Q2 – 2-Year On-Site Service **+$1,329**
Opt. Q3 – 3-Year On-Site Service **+$2,128**

ACCESSORIES

Recommended Probes and Hard Copy Units – See page 67.
Recommended Software – See page 67.

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

NEW

11201A *400-MHz DIGITIZING OSCILLOSCOPE*

- *400-MHz Bandwidth*
- *8-Channel Display, 4-Channel Acquisition*
- *Switchable Impedance: 50 Ω, 1 MΩ*
- *10-ps Horizontal Resolution, 9-bit Vertical Resolution*
- *Waveform Processing and Automatic Pulse Parameters*
- *Multiple 10,240-Point Waveform Records*
- *Simplified Feature Access*
- *External Trigger*
- *Fully Programmable via GPIB and RS-232-C*

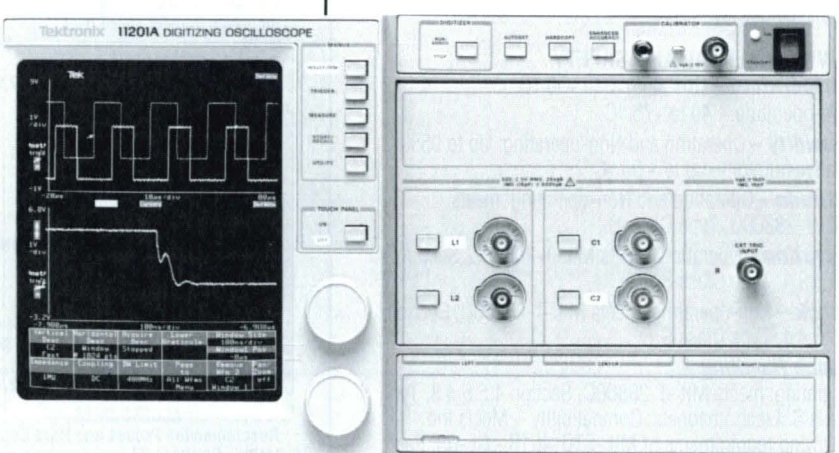
With all the waveform processing power of the 11400-Series Digitizing Oscilloscopes, the 11201A offers a new level of value in high-performance measurement. Its monolithic design includes state-of-the-art features that make it excellent for ATE systems.

CHOOSE YOUR COMPUTER INTERFACE

The 11201A has both IEEE Standard 488 and RS-232-C interfaces as standard features for data transfer and instrument control. The RS-232-C port lets you control the instrument with a PC, upload or download waveforms from a workstation or mainframe, or run diagnostics over a modem. GPIB and RS-232-C menus let you match interface parameters with a controller, modem, or host. If speed is a consideration, the DMA option can be added to make GPIB data transfers even faster. Whichever bus is chosen, the 11201A responds to a logical set of Tektronix *Standard Codes and Formats* commands that make it easy to write your test procedures.

ACCURATE, AUTOMATIC MEASUREMENTS

The 11201A performs waveform-processing functions, pulse-parameter analysis, cursor functions, and trigger-to-trigger measurements that cover a full range of measurement needs. A special annotation mode shows where measurements are being made on the trace so that you can feel confident that the oscilloscope is performing the measurement you intended it to make. Dot cursors can be split between two waveforms to make propagation-delay measurements or to compare voltages.



Measurement zones can be set to limit the automatic measurement to a portion of a displayed trace. You can set proximal, distal, and mesial levels to customize timing measurements. Up to six measurement results can be displayed and continuously updated as the data changes. This lets you make adjustments and see the results quicker than ever before. A direct hard-copy output includes time and date stamp of the measurement for archiving.

GPIB* IEEE-488

** The 11201A Oscilloscopes comply with IEEE Standard 488.1-1987, RS-232-C and Tektronix Standard Codes and Formats.*

CHARACTERISTICS

VERTICAL SYSTEM

Equivalent-Time Bandwidth –

≥10 mV: 400 MHz.

5 to 9.95 mV: 350 MHz.

2 to 4.98 mV: 250 MHz.

1 to 1.99 mV: 200 MHz.

Vertical Resolution – 9 bits (512 levels).

Two built-in four-pole bandwidth-limit filters (100 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 high-resolution calibrated dc offset has a setability of 25 μV and a range of ±1 V (equivalent to 16 bits), giving an effective screen height of 2000 div.

Number of Channels – Four.

Calibrated Deflection Factors –

Coarse steps: 1 mV to 10 V/div in 1-2-5 sequence.

Fine steps: Between coarse steps in 1% increments of next more-sensitive coarse step.

Accuracy –

ΔVolts dc accuracy: ±(1.4% + 0.012 div).

DC Balance, 1 to 99.5 mV/div: ±(1.0 mV + 0.10 div).

Offset Accuracy, 1 to 99.5 mV/div (±1 V range): ±(0.4% + 0.5 mV).

For absolute dc accuracy of single-point measurements using offset, add the Offset Accuracy and DC Balance terms.

Offset Range –

1 to 99.5 mV/div: ±1 V; Resolution: 25 μV.

100 mV to 0.995 V/div: ±10 V; Resolution: 250 μV.

1 to 10 V/div: ±100 V; Resolution: 2.5 mV.

Typical Noise (RMS) –

1 to 1.99 mV/div: 0.22 div.

2 to 4.98 mV/div: 0.13 div.

4 to 9.95 mV/div: 0.07 div.

10 mV to 10 V/div: 0.06 div.

Input Impedance – Switchable: 1 MΩ in parallel with 15 pF, or 50 Ω ±2.0%.

Input Coupling Modes – AC, DC, and OFF.

Maximum Input Voltage –

1 MΩ: 500 V (dc + peak ac).

50 Ω: Input automatically disconnects when the input signal exceeds safe limits. Manual reset.

HORIZONTAL SYSTEM

Time Bases – Two identical built-in time bases.
Record Duration – 5.12 ns to 1024 s in 1-2-5 sequence.
Time Base Accuracy – 100 ps + 0.002% of measurement interval.
Record Length – 512 points to 10,240 points.
Sampling Rate – 20 MS/s max.
Main Record Positioning – The main record is positioned with respect to the trigger point.
Pretrigger: One record duration.
Posttrigger: One record duration.
Resolution: One Main record point.
Windows – In addition to the main record, either one or two window records may be acquired and displayed. The window records may be of a different length (duration) and may have a smaller time/div than the main record. If two window records are used, they have the same duration and time/div settings but can be positioned independently.
Window Record Positioning – The window records are positioned relative to a window trigger point, which may be delayed by either time or events relative to the main record's trigger point .
Main-to-Window Trigger Time Measurement – The time between the Main record trigger and the Window trigger can be measured precisely, even if each trigger occurs only once. Repetitive events allow this measurement to be averaged for better resolution and accuracy.

Single Trigger Precision	200 ps
Repetitive Precision	10 ps, after 100 averages
Accuracy	250 ps + 0.002% of record duration

TRIGGERING SYSTEM

Range – ±Full screen.
Bandwidth – 400 MHz max.

Internal Coupling and Sensitivity

DC Coupled – 1.0 div from dc to 50 MHz, increasing to 2 div at 400 MHz.
Noise Reject Coupled – 1.2 div or less from dc to 50 MHz, increasing to 4 div a 400 MHz.
AC Coupled – 1.0 div from 60 Hz to 50 MHz, increasing to 2 div at 400 MHz. Attenuates signals below 60 Hz.
HF Reject Coupled – 0.7 div from dc to 30 kHz.
LF Reject Coupled – 0.7 div from 80 kHz to 50 MHz, increasing to 2 div at 400 MHz.

External Coupling and Sensitivity

DC Coupled – 1 V from dc to 50 MHz, increasing to 2 V at 400 MHz.
Noise Reject Coupled – 1.2 V from dc to 50 MHz, increasing to 35 V at 400 MHz.
AC Coupled – 1 V from 60 Hz to 50 MHz, increasing to 2 V at 400 MHz; attenuates signals below 60 Hz.
HF Reject Coupled – 1 V from dc to 30 kHz.
LF Reject Coupled – 1 V from 80 kHz to 50 MHz, increasing to 2 V at 400 MHz.
Maximum Input – 150 V (dc + peak ac).
Impedance – 1 MΩ paralleled by 15 pF.
Holdoff Range – 500 ns to 10 s.

MEASUREMENT SYSTEM

Waveform-Processing Functions

Measurement Set – Amplitude, timing, and area and energy.
Cursors – Horizontal and Vertical Bars; measurement-zone Delimiters.

CRT AND DISPLAY FEATURES

Standard CRT – 9 in-diagonal, monochrome, magnetic deflection. Vertical raster-scan orientation.
Standard Phosphor – GH (P31).
Video Resolution – 552 horizontal by 704 vertical displayed pixels.

INPUTS/OUTPUTS

Printers and Plotters – Centronics Interface supports Epson graphics-compatible dot matrix printers.

POWER REQUIREMENTS

Line-Voltage Ranges – 90 to 132 V RMS; 180 to 250 V RMS.
Line Frequency – 48 to 440 Hz.
Maximum Power Consumption – 320 W.

ORDERING INFORMATION

11201A 400-MHz Programmable Digitizing Oscilloscope. **$11,900**
Includes: Tutorial (070-7803-00); User/Programmer Reference (070-7804-00); Command Reference (070-7421-01); Service Reference (070-7805-00); Quick Reference (070-7734-01).

INSTRUMENT OPTIONS

Opt. 23 – Includes four P6134 probes. **+$680**
Opt. 25 – PEP 301 Instrument/System Controller. **+$7,995**
Opt. 1C – Cable Feedthrough Connectors. **+$200**
Opt. 1R – Rackmount. **+$250**
Opt. 4D – DMA Controller. Increases transfer speed over GPIB. **$400**
See page 67 for additional option information.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – A5 Available **NC**
See page 499.

WARRANTY-PLUS SERVICE PLAN OPTIONS

See page 488.
Opt. Q0 – On-Site Product Installation and Setup. **+$475**
Opt. Q1 – 1-Year On-Site Service. **+$535**
Opt. Q2 – 2-Year On-Site Service. **+$1,430**
Opt. Q3 – 3-Year On-Site Service. **+$2,260**

ACCESSORIES

Power-Supply Extended Diagnostics – (067-1264-00). **$320**
Recommended Cart – See page 67.
Recommended Probes – See page 67
Recommended Software – See page 67.

PHYSICAL CHARACTERISTICS

	Cabinet		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	448	17.6	483	19.0
Height	238	9.4	222	8.8
Depth	599	23.6	550	21.6
Weights ≈	**kg**	**lb**	**kg**	**lb**
Net	19	41.6	22.0	48.0
Shipping	28.0	62.0	31.4	68.0

11302A *BRIGHTEYE ™ COUNTER-TIMER, ANALOG OSCILLOSCOPE*

BrightEye™ CRT is more than a thousand times brighter than the CRTs of conventional oscilloscopes.

- *Built-In 750-MHz Universal Counter-Timer with Counter View*
- *Up to 8 Traces Displayed Simultaneously*
- *Autoset*
- *Automatic Time and Amplitude Measurements*
- *Dual Delayed Sweeps*
- *6-cm/ns Visual Writing Rate*
- *Fully Programmable via IEEE Standard 488 and RS-232-C*
- *Video Holdoff Pal/NTSC*
- *Countdown Holdoff*
- *Timing Analysis of Complex Signals*
- *Waveform Characterization*
- *Component Evaluation*
- *Timing Accuracy*
- *Improved Measurement Confidence*

GPIB IEEE-488 *

**The 11302A complies with IEEE Standard 488.1-1987, RS-232C.*

Combining Tektronix's proprietary microchannel plate BrightEye ™/MCP CRT, the fastest update rate of an analog oscilloscope and an integral 750 MHz, 10-digit counter-timer, the 500-MHz 11302A lets you see otherwise invisible events and measure otherwise unknown quantities – proving again how indispensible analog technology remains for many applications.

The 11302A is a versatile counter-timer analog oscilloscope. The oscilloscope is fully programmable via either IEEE Standard 488 or RS-232-C, with any RS-232-C-equipped personal computer. The 11302A is equally at home in the most complex automated production-test system or in smaller scale computer-assisted testing and data-logging applications in the engineering environment. The CRT readout displays oscilloscope and plug-in settings, as well as numeric readout of desired measurements; so there is no need to count or interpolate between graticule divisions.

WIDE CHOICE OF PLUG-INS

A choice of five amplifier plug-ins provides display of up to eight traces at 250-MHz bandwidth or four traces at 500 MHz. All plug-in inputs are supported by the TekProbe interface, which enables the use of the active and passive probes. For more information on 11000-Series plug-ins, see page 63.

BUILT-IN 750-MHz UNIVERSAL COUNTER-TIMER

The built-in 750-MHz Universal Counter-Timer, with its 1.8-ns single-shot resolution, performs as an integral part of the 11302A. This combination of high-performance counter and high-performance oscilloscope greatly simplifies the most difficult counter-timer measurements and provides measurement capabilities not possible with conventional counter-timers. A counter-view trace indicates exactly what portions of a signal are being measured by the counter-timer. This completely eliminates the concern that usually accompanies the measurement of complex signals with a conventional counter, which does not allow you to see exactly what is being measured (see Figure 1).

The combination of an integral oscilloscope and a counter-timer allows you to make counter-timer measurements on any of 12 plug-in input channels or on the signals at the A and B External Trigger Counter Inputs. Use of the A and B External Trigger Counter Inputs allows the use of the counter-timer without tieing up the oscilloscope functions of the instrument.

BRIGHTEYE™ HIGH-WRITING-RATE CRT

The microchannel-plate CRT of the 11302A provides 6-cm/ns visual writing rate, bright enough to view the fastest single-shot transient in normal ambient room light. This allows viewing of intermittent glitches in the midst of bright repetitive signals at the full bandwidth of the scope. BrightEye oscilloscopes provide the highest single-shot bandwidth available (see Figure 2).

Using the Digitizing Camera System (DCS) from Tektronix, you can digitize single-shot events up to the full bandwidth of the oscilloscope, creating a high-performance waveform digitizing oscilloscope.

AUTOSET

The Autoset feature provides a scaled, triggered display of the signal immediately and automatically.

AUTOMATIC MEASUREMENTS

Up to eight of the sixteen available automatic measurements can be displayed with the touch of a button. Measurements available include rise, fall, RMS, overshoot, undershoot, top, base, mean, peak-to-peak, min, max, mid, frequency, period, width, duty cycle, and propagation delay (see Figure 3).

CURSORS

Both vertical and horizontal cursors can be displayed to aid in making amplitude and timing measurements. Cursor scaling permits percentage, dB, and degree comparisons without the need for calculations.

BUILT-IN TIME BASES

Two built-in time bases provide sweep rates to 500 ps/div and dual delayed sweeps.

HOLDOFF

Holdoff provides the means of holding off the occurrence of the main sweep until a selected amount of time or number of events has occurred. This capability is essential in inspecting groups of pulses or events, particularly when they are not synchronized with any controllable framing pulse.

The 11302A offers several modes of holdoff. Holdoff by Time is settable either as a function of main-sweep time/division or in 1.8-ns increments up to 0.99 seconds. Holdoff by events is settable up to 500,000,000 events.

The Countdown Holdoff function allows the sweep to be triggered on every Nth event within a pulse train. Thus, any pulse within the pulse train can be inspected in detail and easily compared to other events occurring within a circuit at the same time.

The Holdoff by Events function permits the main sweep to run immediately, or to be armed for triggering by another signal source, after N events following a selected start event.

Video holdoff allows you to select individual lines from either the odd or even field (see Figure 1).

And, the counter functions are available in all the holdoff modes.

STORED FRONT-PANEL SETUPS

Up to 10 complete non-volatile, front-panel setups can be stored and recalled for immediate setup of all instrument controls for repetitive testing. Manual sequencing of the stored setups can be accomplished by means of the pushbutton at the probe tip.

REFERENCE WAVEFORMS

On-board storage and display of two, externally loaded, reference waveforms can provide templates for quick visual go/no-go comparison of complex waveforms.

CHARACTERISTICS

VERTICAL SYSTEM

System Bandwidth – Determined by the plug-in used. See page 63.

Accuracy – Determined by the plug-in used. See page 63.

ΔDelay Between Channels – Adjustable ±500 ps.

Vertical System Delay – Pretrigger: 20 ns min.

HORIZONTAL SYSTEM

Main-Sweep Timing Range – 5 ns to 0.5 s/div in 1-2-5 steps, plus 1% increments between steps and to 1.0 s/div. 500 ps with X10 Mag.

Delayed-Sweep Timing Range – Same as above.

ΔTime Accuracy Using Cursors – ±(0.5% of time interval plus 0.03 div).

ΔTime Accuracy Using Delayed Sweep – ±(0.03 of time interval plus 0.01 div).

X-Y Operation – From center plug-in: Horizontal bandwidth is dc to 3 MHz.

TRIGGERING

Minimum p-p signal required for stable triggering from A and B external inputs:

DC Coupled – 0.35 div from dc to 50 MHz, increasing to 1.0 div at system bandwidth.

AC Coupled – 0.35 div from 50 Hz to 50 MHz, increasing to 1.0 div at system bandwidth.

HF Reject Coupled – 0.5 div from dc to 30 kHz.

LF Reject Coupled – 0.5 div from 80 kHz to 50 MHz, increasing to 1.0 div at system bandwidth.

TV Trigger – Triggers from TV line or TV field sources; 0.5 div or less required for stable composite TV triggers.

DC Coupled – 20 mV from dc to 50 MHz, increasing to 150 mV at system bandwidth.

AC Coupled – 20 mV from 50 Hz to 50 MHz, increasing to 150 mV at system bandwidth.

HF Reject Coupled – 28 mV from dc to 30 kHz.

LF Reject Coupled – 28 mV from 80 kHz to 50 MHz, increasing to 150 mV at system bandwidth.

HOLDOFF

Holdoff By Time – Range: 20 times sweep reset time.

Holdoff By 2-ns Step – Settable in 1.8-ns increments from minimum inherent period of the sweep (function of time/div) to 966 ms.

Countdown Holdoff – Settable from 2 to > 500 million events. Maximum event frequency is 100 MHz.

Holdoff By Events – Settable from 2 to > 500 million events. Maximum event frequency is 500 MHz. (One Start mode limits event frequency to 100 MHz.)

Video Holdoff – Select individual lines from 625/50 and 525/60 standards.

The 11302A Oscilloscope makes up to eight measurements, automatically, on the selected signal.

BUILT-IN COUNTER/TIMER

Mode – Frequency, period, width, ratio, time A→B, and totalize.

Number of Digits – Up to 7; up to 10 with optional High-Stability Counter-Timer (Option 1T); >10 using the nulling feature.

Averaging – Selectable in two-decade steps (1, 10^2, 10^4, 10^6, etc.) up to 10^{10} for frequency, period, width, ratio, and time A→B measurements. Auto Average provides maximum resolution achievable with a 3 readings/s update rate (or at a user-programmable rate).

Gating – Via External B input or internal delayed sweep gate, or open on External A and close on External B. Minimum external gate width: < 25 ns.

Counter View – Shaped 1-div, p-p display of any one or more of the following signals: Counter In, Gate, Sync Gate, A External Input, and B External Input.

Sensitivity – Via plug-in inputs: 2X sweep-triggering sensitivities. Via External A and B Inputs: < 100 mV p-p dc to 100 MHz, increasing to 500 mV p-p at 500 MHz.

Counter Ref Clock In/Out – Connector on rear panel allows application of 0 dBm, 10-MHz external clock.

Trigger-Level Range – Plug-ins: ±10x size/div setting. External A and B Inputs: ÷1, ±500 mV; ÷5, ±2.5 V.

Trigger-Level Accuracy – Internal: Add ±2% to plug-in unit's ΔV DC term (where ΔV is the Level Readout minus Amplifier Offset) divided by V/div, add 0.3 div to DC Balance term, and add peak noise in divisions. (Peak noise is 5 x RMS.)

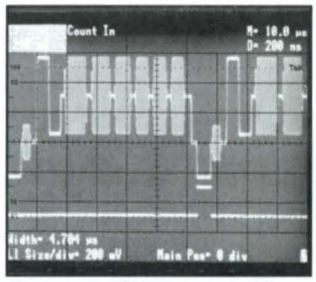


Figure 1. This gated width measurement of a video sync pulse is easily made on the 11302A. The unique counter view trace shows you exactly when the counter is armed and where it is taking the measurement.

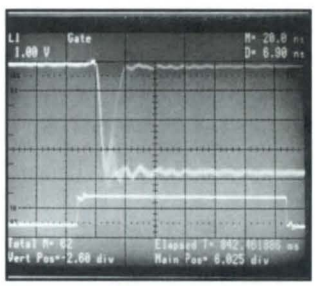


Figure 2. The 11302A's 500-MHz bandwidth, extremely high update rate and 6-cm/ns writing speed of its microchannel plate CRT reveal a metastable event that would be undetectable in any other display. Integral counter enables a readout of the total number of glitches (62) during the elapsed time.

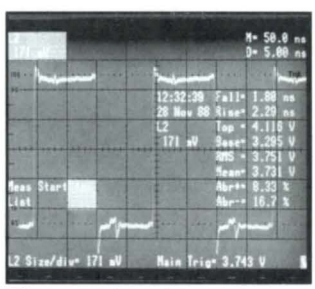


Figure 3. Any eight of the 11302A's 16 automatic measurements are viewable on-screen at once.

BRIGHTEYE ™ COUNTER-TIMER, ANALOG OSCILLOSCOPE

ORDERING INFORMATION

11302A BrightEye™ Counter-Timer, Analog Oscilloscope. **$14,500**
Includes: Introduction manual (070-7174-00); User Reference (070-7175-00); Pocket Reference (070-7176-00); Functional Test (070-7177-00); Power Cord, U.S., 120 V (161-0066-00).

INSTRUMENT OPTIONS

Opt. 1C – Cable Feedthrough Connectors **+$150**
Opt. 1R – Rackmount. **+$250**
Opt. 25 – PEP 301 Instruments/ System Controller and S47P103 Utility software. **+$7,995**
For more option information, see page 67.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1-A5 Available **NC**
See page 488.

CONVERSION KITS

Rackmount Adapter – To convert standard 11302A to Option 1R (040-1214-01). *1
High-Stability Counter-Timer – To convert standard 11302A to Option 1T (040-1232-00). **$405**
Four-Cable Feedthrough – To convert standard 11302A to Option 1C (040-1233-00). *1

ACCESSORIES

11302A Service Manual – (070-7179-00). *1
Cables – See page 67.
Blank Panel – See page 67.
Digitizing Camera System (DCS01, Opt. 01) – Digitizes waveforms or single-shot signals to the full oscilloscope bandwidth to allow analysis with a personal computer. See page 67. **$6,500**
Recommended Cameras – See page 67.
Recommended Cart – See page 67.
Recommended Probes – See page 67.
Recommended Software – See page 67.

PHYSICAL CHARACTERISTICS

Dimensions	Instrument mm	Instrument in.	Rackmount mm	Rackmount in.
Width, with handle	447	17.6	482	19.0
Height, with feet	239	9.4	222	8.8
Depth	581	22.9	548	21.6
Weight ≈	**kg**	**lb**	**kg**	**lb**
Net	20.0	44.0	23.0	50.4
Shipping	23.6	52.0	27.0	58

*1 *Contact your local sales representative.*

External A and B Inputs (for signals with 10% to 90% transition time >10 ns) – ÷1 (max signal, ±1V): ±[3% of setting +4% of p-p signal +10 mV + (0.5 mV times probe attenuation factor)].
÷5 (max signal, ±5 V): ± [3% of setting + 4% of p-p signal + 50 mV +(0.5 mV times probe attenuation factor)].

FREQUENCY

Range – <.001 Hz to 750 MHz.
LSD – Greater of (1.8 ns x F^2)/N rounded to the next higher decimal digit, or 1 count.
Resolution – Greater of LSD ±1.4 (TJE)F^2/N.
Accuracy – Resolution ±F (TBE).

PERIOD

Range – 2 ns to 1250 hrs.
LSD – 1.8 ns/N.
Resolution – LSD ±1.4 (TJE)/N.
Accuracy – Resolution ±(TBE)(P).

WIDTH

Range – 2 ns to 1250 hrs.
Maximum Repetition Rate – 200 MHz.
LSD – 2 ns (for N=1); 1 ns/ $\sqrt{N}$ (for N > 10).
Resolution – [LSD ±(1.4 (TJE_L) ±1.4 (TJE_T))] /$\sqrt{N}$ ±2 ps.
Accuracy (Gated and Nongated) – Resolution ±Width (TBE)
±Hysteresis error
±TLE/($Slew_E$ - $Slew_S$) ±1 ns.

TOTAL

Range – 0 to 10^{15} counts (engineering notation used above 10 digits).
Repetition Rate – > 0 to 500 MHz.
LSD, Resolution, and Accuracy – 1 up to 10^{11} - 1.
Elapsed Time Range – 25 ns to 1250 hrs.

RATIO

Range – 10^{-11} to 10^{11}.
Frequency Range – 1 Hz to 400 MHz.
LSD – Ratio/10^{10}.
Resolution – LSD ±[1.4 (TJE_D)N_D] ±[1.4 (TJE_M/ N_M)] ±[F_M^2/F_D^2 ±$F_M F_D$)] where N refers to trigger events.
Accuracy – Same as resolution.

TIME INTERVAL (Main and Delay Trigger Sources)

Range – 2 ns to 1250 hrs.
LSD – 2 ns (for N =1); 1 ns/$\sqrt{N}$ (for N > 10).
Resolution – LSD ±(1.4(TJE_M)+ TJE_D)] /$\sqrt{N}$ ±2 ps.
Accuracy – ±(TBE)(Time Interval) ±Resolution
±Plug-In Delay Mismatch
±TLE_M/Slew
±TLE_D/Slew
±200 ps.
Maximum Repetition Rate – 200 MHz.
Channel Delay Mismatch – Not more than ±500 ps (without null).

STANDARD TIME BASE

Frequency at Calibration – 10 MHz ±0.02 x 10^{-6}.
Temperature Stability – 0.2 x 10^{-6}, 0 to 50°C.
Warm-Up Time – 10 minutes at 25°C to within 0.2 x 10^{-6} of final frequency.
Aging – < 1x10^{-8}/day at time of shipping. < 4x10^{-8}/ week after 30 days continuous operation. <1x10^{-6}/year after 60–days continuous operation.
Short-Term Stability – < 1x10^{-9} RMS based on 60 consecutive 1 s measurements.
Adjustment Resolution – 0.02 x 10^{-6}.
Adjustment Range – Sufficient for 8 years of aging.

EXTERNAL CONNECTORS

Camera Power, Calibrator Output, A and B External, Trigger and Counter Inputs, Trigger Ready Output, Trigger Reset Input, Sweep Gate Output, Left, Vertical Out, Counter Ref Clock In/Out, Main/Delayed Sweep Output, Z-Axis Input, RS-232-C, and IEEE Standard 488.

CRT AND DISPLAY FEATURES

CRT – 18 x 10 div (1.0 cm/ div); P31 phosphor. Writing speed: 6 cm/ns single-shot visual writing speed in 20 fC ambient illumination.

POWER REQUIREMENTS

Line Voltage – 90 to 132 V ac, and 180 to 250 V ac.
Line Frequency – 48 to 440 Hz.
Maximum Power Consumption – 240 W.

ENVIRONMENTAL AND SAFETY

Temperature – Operating: 0 to +50°C. Nonoperating: – 45 to +75°C.
Humidity – Operating and Nonoperating: Up to 95% relative humidity, up to 50°C.
Altitude, Vibration, Shock, and Bench Handling – Meets MIL-T-28800C, Type III, Class 5.
Electromagnetic Compatibility – Referenced to MIL–T-28800C and MIL-STD-461B.
Safety – Listed UL 1244; CSA Bulletin 556B, September 1973; Tektronix self-certification to comply with IEC 348 recommendations.

Wide bandwidth, unsurpassed accuracy, clean response, low noise, and calibrated DC offset with fast overdrive recovery characterize the amplifier plug-in units available for use with the Tektronix 11000-Series and DSA 600 mainframes. The 11A72 provides two channels at 1 GHz bandwidth in the 11403, 11402A, and DSA 600 mainframes; and up to 500 MHz bandwidth in the 11302A. The 11000-Series Maximum Bandwidth Matrix below shows the bandwidth of each of the plug-in units in each of the 11000-Series and DSA 600-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-232-C bus. A single pushbutton 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 P6703), to sense the type (and, with some probes, the serial number) of the probe, to supply offset voltage to probes so equipped, to detect activation of the probe's ID pushbutton, and to provide other communication between the probe and the oscilloscope as appropriate to the type of probe. A serial data line in the TekProbe™ interface provides the means for high-level communication with special-purpose probes.

CSA 803/11800-SERIES SAMPLING HEADS

The CSA 803/11800-Series accepts SD-Series Sampling Heads. See pages 48-50 for more information on CSA 803/11800-Series sampling heads.

11000-Series Probe/Plug-in/Mainframe Bandwidth Matrix

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

	No probe	P6134C	P6231	P6203	P6204	P6156	P6701*1	P6702*2	P6703*3	P6501 Opt. 02*4
		passive 10 MΩ 11.3 pF 10X	bias/offset 450 Ω 1.6 pF 10X	active 10kΩ 2.0 pF 10X	active 10MΩ 1.9 pF 10X	passive 500, 5 kΩ <1 pF, <1.1 pF 10X, 100X	optical — — —	optical — — —	optical — — —	active 1MΩ 1.8 pF 10X
11302A										
11A32	350	350	350	325	325	350	300	275	350	325
11A34	250	250	250	250	250	250	225	225	250	225
11A52	400	—	375	375	375	400	350	300	400	350
11A72	500	—	475	450	450	500	400	350	500	425
DSA 600, 11400										
11A32	400	400	375	375	375	400	350	300	400	350
11A34	300	300	300	275	275	300	275	250	300	275
11A52	600	—	550	500	500	600	450	375	600	475
11A72	1000	—	825	700	700	1000	575	450	1000	600

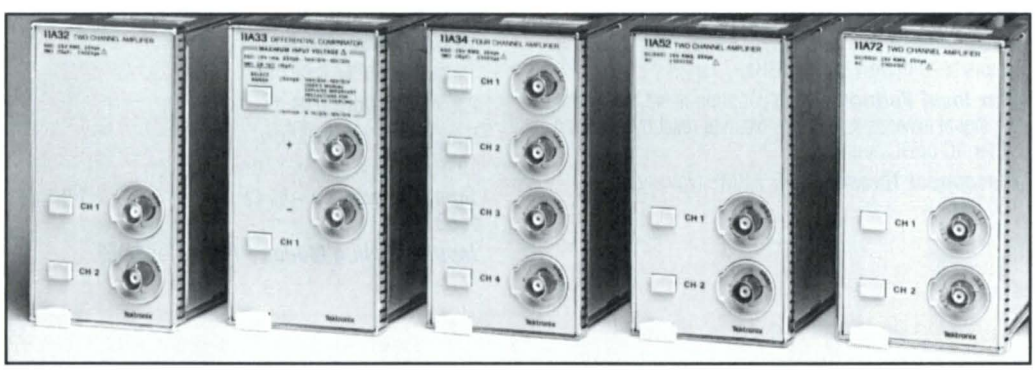
*[1] *P6701 – Wavelength is 450 to 1050 nm*

*[2] *P6702 – Wavelength is 1000 to 1700 nm*

*[3] *P6703 – Wavelength is 1100 to 1700 nm*

*[4] *P6501 Option 02 microprobe is a probe-card mounted, active probe that draws power from the TekProbe™ interface found on 11000-Series plug-ins.*

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.



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NEW 11A72

- *Two Channels*
- *50-Ω Input Impedance*
- *DC to 1-GHz Bandwidth (in 11400 and DSA 600)*
- *10-mV to 1-V/Div Calibrated Deflection Factors*
- *± 25 Division Offset*

11A52

- *Two Channels*
- *50-Ω Input Impedance*
- *DC to 600-MHz Bandwidth (in 11400 and DSA 600)*
- *1-mV to 10-V/Div Calibrated Deflection Factors in 1% Increments*
- *High-Resolution Calibrated DC Offset*
- *Fast Overdrive Recovery*

ORDERING INFORMATION

11A72 Two-Channel Vertical Amplifier **$4,150**
Includes: User Reference (070-7255-00); Service Reference (070-7257-00).

11A52 Two-Channel Vertical Amplifier **$2,800**
Includes: User Reference (070-6114-00); Service Reference (070-6786-00).

INSTRUMENT OPTIONS

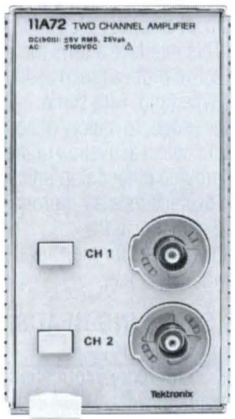
Opt. 25 – Includes two P6231 probes. **+ $950**

Opt. 26 – Includes two P6203 probes.
(11A72) **+ $1,720**
(11A52) **+ $1,700**

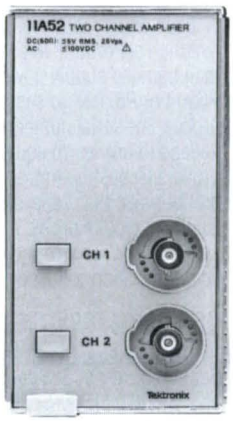
Opt. 27 – Includes two P6204 probes.
(11A72) **+ $2,850**
(11A52) **+ $2,790**

ACCESSORIES

See page 67.



11A72 Two-Channel Amplifier



11A52 Two-Channel Amplifier

11A72 TWO-CHANNEL AMPLIFIER

The 11A72 is the highest bandwidth amplifier for the 11000-Series mainframes. It offers two channels of 1-GHz bandwidth each in the 11400-Series or DSA 600-Series mainframes. DC offset can be set to 40 steps/division resolution over a range of ±25 div at all sensitivities.

CHARACTERISTICS

11A72:

Bandwidth – 1 GHz in the 11400/DSA 600; 500 MHz in the 11302A.

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

Accuracy – ΔVolts dc accuracy:
With 11302A: ±(1.2% to +0.04 div).
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 divisions, 0.025 div resolution.

Typical Noise (RMS) – 0.022 div.

Input Impedance – 50 Ω ±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.

Max Input Voltage – Input coupling is set to Off when the signal exceeds safe limits. Manual reset by selecting either AC or DC coupling.

Disconnect Threshold – 5 V RMS typical (dc to 100 MHz).

11A52 TWO-CHANNEL AMPLIFIER

The 11A52 is a high-bandwidth, two-channel amplifier plug-in for the 11000-Series mainframes. Two built-in four-pole bandwidth-limiting filters (100 MHz and 20 MHz) may be activated to reduce unwanted high-frequency noise at 24 dB/octave.

Both coarse and fine deflection-factor steps are fully calibrated. At 1 mV/div, the calibrated dc offset has 25 μV resolution and a range of ±1 V (equivalent to 16 bits), giving an effective screen height of 2000 divisions and permitting absolute dc measurement accuracies to ±0.3%.

CHARACTERISTICS

11A52:

Bandwidth (MHz) –

Volts/div	11302A	11400/DSA 600
>10 mV	400	600
5 to 9.95 mV	350	400
2 to 4.98 mV	250	250
1 to 1.99 mV	200	200

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

Accuracy – ΔVolts dc accuracy:
With 11302A: ±(1.0% +0.04 div).
With 11400: ±(0.8% +0.01 div).
With DSA 600: ±(0.9% +0.02 div).
DC Balance, 1 to 99.5 mV/div:
With 11302A: ±(0.2 mV to +0.13 div).
With 11400/DSA 600: ±(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.

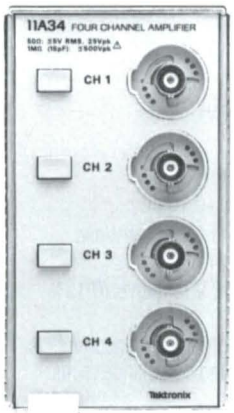
Overdrive Recovery – 1 to 99.5 mV/div: To within ±(0.2% +0.1 div) within 20 ns from ±2 V step.

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.

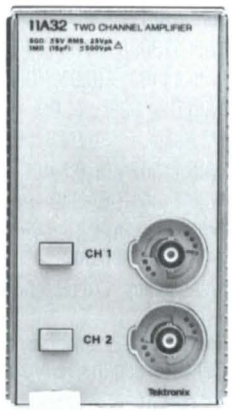
Input Impedance – 50 Ω ±0.5%; VSWR: < 1.3:1 dc to 500 MHz.

Input Coupling Modes – AC, DC, and OFF.

- *DC to 400-MHz Bandwidth (11A32 in 11402A/11403 Mainframe)*
- *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*



11A34 Four-Channel Amplifier



11A32 Two-Channel Amplifier

11A32 AND 11A34 AMPLIFIERS

The 11A32 and 11A34 are excellent medium bandwidth amplifiers for the 11302A, 11400-Series, and DSA 600-Series mainframes. They offer switchable 1 MΩ/50 Ω input impedance, fast overdrive recovery, and wide offset range. The 11A32 is a two-channel unit, and the 11A34 is a four-channel unit.

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

Both coarse and fine deflection-factor steps are fully calibrated. At 1 mV/div, the 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 div and permitting absolute dc measurement accuracies to ±0.4%.

CHARACTERISTICS

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

Bandwidth – 11A32

Volts/div	11302A	11400/DSA 600
>10 mV	350 MHz	400 MHz
5 to 9.95 mV	250 MHz	350 MHz
2 to 4.98 mV	200 MHz	250 MHz
1 to 1.99 mV	200 MHz	200 MHz

Bandwidth – 11A34

Volts/div	11302A	11400/DSA 600
>10 mV	250 MHz	300 MHz
5 to 9.95 mV	250 MHz	200 MHz
2 to 4.98 mV	200 MHz	250 MHz
1 to 1.99 mV	150 MHz	150 MHz

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

Accuracy – ΔVolts dc accuracy:
With 11302A: ±(1.0% + 0.04 div).
With 11402A/11403: ±(0.9% +0.012 div).
With DSA 600: ±(1.0% +0.02 div).
DC Balance, 1 to 99.5 mV/div:
With 11302A: ±(1.0 mV + 0.13 div).
With 11400/DSA 600: ±(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.

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.

ORDERING INFORMATION

11A34 Four-Channel Vertical Amplifier **$3,995**
Includes: User Reference (070-5921-01); Service Reference (070-6785-02).

11A32 Two-Channel Vertical Amplifier **$2,350**
Includes: User Reference (070-5922-01); Service Reference (070-6782-03).

INSTRUMENT OPTIONS

Opt. 22 – (11A32) **+$340**
Includes: two P6134C probes.

Opt. 23 – (11A34) **+$680**
Includes: four P6134C probes.

ACCESSORIES

See page 67.

11A33 *PLUG-IN DIFFERENTIAL COMPARATOR AMPLIFIER*

- ***DC to 150-MHz Bandwidth***
- ***1-mV to 10-V/Div Calibrated Deflection Factors in 1% Increments***
- ***Very-High-Resolution Calibrated DC Offset 16000-Division Effective Screen Height***
- ***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***

ORDERING INFORMATION

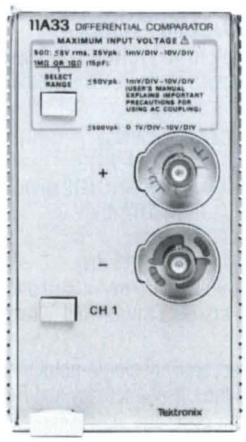
11A33 Differential Comparator **$3,450**
Includes: User Reference (070-6119-00); Service Reference (070-6784-01).

INSTRUMENT OPTIONS

Opt. 24 – Includes a P6135A probe pair. **+$510**

ACCESSORIES

See page 67.



The 11A33 Differential Comparator plug-in is a single-channel differential amplifier with high common-mode rejection ratio (CMRR) and fast overdrive recovery from large signals. As a differential amplifier, common-mode input-voltage range is ±8 V at 1 mV/div. As a comparator, the built-in comparison voltage (Vc) is used to measure the fine structure of very large signals with unprecedented accuracy and resolution.

Maximum bandwidth in the 11302A, 11400-Series, and DSA 600-Series mainframes is 150 MHz. 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 factors are fully calibrated. At 1 mV/div, the comparison voltage has a resolution of 25 μV throughout its ±8 V range (equivalent to 19 bits), giving an effective screen height of 16,000 div and permitting absolute dc measurement accuracies of ±0.2%.

CHARACTERISTICS

Number of Channels – One.

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

Calibrated Deflection Factors –

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

Accuracy – ΔVolts dc accuracy:

With 11302A: ±(1.0% +0.04 div).

With 11400: ±(0.9% +0.01 div).

With DSA 600: ±(1.0% +0.02 div).

DC Balance, 1 to 99.5 mV/div:

With 11302A: ±(0.5 mV +0.13 div).

With 11400/DSA 600: ±(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.

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.

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 V/div; Overdriving signal steps to 0.0 V from ±8.0 Volts; Slew rate ≤ 0.5 V/ns.

Typical Noise (RMS) –

1 to 1.99 mV: 0.24 div.

2 to 4.98 mV: 0.12 div.

5 to 9.95 mV/div: 0.05 div.

10 mV to 10 V/div: 0.03 div.

Common-Mode Rejection Ratio –

1 to 99.5 mV/div: 10,000:1 dc to 1 MHz; 2000:1 at 5 MHz (8 V p-p signal).

100 mV to 0.995 V/div: 1000:1 dc to 1 MHz; 100:1 at 10 to 20 MHz (30 V p-p signal).

1 to 10 V/div: 500:1 dc to 250 kHz (100 V p-p signal).

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

Input Coupling Modes – DC, AC, Vc, and OFF for each input. Vc Coupling internally connects an 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 voltage 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.

ORDERING INFORMATION

Accessory	Key Characteristics *(The following accessories are compatible with all 11000-Series amplifiers/mainframes, unless specified otherwise. For complete specifications refer to the corresponding page(s) listed in this table.)*	Page	Order	Price
Probes				
Passive Probes (1-MΩ Iinput)	10X, DC - 400 MHz, with readout and identify (11A32, 11A33, 11A34 only)	414	P6134C	*1
	1X/10X, DC - 200 MHz with readout (11A32, 11A33, 11A34 only)	411	P6063B	**$240**
Low-Z Probes (50-Ω Iinput)	10X, DC - 9.0 GHz (11800 and CSA 803 only)	419	P6150	**$1,260**
	10X, DC - 3.5 GHz, ≤1 pF, 500 Ω	419	P6156	**$240**
	100X, DC - 3.0 GHz, ≤1.1 pF, 5000 Ω	419	P6156 Opt. 25	**$295**
Bias-Offset Probe	10X, DC - 1.5 GHz, 1.6 pF, 450 Ω	414	P6231	**$475**
Active Probes	10X, DC - 1 GHz, ≥10 MΩ input impedance, 1.9 pF	415	P6204	**$1,425**
	10X, DC - 1 GHz, ≥10 kΩ input impedance, 2.0 pF	415	P6203	**$860**
Differential Probe	10X, DC - 150 MHz (11A33 only), 1 MΩ, 10.5 pF	418	P6135A	**$510**
Optical-to-Electrical Converters	DC - 6.4 GHz, 1000-1700 nm (sampling head for 11800 and CSA 803 only)	372	SD42	**$3,400**
	DC - 1 GHz, 1100-1700 nm	371	P6703	**$2,750**
	DC - 700 MHz, 450-1050 nm	371	P6701	**$2,000**
	DC - 500 MHz, 1000-1700 nm	371	P6702	**$2,095**
Current Probes/Systems	DC - 50 MHz, 0-20 A (dc + peak ac)	425	AM503S	**$2,200**
	DC - 15 MHz, 0-100 A (dc + peak ac)	425	AM503S Opt. 01	**$3,375**
	25 kHz-1 GHz, max current of 0.5 A RMS	427	CT-1	**$260**
Cart	Instrument cart with tilt tray, drawer, power strip	400	K217S	**$660**
Blank Panels	Plug-in (11302A, 11400, DSA 600)	440	016-0829-00	**$115**
	Sampling Head (11800, CSA 803 only)	440	200-3395-00	**$.75**
Cameras	Fast writing speed, adjustable f-stop and shutter speed (11302A only)	394	C-51P	**$2,680**
	ssMedium writing speed, adjustable f-stop and shutter speed (11302A only)	394	C-53P	**$2,220**
Digitizing Camera	Digitizing Camera System (11302A only)	172	DCS01, Opt. 1A	**$6,645**
Hard Copy Output and Printers	4-color pen plotter (11201A, 11400, 11800,CSA 803, DSA 600 only)	384	HC100	**$895**
	Color ink-jet printer (11201A, 11400, 11800,CSA 803, DSA 600 only)	466	4696	**$1,795**
	Color image printer (11201A, 11400, 11800, CSA 803, DSA 600 only)	466	4693D	**$8,495**
Cables	GPIB, 2 m (DSA 600 only)	436	012-0630-03	**$110**
	GPIB, 2 m (11201A, 11302A, 11400, 11800, CSA 803, DSA 600 only)	436	012-0991-00	**$160**
	RS-232-C, 10 ft.	436	012-0911-00	**$100**
	Centronics, 10 ft.	436	012-0555-00	**$125**

Note: Other available accessories can be found on pages 383.

*1 *Contact your local sales representative.*

Software Packages

11000-Series/IBM PC Utility Software – Waveform/measurement data logging, graphics and statistical analysis, and GPIB and RS-232-C support. Order S47P108 for 11201A/11400 Series, 11800 Series, CSA 803, and DSA 600 Series. Order S47P103 for 11302A.

i-Pattern™ Software – Uses two-and three-dimensional graphic displays. Jitter and noise measurement pulse parametric measurements, mask testing, and Pass/Fail limit testing. Requires DCS01 for operation with 11302A. Order S47P107.

11000-Series Template/Waveform Processing Program – Menu-driven waveform template generator provides template waveforms for storage and controller based save-on-delta function. Order S47P110.

EZ-TEST – Provides a simple means to specify high-level test functions using instruments in an online learning mode. Test procedures include instrument control, measurements, pass/fail, waveform acquisition and pulse parameter analysis, and more. Order S45F030.

SPD Signal Processing & Display Software – A library of 196 signal processing, analysis and display routines callable from Microsoft C or BASIC. SPDMENU lets you interactively control instruments and analyze data using a convenient system of menus and graphical displays of data. Order S3FG130.

ASYST – Sophisticated scientific software for the personal computer. Interactive or fully programmable operation for integrated data acquisition, analysis, and display. Supports RS-232-C, GPIB, or A/D acquisition boards. Order S42P301 for ASYST Modules 1, 2, and 4.

11000-Series ASYST Driver – Menu-driven package written in the ASYST language for mainframe control, waveform acquisition, data logging, graphing, and FFT analysis. Order S47P305.

ASYSTANT™ GPIB – Fully integrated, completely menu-driven environment, designed for data acquisition and instrument control via GPIB interface coupled with a broad range of statistical and numerical analysis and waveform processing operations. Order S47P311.

LabWindows™ – An integrated software system that supports rapid prototyping, development, and operation of test and measurement applications in either C or BASIC. Order S3FG910.

DADiSP – An interactive technical worksheet for scientists and engineers. Over 160 functions can be applied to waveforms; including signal arithmetic, waveform generation, frequency domain analysis, and statistical routines. Order S3FG916 or S3FG918.

11400/HP-200/300 Time and Amplitude Measurement (TekMAP) Software – RM BASIC code providing softkey access to waveform acquisition, analysis, pulse parametrics, FFT, propagation delay, and measurement data logging and statistics. Order S47H211.

For Macintosh users, virtual instrument panels and icons are available for the LabView ™ instrumentation software from National Instruments.

See page 342 for a complete description of the software packages available.

Mainframe Options

(DSA 600, CSA 803, 11800, 11400, 11201, 11302A)

Opt. 1C – Cable Feedthrough Connectors. Provides cable routing from rear to front for easier connection of input signals in rackmount applications. Not available for the CSA 803/11800-Series. **+$200**

Opt. 1R – Rackmount. Includes all hardware, tooling, and instructions for converting bench model to rackmount configuration. **–$300**

Opt. 25 – PEP 301 Instruments/ System Controller and Utility Software. **+$7,995**

See individual mainframe pages for additional options and their prices.

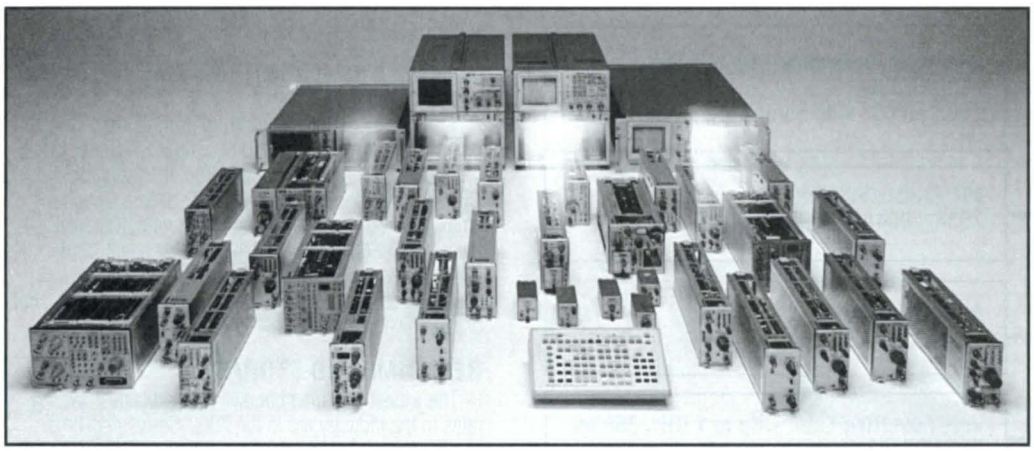
Complementary Modular Test Instruments available on page 243.

PRODUCT LITERATURE AND APPLICATION NOTES

PRODUCT LITERATURE AND APPLICATION NOTES

Tektronix product literature is readily available from your local Tektronix Sales Office.
For data sheets and product brochures, just ask for literature on the specific instrument.
Additional related publications also available are listed below.

Product	Title	Description	Order
DSA 600	Hardcopy Support	Lists the printers/plotters that the DSA 600 Series supports and gives helpful hints	47W-7427
DSA 600	Triggering	Gives a guide to the event, time-qualified, edge, and Boolean trigger functions	47W-7428
DSA 600	Dejitter	Describes how to reduce time jitter with the Dejitter function	47W-7429
DSA 600	Repetitive Single-Shot Acquisition	Discusses one of the most advanced features of the DSA 600 Series, repetitive single-shot acquisition	47W-7430
DSA 600	Act on Delta	Describes pass/fail testing using the DSA 600 Series	47W-7431
DSA 600	FFT Spectral Estimation	Use the DSA 600 Series built-in FFT (Fast Fourier Transform) to investigate the frequency domain	47W-7435-1
DSA 600	Software Support	Includes a short description of each package available for the DSA 600 Series	47W-7437
DSA 600	The ASCII Interface	Descibes communication through the GPIB and RS-232-C interface ports	
DSA 600	Multi-Channel Concurrent Acquistion	Lists the conditions and resulting sample rates for multi-channel acquisition	47W-7441
DSA 600 and 11000 Series	DSA 600 Series Plug-ins and Probes	Reviews the plug-ins and probes available for the 11000 Series and DSA 600 Series	47W-7443
11800	Sampling Head Bandwidth Verification and Frequency Characterization	Verifies the bandwidth of the 11800-Series sampling heads, and characterizes the amplitude versus frequency response.	47W-7298
11800	TDR CrossTalk	Characterizes the crosstalk of a ribbon cable using the TDR and TDT capabilities of the 11800 Series	47W-7498
11800	Differential TDR	Characterizes a differential amplifier using the TDR and TDT capabilities of the 11800 Series	47W-7499
11800	Characterization of a Differential Line Using the 11800-Series Oscilloscope Differential TDR Capabilities	Describes differential transmission line measurements	47W-7519
11403/11402A	High-Resolution Main-to-Window Trigger Time Measurements	Discusses one of the most valuable and unique features of the 11403/11402A, the Main-to-Window trigger time measurements	47W-7453
11403/11402A	11403 Measurement Statistics	Describes 11403 statistics algorithms	47W-7456
11400/11201A	Automatic Timing Measurements: The 11400 Series Solution	Includes example computer program listings	47W-6549
11400/11201A	Switching Power Supply Testing Using the 11400	Gives a general overview of switching power supply measurement techniques	47W-6550
11400/11201A	Using Windows	Gives a guide to the 11400 Series window time bases	47W-6562
11302A	Using Holdoff	Gives a guide to the sophisticated 11302A Holdoff system	47W-6685
11302A	11300A Series Timing Measurement Primer	Describes how to use the 11302A	47W-6783
11302A	Troubleshooting Metastable Events Using the Gated Totalize Counter Feature of the 11300A Series	Discusses troubleshooting one the toughest faults, metastable events, using the 11302A	47W-7008
11302A	Make Propagation Delay and Risetime Measurements to Picosecond Accuracy Using the Integral Counter Capabilities of Tektronix 11300A Series Oscilloscopes	Shows how the 11302A can be used to resolve small timing differences	47W-7011



7000 SERIES

All 7000-Series instruments have benefits in common. These benefits always rate very high with users because of the extended capability they have when they become familiar with the products:

- Consistent User Interface
- High-Accuracy, Differential Measurements, and Large DC Offset
- High-Writing-Rate CRTs Suitable for Photography
- Wide Selection of Plug-ins for Flexibility and Configuring a System to Your Particular Application

Modular instruments, also called plug-in or laboratory instruments, combine a mainframe and one or more interchangeable plug-in modules.

Tektronix modular oscilloscopes include the 11000 Series, the 7000 Series, and the 5000 Series. Each series has a group of "families" with particular sets of user advantages. Each series incorporates a basic technology to achieve excellence in waveform acquisition and measurement for a particular range of applications.

THREE FEATURED FAMILIES

The 7000 Series consists of three product families:

- The first family is the **analog real-time** family. This includes the highest bandwidth and fastest writing rate oscilloscopes in the world.
- The second 7000-Series family has the ability to capture and save waveforms in analog form. It is known as the **real time/CRT storage** family.
- The third family consists of an analog real-time digital mainframe (which accepts all 7000-Series analog plug-ins), and a digital plug-in (which will operate in any of the lower bandwidth, analog, real-time mainframes). It is known as the **real time/digital** family.

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Signal Type to Measure

Repetitive

Very High Frequency – Up to 1 GHz
7104/R7103
7603, R7603 with Sampling – Up to 14 GHz

350 MHz to 500 MHz
7934, 7904A, R7903, R7844, 7854

DC to 100 MHz
7600 Series

Single Shot

Very Fast Rise Time – Up to 1 GHz, 350 ps
7104/R7103

Up to 500 MHz, 700 ps
7934, 7904A, R7903

Up to 350 MHz, 1 ns
R7844, 7854

Up to 100 MHz, 3.5 ns
7603, R7603, 7613, R7613
7623A, R7623A, 7633, R7633

SUPERIOR PERFORMANCE

The 7000-Series modular laboratory instruments embody state-of-the-art performance features. The 7104 and R7103 Oscilloscopes feature a 1-GHz bandwidth combined with the fastest rise time and highest photographic writing speed available.

MAXIMUM FLEXIBILITY

With the Tektronix 7000-Series high-performance modular plug-in design, you can choose the optimal oscilloscope system for your measurements.

A choice of 15 mainframes, 19 plug-ins, and 4 sampling heads give you the flexibility to configure the oscilloscope to meet your individual needs. When your needs change, your oscilloscope can be reconfigured with minimum effort.

The 15 mainframes range from medium performance to the highest performance available in a general-purpose oscilloscope. Seven of these mainframes are configured for rackmount.

You'll find bandwidths ranging from DC to 1 GHz and rise times from 3.5 ns to 350 ps. The 7000 Series offers more choices in storage modes, too, including digital, CRT, and fast photographic writing speeds. Choose single beam or dual beam capability, with 400-MHz bandwidth and full scan overlap in dual beam. And, 7000-Series waveform digitizers offer the acquisition capability to capture high-speed, low-speed, single-shot, or repetitive signals up to 400 MHz.

REAL TIME AND STORAGE

The widest real-time bandwidths and fastest writing rates in the industry are in the 7000-Series real-time oscilloscopes. The microchannel plate (MCP) CRT of the 7104, for example, enables even the fastest full-screen single-shot event to be seen in moderate light and photographed with conventional film.

A Tektronix CRT storage oscilloscope offers the following distinct advantages:

- acquires fast single-shot events
- acquires a complete picture of a slowly occurring signal
- maintains a reference signal on the screen for comparison with an incoming signal
- reduces the time and cost of preparing photographic references.

Digital storage allows you to view pretrigger data, and digitize waveforms for processing or transmission over the IEEE Standard 488 interface, and more.

ANALOG AMPLIFIER TECHNOLOGY

An integral portion of any waveform acquisition and measurement system is the analog circuitry that is intially used for acquiring and conditioning the electronic signal. The highest level of precision and accuracy in this part of waveform testing resides in Tektronix instruments. Tektronix Digital Sampling Oscilloscopes (DSO), Digitizing Signal Analyzers (DSA), Communications Signal Analyzers (CSA), and analog real-time oscilloscopes have superior accuracy because of this technical strength. The 7000-Series instruments are among the analog real-time oscilloscopes that have this superior accuracy.

7000-SERIES SELECTION GUIDE

Instrument	Real-Time Bandwidth	Rise Time	Minimum Deflection Factor	Maximum Sweep Speed	Four Traces	Delayed Sweep	Technology
7104/R7103	1 GHz	350 ps	10 mV/div @ BW 10 µV/div 1 mA/div	200 ps/div	yes	yes	(MCP) Real Time
7904A/R7903	500 MHz	700 ps	10 mV/div @ BW 10 µV/div 1 mA/div	500 ps/div	yes	yes	Real Time
R7844	400 MHz	900 ps	10 mV/div @ BW 10 µV/div 1 mA/div	1 ns/div	yes (dual beam)	yes	Real Time
7603/R7603	100 MHz	3.5 ns	5 mV/div @ BW 10 µV/div 1 mA/div	5 ns/div	yes	yes	Real Time

Instrument	Real-Time Bandwidth	Rise Time	Maximum Sweep Speed	Stored Writing Speed	Storage Mode			Technology
					Bistable & Fast Bistable	Variable Persistance	Fast Variable Persistance	
7934	500 MHz	700 ps	500 ps/div	4000 cm/µs	yes	yes	yes	Real Time/ CRT Storage
7633/R7633	100 MHz	3.5 ns	5 ns/div	1000 cm/µs	yes	yes	yes	Real Time/ CRT Storage
7623A/R7623A	100 MHz	3.5 ns	5 ns/div	135 cm/µs	yes	yes	yes	Real Time/ CRT Storage
7613/R7613	100 MHz	3.5 ns	5 ns/div	4.5 cm/µs	no	no	yes	Real Time/ CRT Storage

Instrument	Real-Time Bandwidth	Analog/ Digitizing Bandwidth	Maximum Digitizing Rate	Vertical Resolution	Digitized Points per Waveform	Maximum Stored Waveforms	Technology
7854	400 MHz	400 MHz	500 kHz (ext. clock)	10 bits	up to 1024	40	Real Time/ Digital
7D20	10 MHz	70 MHz	40 MHz	8 bits	up to 1024	6	Real Time/ Digital

TECHNOLOGY HIGHLIGHTS

The highest performance, real-time oscilloscopes are the 7104 and R7103. The microchannel plate (MCP) CRT provides a trace 1,000 times brighter than conventional CRTs. This permits easy viewing or photographing of 1-GHz transient events. The MCP technology is a unique Tektronix technical advantage in real-time oscilloscopes. There are seven oscilloscopes in the real-time family.

The CRT storage technique is another Tektronix technical superiority that is incorporated into real-time oscilloscopes. The 7934 is an outstanding example of a 500 MHz, real-time oscilloscope that can capture single-shot or low-repetition rate events for long-term viewing or photography. There are seven oscilloscopes in the real-time, CRT-storage family.

The 7854 programmable digital oscilloscope has 400 MHz real-time capability, waveform digitizing features, calculations, stored programs, and plotter output capability. This oscilloscope, along with the 7D20 Programmable Digitizer, compose the two members of the real time/digital family.

OSCILLOSCOPE CONFIGURATIONS

Benchtop	
4 plug-in Compartments, 1 GHz	**7104**
4 plug-in compartments, 500 MHz, CRT Storage	**7904A, 7934**
4 plug-in compartments, 400 MHz, Digital Storage	**7934**
3 plug-in compartments, 100 MHz, CRT Storage	**7854**
3 plug-in compartments, 100 MHz	**7613, 7623A, 7633**
	7603
Rackmount	
3 plug-in compartments, 1 GHz	**R7103**
3 compartments, 500 MHz	**R7903**
4 plug-in compartments, 400 MHz, Dual-Beam	**R7844**
3 plug-in compartments, 100 MHz, CRT Storage	**R7613, R7623A, R7633**
3 plug-in compartments, 100 MHz	**R7603**

A TECHNOLOGY FOR EVERY APPLICATION

Real-Time

7104/R7103,7904A/ R7903,R7844,7603/ R7603

- You can capture the fastest transients at the rated bandwidth of each oscilloscope without expensive high-speed film or other time-consuming and complex techniques like fogging or reducing the scan.
- The 7104/R7103's outstanding writing speed means unsurpassed single-shot capability. Designers can monitor performance of digital-communication systems using phase-constellation displays.
- Real-time oscilloscopes (7104, 7904A) with 4 plug-in compartments are available for benchtop use at 1 GHz and 500 MHz. Rackmountable oscilloscopes with three plug-in compartments are available in the same bandwidth range (R7103, R7903). One rackmountable, dual-beam real-time oscilloscope features four plug-in compartments and 400 MHz real-time bandwidth (R7844). And there are two models at 100 MHz with three plug-in compartments (7603/R7603).

Real-Time/CRT Storage

Configurable CRT storage, real-time oscilloscopes, with bandwidths of 500 MHz and 100 MHz are included in this family.

7934

- The 7934 Storage Oscilloscope is used for fast single-shot, low-repetition rate, and high-speed pulse analysis.

7633/R7633,7623A/ R7623A,7613/R7613

- The 7600-Series CRT-Storage Oscilloscopes capture 100 MHz events for analysis. Capabilities include storing unexpected transient pulses common in power-generation and fast pulses – for applications ranging from lasers to high-speed ECL design.

Real-Time/Digital

7854/7D20

- The 7854 Waveform-Processing Oscilloscope has the features of a real-time oscilloscope and a digital-storage oscilloscope. The 7854 offers programmable measurement routines and a GPIB interface.
- The 7D20 is a GPIB programmable plug-in. With an R7603, Option 20 mainframe, it creates a fully programmable, digitizing oscilloscope.
- Dual samplers simultaneously acquire two channels like a dual-beam oscilloscope.
- Both units include popular features. Signal averaging recovers signals buried in random noise and improves measurement accuracy. One or two cursors are selectable for voltage and time measurements. Two cursors enable Δtime and Δvoltage measurements.

7104 R7103 *1-GHz OSCILLOSCOPES*

- ***Displays Fast Transients and Low Repetition Rate Signals Under Normal Lighting***
- ***1-GHz Bandwidth (350-ps Rise Time) at 10-mV/Div***
- ***200-ps/Div Fastest Calibrated Sweep Rate***
- ***350-MHz Horizontal Bandwidth***
- ***Ultra-High Photographic Writing Rate***
- ***Requires Only 7 Inches of Rackmount Space (R7103)***

The 7104/R7103 have both the highest writing speed and highest bandwidth available in a general-purpose oscilloscope today.

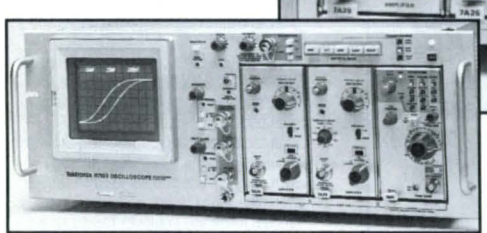
The 7104/R7103's outstanding writing speed means unsurpassed single-shot capability, with trace brightness about one thousand times that of conventional oscilloscopes. Any single-shot signal within the 1-GHz bandwidth can be seen directly on the CRT in average room light. Single-shot photography is now simple and straightforward, using standard oscillographic cameras and film.

You can capture the fastest transients without expensive high-speed film or other time-consuming and complex techniques like fogging or reducing the scan. In fact, you can see those signals on the CRT and eliminate costly time-consuming photographs.

Anomalies such as ringing and overshoot can only be dealt with by evaluating the signal's analog characteristics.

With a horizontal bandwidth of 350 MHz, and the Option 2, X-Y Phase-Compensation (7104), the 7104 will give accurate X-Y displays to 250 MHz.

7104 1-GHz Oscilloscope



R7103 1-GHz Oscilloscope

CHARACTERISTICS (7104/R7103)

VERTICAL SYSTEM

Channels – Two left-most plug-in compartments. Compatible with all 7000-Series plug-ins (except the 7D20).

The 7D20 Digitizer is not recommended for use in the 7104/R7103 mainframe. Such use will void the 7104/R7103 warranty.

Bandwidth, Rise Time and Deflection Factor – Determined by the plug-in used. See page 83.

Display Modes – Left, Alt, Add, Chop, and Right. Chopped-mode repetition rate is ≈1 MHz.

Trace Separation – (7104) In dual-sweep modes, positions B trace at least four divisions above and below A trace.

Delay Line – Permits viewing leading edge of displayed waveform.

HORIZONTAL SYSTEM

Channels – Two right-most plug-in compartments (7104 only, R7103 has one horizontal compartment). Compatible with the 7B10-Series, 7B80-Series, 7B92A, 7000-Series vertical amplifiers, and specialized plug-ins (the 7D20 is not recommended).

Bandwidth – DC to 350 MHz.

Display Modes – (7104) A, Alt, Chop, B. Chopped-mode repetition rate is ≈ 200 kHz.

Fastest Calibrated Sweep Rate – 200 ps/div with the 7B10 or 7B15.

X-Y Mode – With Option 02, X-Y Phase Compensation (7104 only): Phase shift is 2° from dc to 50 MHz . Phase balance can be obtained at any frequency up to 250 MHz. Without Option 02, X-Y Phase Compensation: Phase shift is 2° from dc to 50 kHz.

CRT AND DISPLAY FEATURES

CRT – Internal 8 x 10-division (0.85 cm/div) graticule with variable illumination. Accelerating potential is 12.5 kV.

Readout and Graticule Modes – Continuous or pulsed. Pulse source front-panel selectable: + Gate, External, Manual. Pulsed graticule is on for ≈ 0.5 s.

Photographic Writing Speed – 20 cm/ns.

Autofocus – Compensates for changes in intensity after focus control has been set.

Beam Finder – Aids in locating offscreen signal.

External Z-Axis Input – 2 V p-p for full intensity range. A positive signal blanks the trace. Maximum input voltage is 15 V (dc + peak ac) or 15 V p-p ac. Input is dc coupled.

CALIBRATOR

Voltage Output – Square wave, positive-going from ground.

Voltage Ranges – 40 mV, 0.4 V, and 4 V into 100 kΩ; 4 mV, 40 mV, and 0.4 V into 50 Ω. Amplitude accuracy is within 1%. Repetition rate is 1 kHz within 0.25%. Output R is 450 Ω.

Current Output – 40 mA rectangular waveshape with optional current loop accessory (012-0341-00) connected to calibrator output.

OUTPUTS/INPUTS

+ Sawtooth – Starts 1 V or less from ground into 1 MΩ. Output voltage is 50 mV/div (±15%) into 50 Ω, 1 V/div (±10%) into 1 MΩ. Output R is ≈ 950 Ω.

+ Gate – Positive-going rectangular waveform. Output voltage is 0.5 V (±10%) into 50 Ω, 10 V (±10%) into 1 MΩ. Rise time is 5 ns or less into 50 Ω. Output R is ≈ 950 Ω.

Vertical Signal Out – Output voltage is 25 mV/div into 50 Ω, 0.5 V/div into 1 MΩ. Output R is ≈ 950 Ω. Bandwidth is determined by the plug-in used, see page 83.

Camera Power – C-50-Series camera. See pages 96-97.

Probe Power – Two rear-panel connectors for active probes. See pages 96-97.

External Single-Sweep Reset – A ground signal applied to the rear-panel BNC input will reset the sweep.

Single-Sweep Ready Indicator – Rear-panel BNC provides 5 V out to indicate single-sweep ready condition.

Graticule/Readout, Single Shot – Ground closure, rear-panel BNC input initiates one frame of CRT readout. Graticule is illuminated for ≈ 0.5 s.

POWER REQUIREMENTS

Line-Voltage Ranges – 90 to 132 V ac and 180 to 250 V ac.

Line Frequency – 48 to 440 Hz.

Maximum Power Consumption – 215 W (7104) and 165 W (R7103), 3.3 A at 90 V line, 60 Hz.

ENVIRONMENTAL AND SAFETY

Temperature – Operating: 0 to 50°C.

Humidity – Operating and Nonoperating: 95%, five cycles (120 hours), referenced to MIL-E-16400F.

EMC Capability – (R7103, 7104 Option 03) Meets MIL-STD-461B requirements when tested in accordance with certain test methods of MIL-STD-462.

Safety – UL listed (UL 1244) and CSA certified (CSA 556B).

CHARACTERISTICS (R7103 ONLY)

The R7103 requires only seven inches of rack height in a standard 19-inch rack. It is fan cooled and comes complete with slideout chassis.

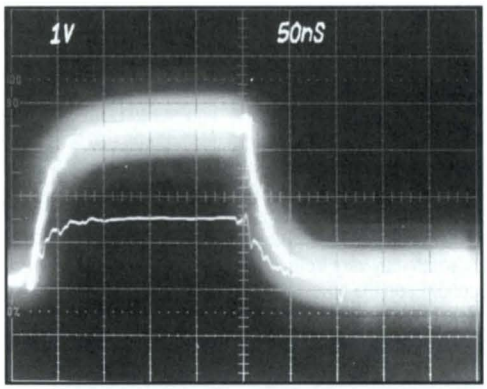
HORIZONTAL SYSTEM

Single Channel – Right-hand plug-in compartment compatible with 7000-Series time bases. The 7B10 and 7B15 are recommended.

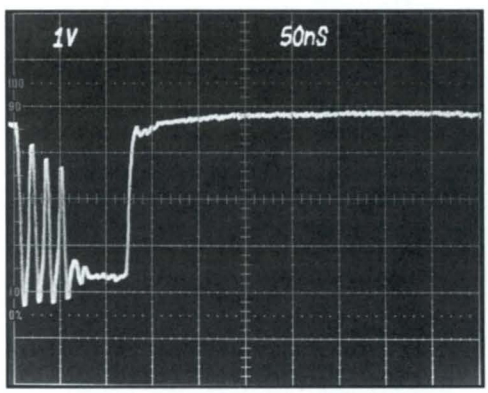
X-Y Mode – Phase shift is 2° from dc to 50 kHz.

OUTPUTS/INPUTS

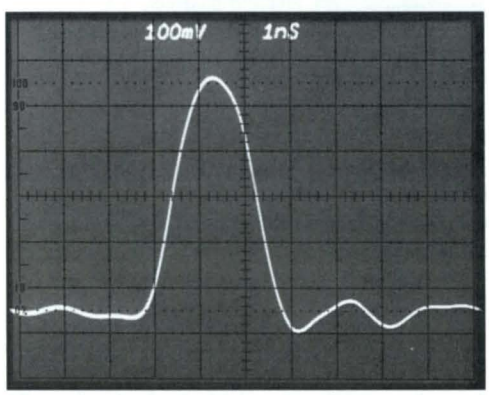
Vertical Signal Out – Output voltage is 25 mV/div within 25% into 50 Ω, 0.5 V into 1 MΩ. Output R is ≈ 950 Ω.



A pulse train with a low level pulse on the 7104/R7103, with one thousand times the brightness of conventional oscilloscopes. The researcher can view the pulse directly and take pictures with ease.



A pulse on the 7104/R7103 readily indicates that the problem is input-signal bounce.



View of a single clocking pulse of 0.8-ns rise and 2-ns pulse width.

ORDERING INFORMATION

(PLUG-INS NOT INCLUDED)

7104 1-GHz Oscilloscope **$29,995**
Includes: Power cord (161-0066-00); instruction manual (070-2314-00); operator manual (070-2315-00).

R7103 1-GHz Rackmount Oscilloscope **$30,200**
Includes: Power cord (161-0066-00); operator manual (670-5038-00); mask frame (426-0514-00); CRT filter (378-0625-00); drawer slide (351-0375-01); right spacer (361-0806-00); left spacer (361-0807-00); hardware kit (016-0099-00) instruction manual (070-5039-00).

INSTRUMENT OPTIONS (7104)

Opt. 02 – X-Y Horizontal Compensation **+$375**
Opt. 03 – EMC Capability **+$420**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1-A5 – Available **NC**
See page 488.

CONVERSION KIT (7104)

EMC Modification – Order 040-0965-00. **$605**

ACCESSORIES

Recommended Cameras – See pages 96-97.
Recommended Carts – See page 97.
Recommended Probes – See pages 96-97.

PHYSICAL CHARACTERISTICS

	7104		R7103	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	305	12.0	483	19.0
Height	345	13.6	178	7.0
Depth	592	23.3	704	27.7
Weight ≈	**kg**	**lb**	**kg**	**lb**
Net	20.4	45.0	20.0	44.0
Shipping	25.4	56.0	30.9	68.0

7934 *500-MHz, CRT-STORAGE OSCILLOSCOPE*

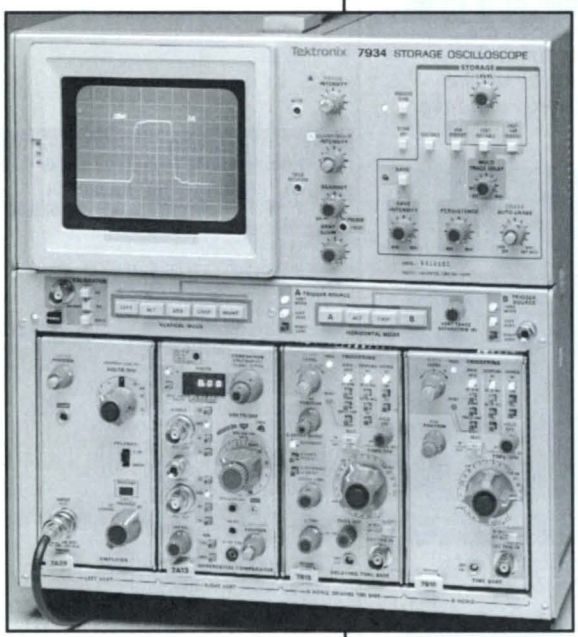
- ***Real-Time Storage of Fast Transients for Later Analysis***
- ***Displays Low Repetition Rate Signals***
- ***Wide Selection of Versatile Plug-Ins***
- ***700-ps Single-Shot Rise-Time Storage Capability***
- ***DC to 500-MHz Bandwidth***
- ***4000-cm/μs Stored Writing Speed***
- ***500-ps/Div Fastest Calibrated Sweep Rate***

The 7934 CRT-Storage Oscilloscope is used for single-shot and low-repetition rate pulse analysis. Capabilities include storing unexpected transient pulses, high-frequency bursts occurring at low-repetition rates, and fast pulses in applications using high-speed ECL.

A 4000 cm/μs storage writing rate, 700 ps rise time, and 500 MHz bandwidth ensure undistorted capture and clear display of the fastest waveform details. The 7934 can be used as a non-storage oscilloscope as well.

The mainframe bandwidth is 500 MHz. System bandwidth may vary from 80 MHz to 500 MHz, depending on the plug-in used.*1

The instrument has four storage modes. Bistable mode provides stored displays with long (30 minute) view time. When viewing changing waveshapes, Variable Persistence mode provides continuous bright displays of new information as old information fades from the CRT. Fast Bistable mode increases writing speed to 350 cm/μs (reduced scan). Fast Variable Persistence mode provides the maximum stored writing speed of 4000 cm/μs (reduced scan). View time is at least 30 seconds.



*1 *High-gain differential amplifiers offer very high gain at lower bandwidth.*

CHARACTERISTICS

VERTICAL SYSTEM

Channels – Two left-most plug-in compartments. Compatible with 7000-Series amplifier plug-ins.

Bandwidth, Rise Time, and Deflection Factor – Determined by the plug-in unit used. See page 83.

Display Modes – Left, Alt, Add, Chop, Right. Chopped-mode repetition rate is 1 MHz.

Trace Separation – Positions B trace at least four divisions above or below the A trace.

Delay Line – Permits viewing leading edge of displayed waveform.

HORIZONTAL SYSTEM

Channels – Two right-most plug-in compartments. Compatible with most 7000-Series plug-ins.

Bandwidth – DC to at least 1 MHz.

Display Modes – A, Alt, Chop, B. Chopped-mode repetition rate is ≈ 200 kHz.

Fastest Calibrated Sweep Rate – 500 ps/div.

X-Y Mode – Phase shift between vertical and horizontal channels is within 2° from dc to 35 kHz without phase correction (dc to 1 MHz with phase correction, B horizontal only, Option 02). Bandwidth is dc to at least 1 MHz.

CRT AND DISPLAY FEATURES

CRT – Internal variable illuminated graticule. 8 x 10 divisions (0.9 cm/div) graticule in full scan and 8 x 10 divisions (0.45 cm/div) in reduced scan.

Autofocus – Maintains CRT focus following changes in display intensity after focus control has been set.

Beam Finder – Aids in locating an off-screen signal.

Autoerase – Variable from < 1 s to >10 s.

Multitrace Delay – Adjusts the transfer cycle time in the fast transfer modes. Variable from < 1 s to > 4 s.

Persistence – (Variable-Persistence Mode only) Controls rate of continuous erasure of the variable-persistence and fast variable-persistence stored displays.

Save – Prevents display from being accidentally erased, and provides up to 30 times longer viewing times in variable-persistence modes.

External Z-Axis Input – 2 V p-p for full intensity range from dc to 1 MHz. Maximum input is 15 V (dc + peak ac).

CALIBRATOR

Voltage Output – Positive square wave.

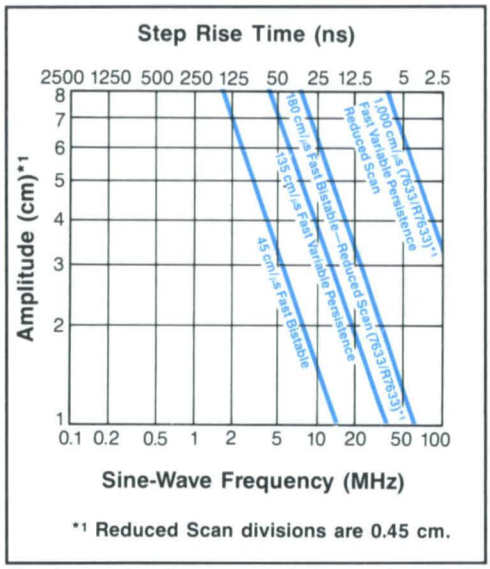
Voltage Range – 40 mV, 0.4 V, and 4 V into 100 kΩ; 4 mV, 40 mV, and 0.4 V into 50 Ω. Amplitude accuracy is within 1%; repetition rate is ≈1 kHz within 0.25%. Output R is 450 Ω.

Current Output – 40-mA square wave with optional current-loop accessory (012-0341-00) connected to calibrator output.

OUTPUTS/INPUTS

+ Sawtooth – Starts 1 V or less from ground into 1 MΩ. Output voltage is 1 V/div (±10%) into 1 MΩ, 50 mV/div (±15%) into 50 Ω. Output R is ≈ 950 Ω.

Vertical-Signal Out – Selected by B Trigger Source switch. Output voltage is 0.5 V/div (±25%) into 1 MΩ, 25 mV/div (±25%) into 50 Ω. Output R is ≈ 950 Ω. Bandwidth is determined by the plug-in used, see page 83.



Graph showing the stored writing speed needed to display a given sine wave or step rise time at a given amplitude.

+ Gate – Positive pulse of the same duration as and coincident with sweep selectable from A Gate, B Gate, or A Delayed Gate. Output voltage is 10 V (±10%) into 1 MΩ, 0.5 V (±10%) into 50 Ω. Output R is ≈ 950 Ω.

Remote Single Sweep Reset, Remote Save, and Remote Erase – Rear-panel BNC connector inputs, ground-closure activated.

Remote Fast Transfer Gate – TTL compatible. Low-to-high transition enables high-speed target to receive information to be stored; high-to-low transition initiates transfer from high-speed target to storage target.

Camera Power – C-50-Series cameras. See pages 96-97.

Probe Power – Two rear-panel connectors for two active probes. See pages 96-97.

POWER REQUIREMENTS

Line-Voltage Ranges – 90 to 132 V ac and 180 to 250 V ac.

Line Frequency – 48 to 440 Hz.

Maximum Power Consumption – 230 W.

ENVIRONMENTAL AND SAFETY

Temperature – Operating: 0 to 50°C.

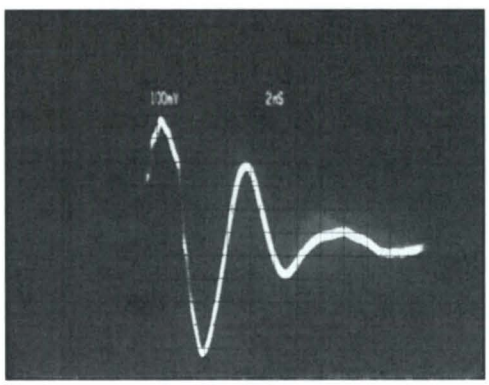
Vibration – Referenced to MIL-T 28800C.

Humidity – Referenced to MIL-E-16400F.

Shock – Referenced to MIL-T-28800C.

EMC Capability – Meets MIL-STD-461B requirements when tested in accordance with certain test methods of MIL-STD-462.

Safety – UL listed (UL 1244) and CSA certified (CSA 556B); meets VDE 0871 Class B.



In laser research – the 7934 captures a laser primary and reflected pulse using Fast Variable-Persistence storage (reduced scan) and two 7A29 plug-ins in ADD mode.

Highest Storage Writing Speed –

	Reduced Scan (Center 8 x 10 div at 0.45 cm/div)			
Display Mode	**Fast Variable Persistence**	**Fast Bistable**	**Variable Persistence**	**Bistable**
Stored Writing Speed	(8800 div/µs)	(776 div/µs)	(12 div/µs)	(0.2 div/µs)
View Time*1	30 s*1	30 min	30 s*1	30 min
≈ Erase Time	1.4 s	1.4 s	0.9 s	0.9 s

*1 *View times are at full-stored display intensity. They may be increased more than 30 times by using reduced intensity in the Save display mode.*

ORDERING INFORMATION

(PLUG-INS NOT INCLUDED)

7934 – CRT-Storage Oscilloscope **$15,100**
Includes:
Installed gray CRT filter (378-0625-02); green CRT filter (378-0625-08); power cord (161-0066-00); operator manual (070-5879-00).

INSTRUMENT OPTIONS

Opt. 02 – X-Y Mode Phase Correction **+$275**
Adds X-Y delay compensation network to equalize the signal delay between the B horizontal compartment and either vertical compartment.

Opt. 03 – EMC capability **+$420**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1-A5 Available **NC**
See page 488.

CONVERSION KITS

X-Y Mode Phase Correction – Order 040-0942-01 **$210**

EMC Modification – Order 040-1195-00 **$525**

ACCESSORIES

Service Manual – Order 070-5880-00 **$150**

Rack Adaptor – See page 97.

Recommended Cameras – See pages 96-97.

Recommended Cart – See page 97.

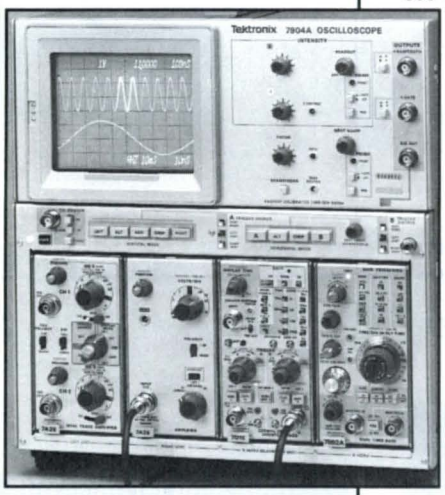
Recommended Probes – See pages 96-97.

PHYSICAL CHARACTERISTICS

Dimensions	**mm**	**in.**
Width	305	12.0
Height	345	13.6
Depth	622.5	24.5
Weight ≈	**kg**	**lb**
Net	17.2	37.8
Shipping	21.6	47.6

7904A R7903 *500-MHz, GENERAL-PURPOSE OSCILLOSCOPES*

- ***500-MHz Bandwidth at 10 mV/Div***
- ***700-ps Rise Time (7904A)***
- ***500-ps/Div Fastest Calibrated Sweep Rate***



The 7904A and R7903 are high-bandwidth oscilloscopes. The 7A29 Amplifier/7904A system attains 500-MHz bandwidth at 10 mV/div. A 7A29 variable-delay option allows for the matching of signal-transit times of two plug-ins and their probes to better than 10 ps.

ORDERING INFORMATION

(PLUG-INS NOT INCLUDED)

7904A – Oscilloscope **$12,750**
Includes: Power cord (161-0066-00); instruction manual (070-4593-00); operator manual (070-1462-00).

R7903 – Rackmount Oscilloscope **$12,100**
Includes: Power cord (161-0066-00); test adaptor (012-0092-00); two 18-in. test leads (012-0087-00); slide guide (351-0314-01); hardware kit (016-0099-00) instruction manual (070-1464-00).

INSTRUMENT OPTIONS

Opt. 02 – X-Y Horizontal Compensation (7904A only). **+$275**
Opt. 03 – EMC Modification. **+$410**
Opt. 10 – (R7903) Pulsed Graticule **+$275**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 - A5 Available **NC**
See page 488.

ACCESSORIES

Recommended Cameras – See pages 96-97.
Recommended Carts – See page 97.
Recommended Probes – See pages 96-97.

PHYSICAL CHARACTERISTICS

	7904A		R7903	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	305	12.0	483	19.0
Height	345	13.6	135	5.3
Depth	622.5	24.5	579	22.8
Weight ≈	**kg**	**lb**	**kg**	**lb**
Net	17.2	37.8	12.3	27.0
Shipping	21.6	47.6	23.6	52.0

CHARACTERISTICS (7904A/R7903)

VERTICAL SYSTEM

Channels – Two left-most plug-in compartments.

Bandwidth, Rise Time, and Deflection Factor – Determined by the plug-in unit used. See page 83.

Display Modes – Left, Alt, Add, Chop, Right. Chopped-mode repetition rate is ≈1 MHz.

Delay Line – Permits viewing leading edge of displayed waveform when using 7B80 and 7B90-Series time bases.

HORIZONTAL SYSTEM

Channels – 7904A: Two right-most plug-in compartments. R7903: One right-most plug-in compartment.

Bandwidth – DC to at least 1 MHz.

Display Modes – A, Alt, Chop, B. Chopped-mode repetition rate is ≈ 200 kHz.

Fastest Calibrated Sweep Rate – 500 ps/div (7B10, 7B15, or 7B92A).

X-Y Mode – With Delay Compensation: Phase shift is within 2° from dc to 1 MHz.

CRT AND DISPLAY FEATURES

CRT – Internal 8 x 10-division (0.85 cm/div) graticule with variable illumination.

Autofocus – Reduces the need for additional manual focusing with changes in intensity after focus control has been set.

Beam Finder – Aids in locating signal.

External Z-Axis Input – 2 V p-p for full intensity range. Maximum input voltage is 15 V.

CALIBRATOR

(Not available with Option 10 on R7903)

Output Waveshape – Rectangular, positive-going from ground.

Voltage Ranges – 40 mV, 0.4 V, 4 V into an open circuit. 4 mV, 40 mV, 0.4 V into 50 Ω. Output R is ≈ 450 Ω.

Current Output – 40 mA with optional current-loop accessory (012-0341-00).

OUTPUTS/INPUTS

+ Sawtooth – Sawtooth starts 1 V or less from ground into 1 MΩ. Front-panel selectable from A or B horizontal. Output voltage is 50 mV/div (±15%) into 50 Ω, 1 V/div (±10%) into 1 MΩ. Output R is ≈ 950 Ω.

+ Gate – Positive-going rectangular waveform derived from A, B, or Delayed Gate, front-panel selectable. Output voltage is 0.5 V (±10%) into 50 Ω, 10 V (±10%) into 1 MΩ. Rise time is 5 ns or less into 50 Ω. R7903: Rise time is 7 ns.

Vertical Signal Out – Selected by B Trigger Source switch. Output voltage is 25 mV/div into 50 Ω, 0.5 V/div into 1 MΩ. Output R is ≈ 950 Ω. Bandwidth is determined by the vertical plug-in used, see page 83.

Camera Power – C-50-Series cameras. See pages 96-97.

Probe Power – Two rear-panel connectors for two active probes. See pages 96-97.

POWER REQUIREMENTS

Line-Voltage Ranges – 90 to 132 V ac and 180 to 250 V ac (7904A); 90 to 132 V ac and 180 to 264 V ac (R7903).

Line Frequency – 48 to 440 Hz.

Maximum Power Consumption – 210 W, 3.5 A at 90 V line, 60 Hz (7904A); 160 W, 2A at 115 V line, 60 Hz (R7903).

ENVIRONMENTAL AND SAFETY

Ambient Temperature – Operating: 0 to +50°C.

Humidity – Operating and Nonoperating: 95%, referenced to MIL-E-16400F.

EMC Capability – (Option 03) Meets MIL-STD-461B requirements when tested in accordance with certain test methods of MIL-STD-462.

Safety – UL listed (UL 1244) and CSA certified (CSA 556B for the 7904A only).

CHARACTERISTICS (R7903 ONLY)

The R7903 requires only 5.25 inches of rack height in a standard 19-inch rack. It is fan cooled and comes complete with slide out chassis tracks.

PULSED GRATICULE OPTION

Option 10, Pulsed Graticule – The graticule lights may be pulsed by the event, an external ground closure, or a front-panel pushbutton. Deletes probe power and CRT readout.

OUTPUTS/INPUTS (STANDARD)

External Single-Sweep Reset – Ground closure, rear-panel input to reset sweep.

Single-Sweep Ready Output – Rear-panel BNC provides 5 V out for single-sweep-ready condition.

Tektronix offers service training classes on the 7904A/R7903. For further training information, contact your local Sales Office and request a copy of the Tektronix Service Training Catalog.

- *View Two Simultaneous Events at Two Different Sweep Speeds*
- *View the Same Event at Two Sweep Speeds*
- *400-MHz Bandwidth (900-ps Rise Time)*
- *1-ns/Div Fastest Calibrated Sweep Rate*
- *Greater Than 1.5-cm/ns Writing speed*
- *8 x 10-cm Display*
- *True Dual Beam (Dual Gun)*
- *Full Vertical Crossover Switching*

The seven-inch rackmount R7844 is a high-bandwidth, dual-beam oscilloscope used for single-shot events. Vertical-signal crossover switching displays a single event from a single probe at two sweep speeds.

CHARACTERISTICS

VERTICAL SYSTEM

Channels – Two left-most plug-in compartments.

Bandwidth, Rise Time, and Deflection Factor – Determined by the mainframe/plug-in used. See page 83.

Display Logic –

	Beam 1	Beam 2
Vertical Compartment	Left	Left
Controlling Beam	Left Right Right	Right Left Right

Crossover – Permits viewing the same signal on two time bases.

Trace Separation – Beam 1 can be positioned ±4 cm with respect to Beam 2.

Delay Line – Permits viewing leading edge of displayed waveform when using 7B10, 7B80, and 7B90–Series time bases. Not compatible with 7B50-Series.

HORIZONTAL SYSTEM

Channels – Two right-most plug-in compartments. Compatible with 7B10-, 7B80-, and 7B90-Series Time Bases; 7000-Series Amplifiers; and specialized plug-ins.

Bandwidth – DC to at least 1 MHz.

Fastest Calibrated Sweep Rate – 1 ns/div.

X-Y Mode – Phase shift is within 2° from dc to 50 kHz.

Horizontal Separation – Beam 1 can be positioned at least 0.25 cm to the right and at least 0.25 cm to the left of Beam 2 with a total 2 cm range.

Display Logic –

Beam 1	Beam 2
A Horizontal	A Horizontal
A Horizontal	B Horizontal
B Horizontal	A Horizontal
B Horizontal	B Horizontal

CRT AND DISPLAY FEATURES

CRT – Dual beam, full overlap. 8 x 10-cm graticule with variable illumination. CRT readout intensity is adjustable with front-panel control.

Pulsed Readout and Graticule Illumination – The graticule lights and CRT readout can be pulsed by the event or a pushbutton.

Typical Photographic Writing Speed –

CRT	Camera	Lens	Writing Speed *1
Std. 8 x 10 cm	C-51	f / 1.2	0.75 cm/ns
Opt. 78, 8 x 10 cm	C-51	1:0.5	1.5 cm/ns

*1 *Option 22 provides a preset automatic method of film fogging for the R7844.*

Autofocus – Eliminates manual focusing with changes in intensity after focus control has been set.

Beam Finder (Beam 1 and Beam 2, Independent Controls) – Aids in locating off-screen signal.

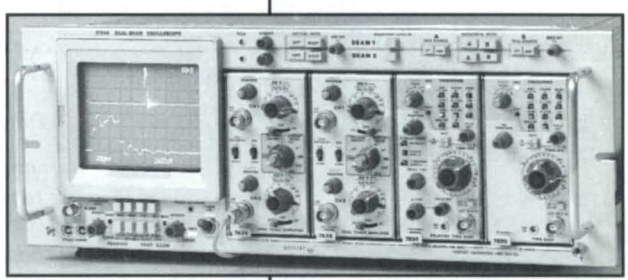
External Z-Axis Input (Beam 1 and Beam 2) – 2 V p-p for full intensity range. Maximum input voltage is 15 V (dc + peak ac), p-p ac, dc coupled.

CALIBRATOR

Voltage Output – Rectangular waveform positive-going from ground, 1 kHz (±0.25%).

Voltage Ranges – 4 mV, 40 mV, 0.4 V, 4 V (±1%) into an open circuit; 0.4 mV, 4 mV, 40 mV, 0.4 V (±1%) into 50 Ω. Output R is 450 Ω.

Current Output – 40 mA (±1%) rectangular wave-shape. Optional current-loop adaptor (012-0341-00) required for R7844.



OUTPUTS/INPUTS

A and B + Sawtooth – Sawtooth starts 1 V or less from ground (into 1 MΩ). Output voltage is 50 mV/div (±15%) into 50 Ω, 1 V/div (±10%) into 1 MΩ. Output R is ≈ 950 Ω.

A and B + Gate – Positive-going rectangular waveform derived from Main or Delayed Gate. Output voltage 0.5 V (±10%) into 50 Ω. 10 V (±10%) into 1 MΩ. Rise time is 5 ns or less into 50 Ω. Output R is ≈ 950 Ω.

Camera Power – C-50-Series cameras. See pages 96-97.

Probe Power – Two connectors provide correct operating voltages for two active probes. See pages 96-97.

External Single-Sweep Reset – Ground closure, rear-panel BNC provides input to reset sweeps.

Single-Sweep Ready Output – +5 V, rear-panel BNC output for single-sweep ready indication.

POWER REQUIREMENTS

Line Voltage Ranges – Selectable 115 V nominal (90 to 132 V), 230 V nominal (180 to 264 V).

Line Frequency – 48 to 440 Hz.

Maximum Power Consumption – 235 W, 2.9 A at 60 Hz 115 V line.

ENVIRONMENTAL AND SAFETY

Ambient Temperature – Operating: 0 to +50°C.

Vibration – Operating: 15 minutes along each of the three major axes. 0.04 cm (0.015 in.) p-p displacement from 10 Hz to 50 Hz in one-minute cycles. Held for three minutes at 50 Hz.

Humidity – Operating and Nonoperating: 95%, referenced to MIL-E-16400F.

EMC Capability – (Option 03) Meets MIL-STD-461B requirements when tested in accordance with certain test methods of MIL-STD-462.

ORDERING INFORMATION

(PLUG-INS NOT INCLUDED)

R7844 Rackmount Oscilloscope **$19,500**
Includes: Power cord (161-0066-00); instruction manual (070-1676-02); operator manual (070-1675-00); hardware rackmount kit (016-0099-00); slide guide (351-0314-01).

INSTRUMENT OPTIONS

Opt. 03 – EMC Modification **+$420**
Opt. 22 – Writing-Speed Enhancer **+$480**
Opt. 78 – BE (P11) Phosphor **+$100**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1-A5 Available **NC**
See page 488.

ACCESSORIES

Recommended Cameras – See pages 96-97.
Recommended Carts – See page 97
Recommended Probes – See pages 96-97.

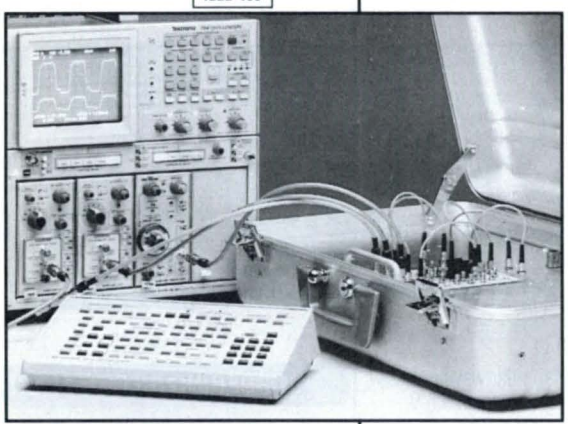
PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	483	19.0
Height	178	7.0
Depth	630	24.8
Weight ≈	**kg**	**lb**
Net	15.0	33.0
Shipping	28.6	63.0

7854 *400-MHz, DIGITAL-STORAGE, WAVEFORM-PROCESSING OSCILLOSCOPE*

- *Real-Time Analog and Digitizing Oscilloscope*
- *On-Board Calculations*
- *Waveform Parameters*
- *DC to 400-MHz Bandwidth at 10 mV/Div*
- *Calibrated Sweep Rates to 500 ps/Div*
- *Stores Repetitive Waveforms*
- *Signal Averaging*
- *Stored Resolution Up to 10-Bits*
- *128, 256, 512, 1024 Points/Waveform*

GPIB* IEEE-488



The 7854 Waveform-Processing Oscilloscope combines the features of a high-performance real-time oscilloscope with digital storage and waveform processing. The 7854 offers programmable measurement routines, IEEE Standard 488 interface for mass data and program storage, plus simultaneous display of real-time and stored waveforms. The 7854's memory stores up to 40 waveforms and 2000 keystrokes.

Waveform-parameter information is obtained at the touch of a button. Calculator-keyboard features enable arithmetic manipulation of waveforms such as differential, integral, log, and absolute value. Signal averaging improves measurement accuracy. One cursor provides voltage measurements and time measurements referenced to time zero. Two cursors enable Δtime and Δvoltage measurements.

CHARACTERISTICS

VERTICAL REAL-TIME SYSTEM

Input – Two 7000-Series plug-in compartments.

Modes – Left, Alt, Add, Chop, Right.

Mainframe Bandwidth – 400 MHz.

Mainframe Step Response – 0.9 ns or less.

Chopped Mode – Chop rate is ≈1 MHz.

Trace Separation Range – B trace can be 4 divisions from the A trace.

CRT AND DISPLAY FEATURES

CRT Display Modes – Conventional display, digital data display, user program text display.

HORIZONTAL REAL-TIME SYSTEM

Input – Two 7000-Series plug-in compartments.

Modes of Operation – A, Alt, Chop, B.

Fastest Calibrated Sweep Rate – 0.5 ns/div.

Chopped Mode – Repetition rate is ≈ 200 kHz.

X-Y Mode – Phase shift between vertical and horizontal channels is dc to 1 MHz with phase correction. (Option 02.)

DIGITAL STORAGE

Equivalent-Time Bandwidth – Determined by the plug-in used, see page 83.

Accuracy – See plug-in specifications, page 83.

Acquisition Channels – One or two simultaneous channels (no Chop mode).

Acquisition Window – ±5 div from center screen, both vertical and horizontal.

Resolution – Vertical: 0.01 div. Horizontal: 128 to 1024 selectable points/waveform.

PLUG-IN COMPATIBILITY

All 7000-Series plug-ins are compatible in the standard oscilloscope display mode.

OUTPUTS/INPUTS

+ Sawtooth – Positive-going with baseline at 0 V ±1 V into 1 MΩ. Voltage is 1 V/div (±10%) into 1 MΩ, 50 mV/div (±15%) into 50 Ω. Output R is ≈ 950 Ω.

+ Gate – Positive pulse of the same duration as and coincident with sweep. Output voltage is 10 V (±10%) into 1 MΩ, 0.5 V (±10%) into 50 Ω. Output R is ≈ 950 Ω. Source is selectable from A gate, B gate, or Delayed gate.

Vertical Signal Out – Selected by A Trigger Source switch. Output is 0.5 V/div into 1 MΩ, 25 mV/div into 50 Ω. Output R is ≈ 950 Ω.

Remote Single-Sweep Reset – Rear-panel BNC, ground closure activated.

TTL Output – Rear-panel BNC, TTL output under keyboard control (SWH and SWL).

External Z-Axis Input – 2 V p-p for full intensity range from dc to 1 MHz. Positive signal blanks the trace. Maximum voltage is 15 V (dc + peak ac).

Camera-Power Output – C-50-Series cameras. See pages 96-97.

GPIB Interface Subsets Implemented – SH1, AH1, T5, L3, SR1, RL1, DC1, DT1, PP0, C0.

CALIBRATOR

Voltage Output – Positive square wave. Ranges are 40 mV, 0.4 V, and 4 V into 100 kΩ; 4 mV, 40 mV, and 0.4 V into 50 Ω. Amplitude accuracy is within 1%; repetition rate is 1 kHz within 0.25%.

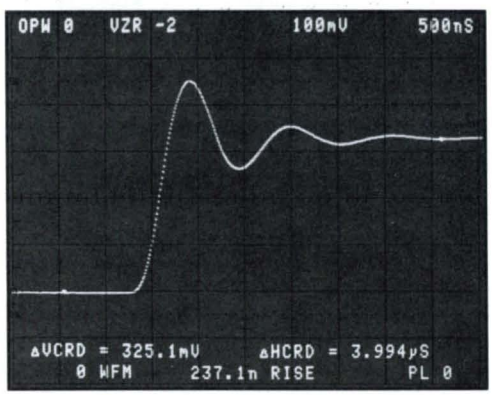
Current Output – 40 mA with optional BNC-to-current-loop adaptor.

POWER REQUIREMENTS

Line-Voltage Ranges – 90/132 V; 180/250 V.

Line Frequency – 48 to 440 Hz.

Maximum Power Consumption – 230 W.



Storage Oscillocope: Rise time is calculated by pushing a single key. Time and voltage differences between cursors are shown on the line above rise time.

ORDERING INFORMATION

(PLUG-INS NOT INCLUDED)

7854 – Oscilloscope, including Waveform Calculator **$17,000**
Includes: Power cord (161-0066-00); BNC-to-BNC cable (012-0208-00); operator manual (070-2873-00); service manual (070-2874-01); signature analysis tables (070-2972-00).

INSTRUMENT OPTIONS

Opt. 02 – X-Y Phase Correction **+$275**
Opt. 03 – EMC Modification **+$420**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1-A5 Available **NC**
See page 488.

ACCESSORIES

Recommended Cart – See page 97.
Recommended Cameras – See pages 96-97.
Recommended Plotter – See page 97.
Recommended Probes – See pages 96-97.
Recommended Software – See page 98.

PHYSICAL CHARACTERISTICS

	7854		Mainframe Calculator	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	305	12.0	277	10.9
Height	348	13.7	69	2.7
Depth	627	24.7	165	6.5
Weight ≈	**kg**	**lb**		
Net	20.4	45.0		
Shipping	28.2	62.0		

**The 7854 is designed to support other products that comply with IEEE Standard 488-1975*

Tektronix offers service training classes on the 7854. For further training information, contact your local Sales Office and request a copy of the Tektronix Service Training Catalog.

- *Automated Testing*
- *Digital Storage*
- *70-MHz Bandwidth for Repetitive Signals (10-MHz Single-Shot Bandwidth)*
- *Two Channels Simultaneous Acquisition*
- *Programmable*
- *Storage of Six Waveforms*
- *Enveloping and Signal Averaging*
- *Cursor Measurements*
- *Pretrigger and Posttrigger*

The 7D20 is a GPIB programmable digitizer, with IEEE Standard 488 interface, that plugs into any 7000-Series mainframes (except not recommended with the 7104/R7103). The 7D20 measures amplitudes of 50-ns-wide transient events. Dual samplers simultaneously acquire two channels like a dual beam oscilloscope.

The 7D20 offers envelope displays, pretrigger, storage of six independent waveforms plus a reference waveform, cursors for dot measurements, user and menu displays, and averaging to reduce noise.

Digital Storage is at a 40-MHz sampling rate. Up to six different setups can be stored in nonvolatile memory and recalled.

TekMAP Software support is available (see page 98). Data results are available in graphic or tabular form.

CHARACTERISTICS

VERTICAL SYSTEM

Input – Two simultaneous channels, BNC connectors.

Acquisition Modes – CH 1, CH 2, Add, Both.

Sensitivity – 5 mV to 5 V/div.

Bandwidth – 70 MHz max. (AC-Coupled Low-Frequency Response: 10 Hz or less.)

Step Response – 5 ns or less.

Input Impedance – 1 MΩ in parallel with by ≈ 20 pF.

Maximum Input Voltage – DC Coupled: 250 V, 1 kHz. AC Coupled: 400 V, 1 kHz.

Signal Isolation – 100:1 dc to 20 MHz.

Vertical Resolution – 8 bits, 256 levels, 0.04 div/level.

Gain Ratio Accuracy – < 2%. max. error over the V/div range. Measurement valid with Cursors or GPIB.

Noise – Less than 0.25%.

Phase Match X-Y – < 2° from dc to 10 MHz.

HORIZONTAL SYSTEM

Time/Division Range – Ext. Clock: 20 s to 50 ns/div.

Digitizing Technique vs Time/Division – Equivalent Time: 1 µs to 50 ns/div.

Note: Single events can be captured as fast as 2 µs/div. For 1 µs to 50 ns/div, repetitive events are required to build a complete waveform.

Time Measurement Accuracy – One Cursor: 0.1% ±300 ps. Two Cursors: 0.1% ±600 ps.

SIGNAL PROCESSING

Cursors Readout – With one cursor (ΔOff), values are referenced to zero volts and zero time. With two cursors (ΔOn), values are the difference between the two cursors.

Waveform Averaging – N waveforms are averaged as in AVE N, then additional waveforms are weighted at 1/N. A running average (smooth) is available in Roll mode.

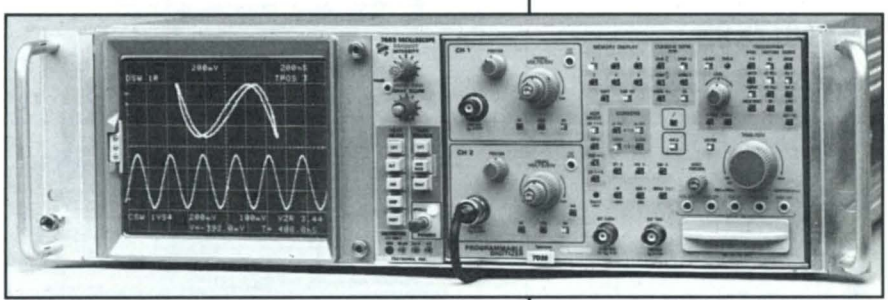
Enveloping – A self-terminating recording of waveform maxima and minima OR a continuous recording of waveform maxima and minima.

Hold Next – Initiates Hold Next condition; connected to Single-Sweep Reset connector.

Programmable Functions – All settings and operating modes are programmable except for Variable V/div and Horizontal Position.

Format – Device-dependent commands in ASCII. Waveform data points selectable as BINARY or ASCII.

Waveform Output Time – 250 ms min for BINARY; and 2.5 s min for ASCII.



TRIGGER POSITION

Pretrigger – 0 to 10 div in 1-div increments.

Posttrigger (delay) – 0 to 1500 div in 1 div increments.

Horizontal Resolution – Up to 1024 pts/waveform.

External Trigger – Max Input Voltage: 250 V (dc + peak ac).

Triggering Sensitivity –

		Min Signal Required	
	Frequency Range*[1]	**Int**	**Ext**
Normal	DC to 30 MHz	0.4 div	60 mV
(DC Coupling)	30 to 70 MHz	1.0 div	150 mV
P-P or Auto	30 to 200 Hz	2.0 div	300 mV
	200 Hz to 30 MHz	0.6 div	90 mV
	30 to 70 MHz	1.2 div	200 mV

[1] The ac-coupling, low-frequency limit is 30 Hz. In time/ div settings of 1 s to 50 ns, when using P-P or Auto, low-frequency limit is 300 Hz .

OUTPUTS

Hold Next Ready – Connected to Single-Sweep Ready connector.

+ Gate Out – Provides high-level output signal for duration of waveform/character readout.

ENVIRONMENT

Temperature – Operating: 0 to 45°C.

GPIB* IEEE-488

ORDERING INFORMATION

7D20 Programmable Digitizer **$8,400**
Includes:
operator manual (070-3857-01);
pocket reference guide (070-3205-01);
service manual (070-3858-01);
Instrument interface guide (070-1728-00).

ACCESSORIES

Recommended Mainframe for 7D20
R7603 Opt. 20 – Permits rear-panel access to the 7D20 GPIB Interface and includes cable (175-7151-00) required inside 7D20. **$5,560**
The 7D20 Digitizer is not recommended for use in the 7104/R7103 mainframe. Such use will void the 7104/R7103 warranty.
Recommended Plotter – See page 97.
Recommended Probe
P6053B – See pages 96-97.
Recommended Software
TekMAP Software is available for the 7D20. See page 98.
Utility software –
(7D20/4041) Order 062-6959-01 **$150**
(7D20/4052A) Order 062-6961-01 **$150**

PHYSICAL CHARACTERISTICS

Dimensions	**mm**	**in.**
Width	206	8.1
Height	127	5.0
Depth	371	14.6
Weight ≈	**kg**	**lb**
Net	3.6	8.1
Shipping	8.0	17.8

**The 7D20 complies with IEEE Standard 488.1-1978, and Tektronix Standard Codes and Formats*

Tektronix offers service training classes on the 7D20. For further training information, contact your local Sales Office and request a copy of the Tektronix Service Training Catalog.

100-MHz, CRT-STORAGE OSCILLOSCOPES

7600 CRT Storage

- *DC to 100-MHz Bandwidth (3.5-ns Rise Time)*
- *5-ns/Div Calibrated Sweep Rate*
- *Requires Only 5.25 Inches of Rackmount Space (R7633/R7623A/R7613)*
- *Long Viewing Time*
- *Large Selection of Plug-Ins*
- *Able to Capture and Store Transients and Low Repetition Rate Signals*

7633/R7633

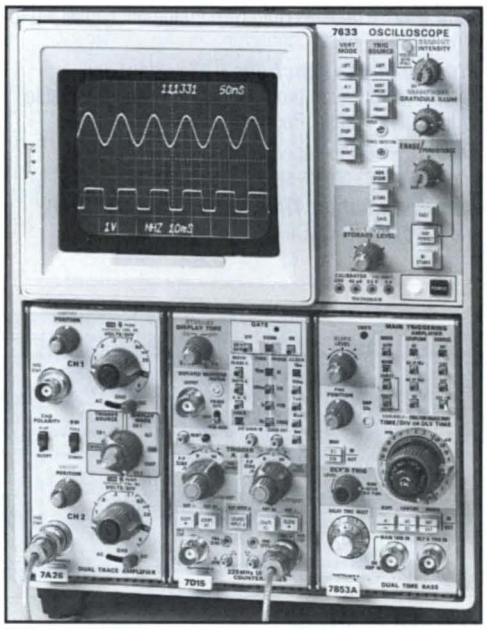
- *1000-cm/μs Stored Writing Speed*
- *Multimode Storage*

7623A/R7623A

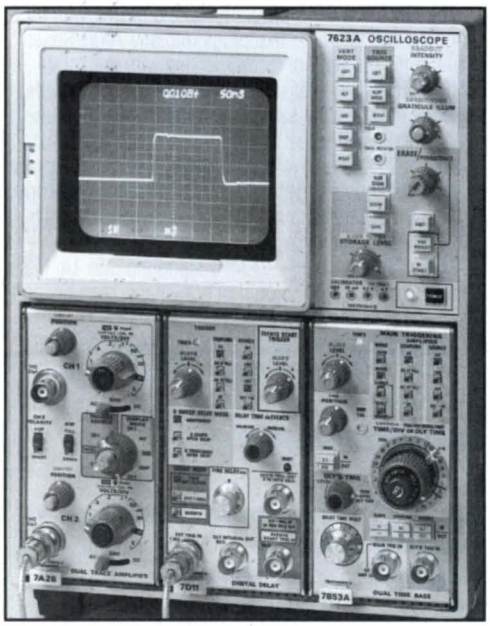
- *135-cm/μs Stored Writing Speed*
- *Multimode Storage*

7613/R7613

- *4.5 cm/μs Stored Writing Speed*
- *Variable-Persistence Storage*



7633 CRT-Storage Oscilloscope



7623A CRT-Storage Oscilloscope

The 7633 Storage Oscilloscope provides 2200 div/μs (1000 cm/μs) stored writing speed and 100 MHz bandwidth. The instrument has three display modes and four storage modes. The maximum writing speed of 1000 cm/μs is achieved in reduced-scan mode.

The 7633/R7633 is used for retention and viewing of fast-rise, low-repetition-rate, single-shot, or slow-moving waveforms.

The 7623A/R7623A Storage Oscilloscopes have all the features and performance of the 7633/R7633 except the reduced-scan mode.

The 7613/R7613 Storage Oscilloscopes only have variable persistence mode with a stored writing speed of 5 div/μs.

The R7633/R7623A/R7613 require only 5.25 inches of rack height in a standard 19-inch rack.

CHARACTERISTICS

VERTICAL SYSTEM

Channels – Two left-most plug-in compartments for 7000-Series plug-ins.

Bandwidth, Rise Time and Deflection Factor – Determined by the mainframe and plug-in unit used. See page 83.

Display Modes – Left, Alt, Add, Chop, Right. Chopped-mode repetition rate is ≈1 MHz.

Delay Line – Permits viewing leading edge of displayed waveform.

HORIZONTAL SYSTEM

Channel – One plug-in compartment (right-most). Compatible with all 7000-Series plug-ins.

Bandwidth – DC to at least 2 MHz.

Fastest Calibrated Sweep Rate – 5 ns/div.

X-Y Mode – Phase shift < 2° from dc to 35 kHz.

CRT AND DISPLAY FEATURES

CRT – Internal 8 x 10-division graticule with variable illumination. The 7633/R7633 has additional graticule for the reduced-scan mode.

Autofocus – Eliminates manual focusing with changes in intensity after focus control has been set.

Beam Finder – Aids in locating an offscreen signal.

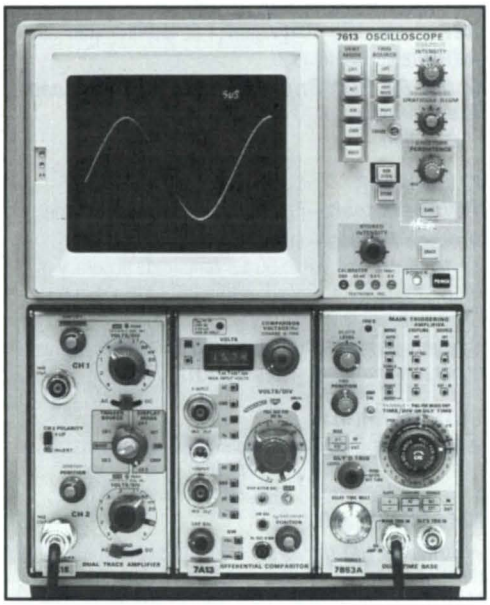
CRT Display Modes – Nonstore, Bistable, Variable Persistence, Fast Bistable, Fast Variable Persistence. Reduced scan may be selected on the 7633/R7633 in all display modes. The 7613/R7613 has nonstore and variable persistence only.

Autoerase – Continuously variable to >10 s.

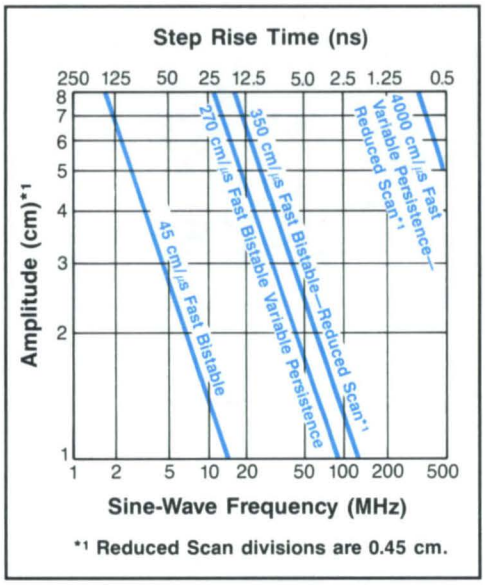
Save – Prevents erasure of display and extends view time up to 30 times longer in all modes.

Persistence (Variable) – Controls rate of continuous erasure of stored displays.

External Z-Axis Input – 2 V p-p for useful intensity range from dc to 2 MHz. Intensity range diminishes to 20% of full range at 10 MHz. Maximum input voltage is 10 V (dc + peak ac) and p-p ac.



7613 CRT-Storage Oscilloscope



Graph showing the stored writing speed.

CALIBRATOR

Voltage Output – Positive rectangular waveshape.

Voltage Ranges – 40 mV, 0.4 V, 4 V into 1 MΩ; 20 mV, 0.2 V, 0.4 V into 50 Ω. Amplitude accuracy is within 1% (15 to 35°C); within 2% (0 to 50°C). Repetition rate is ≈1 kHz. Output R is ≈450 Ω.

Current Output – 40 mA rectangular waveshape with optional current-loop accessory (012-0259-00).

OUTPUTS/INPUTS

+ Sawtooth – Sawtooth starts 1 V or less from ground into 1 MΩ. Output voltage is 50 mV/div (±15%) into 50 Ω, 1 V/div (±10%) into 1 MΩ. Output R is 950 Ω within 2%.

+ Gate – Positive-going waveform of the same duration as and coincident with sweep selectable from main, delay, or auxiliary gate. Output voltage is 0.5 V (±10%) into 50 Ω, 10 V (±10%,) into 1 MΩ. Rise time is 20 ns or less into 50 Ω. Output R is 950 Ω within 2%.

Vertical Signal Out – Selected by Trigger Source switch. Output voltage is 25 mV/div into 50 Ω, 0.5 V/div into 1 MΩ. Output R is 950 Ω within 2%. Bandwidth is determined by the vertical plug-in used, see page 83.

Camera Power Output – C-50-Series cameras. See pages 96-97.

External Single-Sweep Reset – Rear-panel BNC input to reset sweep.

Remote Erase – Rear-panel BNC connector inputs.

POWER REQUIREMENTS

Line-Voltage Ranges – 100, 110, 120, 200, 220, and 240 V ac ±10%; internally selectable with quick change jumpers.

Line Frequency – 50 to 400 Hz (50 to 60 Hz with Option 23).

Maximum Power Consumption – 180 W.

ENVIRONMENTAL AND SAFETY

Temperature – Operating: 0 to 50°C

Vibration – Referenced to MIL-T-28800B.

Humidity – Operating and Nonoperating: 95%, referenced to MIL-E-16400F.

Shock – Referenced to MIL-T-28800C.

EMC Capability – Meets MIL-STD-461B requirements when tested in accordance with certain test methods of MIL-STD-462.

Safety – UL listed (UL 1244) and CSA certified (CSA 556B).

ORDERING INFORMATION

(PLUG-INS NOT INCLUDED)

7633 CRT-Storage Oscilloscope **$10,500**
Includes: 20-in., two-pin-to-BNC cable (175- 1178-00); green CRT filter (378-0625-08); power cord (161-0066-00); instruction manual (070-1767-00); operator manual (070-1766-00).

R7633 Rackmount Oscilloscope **$11,650**
Includes: Same as 7633.

7623A CRT-Storage Oscilloscope **$8,900**
Includes: Same as 7633, instruction manual replaced with (070-1685-00); operator manual (070-1684-00).

R7623A Rackmount Oscilloscope **$9,475**
Includes: Same as 7633 plus rack-mounting hardware, instruction manual replaced with (070-1685-00); operator manual (070-1684-00).

7613 CRT-Storage Oscilloscope **$8,600**
Includes: Same as 7633, instruction manual replaced with service manual (070-1463-00); operator manual replaced with (070-1365-00).

R7613 Rackmount Oscilloscope **$9,200**
Includes: Same as 7633 plus rackmounting hardware, instruction manual replaced with service manual (070-1463-00); operator manual replaced with (070-1365-00).

INSTRUMENT OPTIONS

Opt. 03 – EMC capability.
(7633/7623A/7613) **+$420**
(R7633/R7623A/R7613) **+$400**

Opt. 08 – Protective Panel Cover.
(7623A/7613) **+$125**
(7633) **+$120**

Opt. 23 – 50 to 60 Hz line frequency, VDE RPM Mark.
(7633/7623A/7613) **+$55**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1-A5 Available **NC**
See page 488.

CONVERSION KITS

CRT Readout –
(7633/7623A) Order 040-0748-06 **$730**

EMC Modification –
(7633/7623A) Order 040-0663-01 **$485**
(R7633/R7623A)
Order 040-0678-01 **$395**

Power Supply – To light plug-in pushbuttons. Order 040-0686-01 **$90**

ACCESSORIES

Recommended Cameras – See pages 96-97.
Recommended Carts – See page 97.
Recommended Probes – See pages 96-97.

PHYSICAL CHARACTERISTICS

	7633/ 7623A/ 7613		R7633/ R7623A/ R7613	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	221	8.7	483	19.0
Height	305	12.0	135	5.3
Depth	597	23.5	566	22.3
Weight ≈	**kg**	**lb**	**kg**	**lb**
Net	13.6	30.0	14.5	32.0
Shipping	19.0	42.0	28.2	62.0

7603 R7603 *100-MHz, GENERAL-PURPOSE OSCILLOSCOPES*

- *DC to 100-MHz Bandwidth*
- *3.5-ns Rise Time*
- *5-ns/Div Fastest Calibrator Sweep Rate*
- *Greater Than 260-cm/s Writing Speed With Optional CRT*
- *6.5-Inch CRT*
- *CRT Readout*
- *Requires only 5.25-inches of Rackmount Space (R7603)*

ORDERING INFORMATION

(PLUG-INS NOT INCLUDED)

7603 Oscilloscope **$4,235**
Includes: Clear CRT filter (337-1700-04); blue CRT filter (337-1700-01); 20-in. two-pin-to-BNC cable (175-1178-00); operator manual (070-1310-00); service manual (070-1429-00).

R7603 – Rackmount Oscilloscope **$5,450**
Includes: Same as 7603, plus a rack- mounting hardware kit (016-0099-00).

INSTRUMENT OPTIONS

Opt. 03 – EMC Modification. **+$420**

Opt. 04 – High-Brightness 8 x 10-cm CRT Display. GH (P31) Phosphor **+$530**

Opt. 08 (7603) – Protective Panel Cover. **+$125**

Opt. 20 (R7603) – IEEE Standard 488 Interface for the 7D20 only. **+$110**

INTERNATIONAL POWER PLUG OPTIONS

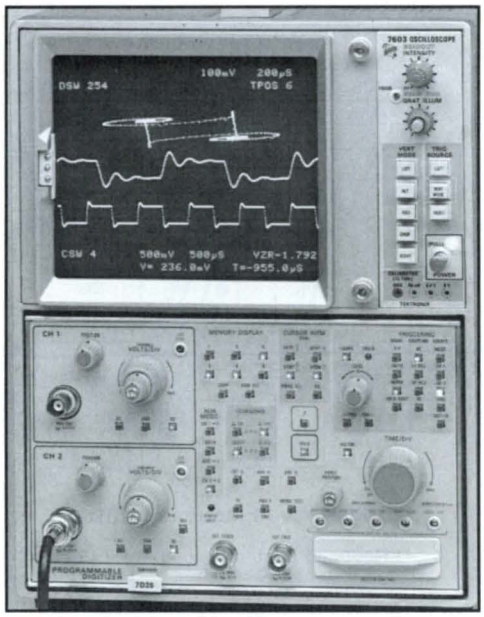
Opt. A1-A5 Available **NC**
See page 488.

ACCESSORIES

Recommended Cameras – See pages 96-97.
Recommended Carts – See page 97.
Recommended Probes – See pages 96-97.

PHYSICAL CHARACTERISTICS

	7603		R7603	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	221	8.7	483	19.0
Height	290	11.4	127	5.2
Depth	610	24.0	627	24.7
Weight ≈	**kg**	**lb**	**kg**	**lb**
Net	13.6	30.0	13.6	30.0
Shipping	20.8	46.0	19.1	42.0



The 7603 and R7603 Oscilloscopes are 100-MHz, real-time oscilloscopes.

The CRT is large – 8 x 10 divisions (1.22 cm/div) – and features an internal graticule with variable illumination. An optional high-brightness CRT with a smaller 8 x 10-cm display gives you greater visual brightness and higher photographic-writing speed.

CHARACTERISTICS

VERTICAL SYSTEM

Channels – Two left-most plug-in compartments.

Bandwidth, Rise Time, and Deflection Factor – Determined by the mainframe/plug-in used. See page 83.

Display Modes – Left, Alt, Add, Chop, Right. Chopped-mode repetition rate is ≈1 MHz.

Delay Line – Permits viewing leading edge of displayed waveform.

HORIZONTAL SYSTEM

Channels – One right-most plug-in compartment.

Bandwidth – DC to 2 MHz.

Fastest Calibrated Sweep Rate – 5 ns/div.

X-Y Mode – Phase shift is within 2° from dc to 35 kHz.

CRT AND DISPLAY FEATURES

CRT – Internal 8 x 10 division (1.22 cm/div) graticule with variable illumination.

Option 04, High-Brightness CRT With Reduced Area – Internal 8 x 10 cm graticule with variable illumination.

CALIBRATOR

Voltage Output – Positive rectangular waveshape.

Voltage Ranges – 40 mV, 0.4 V, 4 V into 1 MΩ; 20 mV, 0.2 V, 0.4 V into 50 Ω. Amplitude accuracy is within 1% (+15 to +35°C); within 2% (0 to +50°C). Repetition rate is ≈1 kHz.

Current Output – 40-mA rectangular waveshape with optional current-loop accessory (012-0259-00).

OUTPUTS/INPUTS

+ Sawtooth Out (Rear Panel) – Sawtooth starts 1 V or less from ground (into 1 MΩ). Output voltage is 1 V/div (±10%) into 1 MΩ, 50 mV/div (±15%) into 50 Ω. Output R is 950 Ω.

+ Gate Out (Rear Panel) – Positive gate of the same duration as and coincident with sweep. Selectable from Main, Delay, or Auxiliary Gate. Output voltage is 10 V (±10%) into 1 MΩ, 0.5 V (±10%) into 50 Ω. Rise time is 20 ns or less into 50 Ω. Output R is 950 Ω.

Vertical Signal Out (Rear Panel) – Selected by Trigger Source switch. Output voltage is 0.5 V/div into 1 MΩ, 25 mV/div into 50 Ω. Output R is 950 Ω. Bandwidth is determined by the vertical plug-in used. See page 83.

Camera Power – C-50-Series cameras. See pages 96-97.

External Single-Sweep Reset – Rear-panel BNC provides input to reset sweep.

Single-Sweep Ready Output – Rear-panel BNC provides 5 V out for single-sweep ready condition.

POWER REQUIREMENTS

Line-Voltage Ranges – 100, 110, 120, 200, 220, and 240 V ac ±10%; internally selectable.

Line Frequency – 50 to 400 Hz.

Maximum Power Consumption – 180 W.

ENVIRONMENTAL AND SAFETY

Temperature – Operating: 0 to 50°C.

Humidity – Referenced to MIL-E-16400F.

EMC Capability – (Option 03) Meets MIL-STD-1-A-6181B.

Safety – UL listed (UL 1244) and CSA certified (CSA 556B).

7000-SERIES VERTICAL AMPLIFIER SPECIFICATIONS

Mainframes	Features	7A29	7A19	7A24	7A26	7A18A	7A42	7A13	7A22
		Widest bandwidth, single trace	High bandwidtth, 50 Ω input	Dual trace, 50 Ω	Dual trace	Dual trace	Four trace	Differential dc offset, 20,000:1 CMRR	DC coupled, differential, high-gain
	Deflection Factor (min)	10 mV/div	10 mV/div	5 mV/div	5 mV/div	5 mV/div	20 mV/div	1 mV/div	10 μV/div
	Accuracy	2%	2%	2%	2%	2%	3%	1.5%	3%
7104 or R7103 (0 to 35°C)	Bandwidth	1 GHz	600 MHz	400 MHz	200 MHz	100 MHz	350 MHz	105 MHz	1 MHz ± 10%
	Rise Time*4	0.35 ns	0.6 ns	0.9 ns	1.8 ns	3.5 ns	1.0 ns	3.4 ns	350 ns ± 9%
7904A or R7903 or 7934 (0 to 30°C)	Bandwidth	500 MHz	500 MHz	350 MHz	200 MHz	100 MHz	300 MHz	105 MHz	1 MHz ± 10%
	Rise Time*4	0.7 ns*2	0.8 ns	1.0 ns	1.8 ns	3.5 ns	1.2 ns	3.4 ns	350 ns ± 9%
	SIG OUT	300 MHz	300 MHz	140 MHz	140 MHz	90 MHz	NA	100 MHz	1 MHz ± 10%
R7844 (0 to 35°C)	Bandwidth	400 MHz	400 MHz	300 MHz	180 MHz	75 MHz	275 MHz	100 MHz	1 MHz ± 10%
	Rise Time*4	0.9 ns	0.9 ns	1.2 ns	1.9 ns	4.7 ns	1.3 ns	3.5 ns	350 ns ± 9%
7854 (0 to 35°C)	Bandwidth	400 MHz	400 MHz*2	300 MHz	180 MHz	75 MHz	275 MHz	100 MHz	1 MHz ± 10%
	Rise Time*4	0.9 ns	0.9 ns	1.2 ns	1.9 ns	4.7 ns	1.3 ns	3.5 ns	350 ns
7600 Series (0 to 50°C)	Bandwidth	100 MHz	100 MHz	100 MHz	100 MHz	75 MHz	100 MHz	75 MHz	1 MHz ± 10%
	Rise Time*4	3.5 ns	3.5 ns	3.5 ns	3.5 ns	4.7 ns	3.5 ns	4.8 ns	350 ns ± 9%
	SIG OUT	65 MHz	65 MHz	60 MHz	60 MHz	50 MHz	NA	55 MHz	1 MHz ± 10%

*1 *Accuracy percentages apply to all deflection factors. Accuracy is without probes.*
*2 *Bandwidth is 325 MHz at 10 mV/div.*
*3 *R7903 with 7A29; rise time is 0.8 ns.*
*4 *Rise time is calculated from the bandwidth.*

7000-SERIES TIME BASE SELECTION GUIDE

Performance Feature	7B10	7B15	7B92A	7B80	7B85	7B53A
Single-trace time base	yes	yes	no	yes	yes	no
Dual-trace time base	no	no	yes	no	no	yes
With mixed sweep	no	no	no	no	no	yes
TV Sync Triggering	no	no	no	no	no	yes (Opt. 05)
Can also use as delayed time base	yes	yes	yes	yes	yes	no
Delaying/ΔDelay sweep	no	yes	no	yes	yes	no

7000-SERIES TIME BASE/MAINFRAME RECOMMENDATION

Mainframe	7B10	7B15	7B92A	7B80	7B85	7B53A
7104/R7103	yes	yes	yes	no	no	no
7904A/R7903	yes	yes	yes	yes	yes	no
7844/R7844	yes	yes	yes	yes	yes	no
7934	yes	yes	yes	yes	yes	no
7854	yes	yes	yes	yes	yes	no
7603/R7603	no	no	no	no	no	yes
7613/R7613, 7623A/R7623A 7633/R7633	no	no	no	no	no	yes

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7A29

- *DC to 1-GHz Amplifier*
- *10-mV to 1-V/Div Calibrated Deflection Factors*
- *50-Ω Input*
- *± 500-ps Variable Delay Line (Option 04)*
- *Overload Protection*

ORDERING INFORMATION

7A29 – 1-GHz Amplifier **$3,775**
Includes: Instruction manual (070-2322-00).

INSTRUMENT OPTION
Opt. 04 – Variable Delay Line **+$535**

ACCESSORIES
See pages 96-97.

7A29 1-GHz AMPLIFIER

The 7A29 is a high-performance, wide-band, single-trace amplifier that provides a bandwidth of 1 GHz in the 7100-Series mainframes. Bandwidth is constant for calibrated deflection factors of 10 mV to 1 V/div. Input impedance is 50 Ω. Manually resettable input-protection circuitry protects the input against most common overloads. Polarity of the display is selectable by a front-panel switch. An optional variable delay line (front-panel adjustable) permits matching the transit time of two 7A29s and/or probes to better than 10 ps.

CHARACTERISTICS

Bandwidth – DC Coupled: 1 GHz (10 mV to 1 V/div). See page 83.

Deflection Factor – Calibrated: 10 mV to 1 V/div in seven steps (1-2-5 sequence). Accuracy is within 2% with gain adjusted at 0.1 V/div.

Uncalibrated: Variable continuously between steps and a maximum of at least 2.5 V/div (with some bandwidth reduction).

Input Z – 50 Ω.

AC Coupling – 3 dB at 1 kHz or less from a 50 Ω source.

Maximum Input Voltage – DC Coupled: 50 V peak or 10 V RMS (whichever is less).

AC Coupled: 100 V additional.

DC Stability – Drift with ambient temperature (line voltage constant): ≤ 0.04 div/°C.

Overload Protection – Automatically disconnects excessive signals of up to 50 V. The "disconnected" condition is indicated and has manual reset.

VARIABLE SIGNAL DELAY OPTION

Option 04, Variable Delay Line – Permits matching the transit time of two preamps and probes to better than 10 ps. Range is ±500 ps.

7A19

- *DC to 600-MHz Bandwidth*
- *10-mV to 1-V/Div Calibrated Deflection Factors*
- *50-Ω Input*
- *± 500-ps Variable Delay Line (Option 04)*

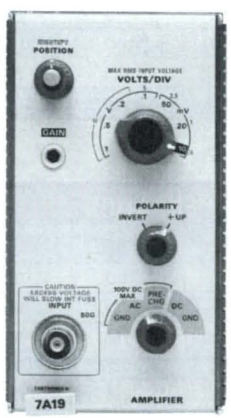
ORDERING INFORMATION

7A19 – 600-MHz Amplifier **$3,340**
Includes: Instruction manual (070-2120-00).

INSTRUMENT OPTION
Opt. 04 – Variable Delay Line **+$460**

ACCESSORIES
See pages 96-97.

7A19 600-MHz AMPLIFIER



The 7A19 is a high-performance, wide-band, single-trace amplifier that provides a bandwidth of 600 MHz in the 7100-Series mainframes. Bandwidth is constant over the entire range of calibrated deflection sensitivities of 10 mV to 1 V/div. Input impedance is 50 Ω. An optional variable delay line (front-panel adjustable) permits matching the transit time of two 7A19s and/or probes to better than 50 ps.

CHARACTERISTICS

Bandwidth – DC Coupled: 600 MHz (10 mV to 1 V/div). See page 83.

Deflection Factor – Calibrated: 10 mV to 1 V/div in seven steps (1-2-5 sequence). Accuracy is within 3%.

Input Z – 50 Ω.

Maximum Input Voltage – DC Coupled: 50 V peak or 10 V RMS (whichever is less).

AC Coupled: 100 V additional.

DC Stability – Drift with Ambient Temperature (Line Voltage Constant): ≤ 0.01 div/°C.

VARIABLE SIGNAL DELAY OPTION

Option 04, Variable Delay Line – Permits matching the transit time of two preamps and probes to better than 50 ps. Range is ± 500 ps.

7A24 400-MHz AMPLIFIER

The 7A24 is a high-performance, wide-band, dual-trace amplifier that provides a bandwidth of 400 MHz in the 7100-Series mainframes. Bandwidth is constant over the entire range of deflection sensitivities from 5 mV to 1 V/div. Input impedance is 50 Ω. The 7A24 features five operating modes, trigger-source selectability, and trace identify.

CHARACTERISTICS

Bandwidth – DC Coupled: 400 MHz (5 mV to 1 V/div). See page 83.

Deflection Factor – Calibrated: 5 mV to 1 V/div in eight steps (1-2-5 sequence). Accuracy is within 2% with gain adjusted at 5 mV/div. Uncalibrated: Variable continuously between steps to a maximum of at least 2.5 V/div.

Input Z – 50 Ω within 0.5%;

Voltage Standing Wave Ratio–

	≤1.25	DC to 350 MHz
5 mV-20 mV	≤1.40	350 to 400 MHz
50 mV-1 V	≤1.20	DC to 400 MHz

Maximum Input Voltage – DC Coupled: 5 V RMS.

DC Stability – Drift with Ambient Temperature (Line Voltage Constant): ≤ 0.02 div/°C. Drift with Time (Ambient Temperature and Line Voltage Constant): ≤ 0.02 div in any one minute after one-hour warm-up.

Displayed Noise – 0.1 div or less at 5 mV/div tangentially measured (with a 7900-Series mainframe).

Common-Mode Rejection Ratio – At least 10:1, dc to 50 MHz.

7A24

- *DC to 400-MHz Bandwidth*
- *Dual Trace Amplifier*
- *5-mV to 1-V/Div Calibrated Deflection Factors*
- *50-Ω Input*

ORDERING INFORMATION

7A24 – 400-MHz Amplifier **$3,075**
Includes: Instruction manual (070-1485-00)

ACCESSORIES

See pages 96-97.

7A26 200-MHz AMPLIFIER

The 7A26 is a dual-trace amplifier that provides a bandwidth of 200 MHz in the 7900- and 7100-Series mainframes. Bandwidth is constant over the entire range of deflection sensitivities of 5 mV to 5 V/div. Bandwidth may be limited to 20 MHz to reduce displayed noise in lower-frequency applications. The 7A26 features five operating modes, trigger-source selectability, and trace-identify.

CHARACTERISITICS

Bandwidth – DC Coupled: 200 MHz (5 mV to 5 V/div). AC Coupled: 10 Hz or less to 200 MHz (5 mV to 5 V/div). See page 83.

Deflection Factor – Calibrated: 5 mV to 5 V/div in ten steps (1-2-5 sequence). Accuracy is within 2% with gain adjusted at 10 mV/div. Uncalibrated: Variable continuously between steps to a maximum of at least 12.5 V/div.

Input R and C – 1 MΩ within 2%; ≈ 22 pF.

Maximum Input Voltage – DC Coupled: 250 V (dc + peak ac), ac component 500 V p-p maximum, 1 kHz or less. AC Coupled: 500 V (dc + peak ac), ac component 500 V p-p max, 1 kHz or less.

DC Stability – Drift with Ambient Temperature (Line Voltage Constant): ≤ 0.02 div/°C. Drift with Time (Ambient Temperature and Line Voltage Constant): ≤ 0.02 division in any one minute after one-hour warm-up.

Displayed Noise – 0.1 div or less at 5 mV/div tangentially measured (with a 7900-Series mainframe).

Common-Mode Rejection Ratio (Add, CH 2 Invert) – At least 10:1, dc to 50 MHz.

7A26

- *DC to 200-MHz Bandwidth*
- *Dual Trace Amplifier*
- *5-mV to 5-V/Div Calibrated Deflection Factors*
- *1-MΩ Input*

ORDERING INFORMATION

7A26 – 200-MHz Amplifier **$2,750**
Includes: Instruction manual (070-1484-01).

ACCESSORIES

See pages 96-97.

7A18A

- *DC to 100-MHz Bandwidth*
- *Dual Trace Amplifier*
- *5-mV to 5-V/Div Calibrated Deflection Factors*
- *1-M Ω Input*
- *Five Operating Modes, Trigger-Source Selectability, and a Trace-Identify Function*
- *DC Offset (Option 06)*

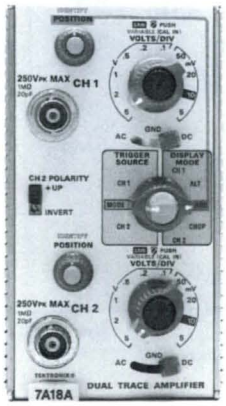
ORDERING INFORMATION

7A18A – 100-MHz Amplifier **$1,790**
Includes: Instruction manual (070-4329-00).

INSTRUMENT OPTION
Opt. 06 – DC Offset. **+$225**

ACCESSORIES
Isolator A6902B – See page 97.

7A18A 100-MHz AMPLIFIER



The 7A18A is a dual-trace amplifier that provides a bandwidth up to 100 MHz in the 7900- and 7100-Series mainframes and up to 75 MHz in 7600- and 7800-Series mainframes. Bandwidth is constant over the entire range of deflection sensitivities.

CHARACTERISTICS

Bandwidth – DC Coupled: 100 MHz; AC Coupled: 10 Hz or less to 100 MHz.

Deflection Factor – Calibrated: 5 mV to 5 V/div in ten steps (1-2-5 sequence). Accuracy is within 2% with gain adjusted to 10 mV/div. Uncalibrated: Variable continuously between steps to a maximum of at least 12.5 V/div.

Input R and C – 1 MΩ within 2%; ≈ 20 pF.

Maximum Input Voltage –

DC Coupled: 250 V (dc + peak ac), ac component 500 V p-p max, 1 kHz or less.

AC Coupled: 500 V (dc + peak ac), ac component 500 V p-p max, 1 kHz or less.

DC Stability – Drift with Ambient Temperature (Line Voltage Constant): ≤ 0.01 div/°C.

Displayed Noise – 0.06 div or less tangentially measured.

Common-Mode Rejection Ratio (Add, CH 2 Invert) – At least 10:1, dc to 50 MHz.

DC OFFSET OPTION

Option 06, DC Offset – Separate Channel 1 and Channel 2 variable offset controls are concentric with the position controls replacing the identify pushbuttons of the standard 7A18A. The ac-dc-ground switch of each channel adds a fourth position for dc offset.

Offset Range Display – ±200 division max., equivalent to ±1 V at 5 mV/div.

Accuracy – When in DC Offset, the deflection accuracy is derated by 1%.

7A42

- *DC to 350-MHz Bandwidth*
- *Four-Trace Amplifier*
- *Boolean-Logic Triggering*
- *Nested Trigger Functions*
- *Variable Switching Thresholds*
- *Precise Amplitude and Timing Measurements*
- *External Clock Synchronization*
- *1-M Ω/50-Ω Switchable Inputs*
- *Variable/Bias Offset Probe Compatibility*
- *Trigger View Trace*

ORDERING INFORMATION

7A42 – Logic-Triggered Amplifier **$6,600**
Includes: Instruction manual (070-4285-00).

ACCESSORIES
See pages 96-97.

7A42 350 MHz, FOUR-CHANNEL, LOGIC-TRIGGERED AMPLIFIER

The 7A42 is a four-trace amplifier combined with triggering technologies. Triggers are generated by Boolean combinations of logic levels and transitions on any or all channels.

CRT readout of attenuator settings, the display of error messages, and use of multicolored LEDs communicate the status of 7A42 functions at a glance. Battery backup preserves the front panel settings when power is removed.

CHARACTERISTICS

VERTICAL SYSTEM

Input – Four channels, BNC connectors.

Bandwidth – DC to 350 MHz max. See page 83.

Input Impedance – Selectable: 1 MΩ or 50 Ω.

Maximum Input Voltage – 1 MΩ: 25 V; 50 Ω: 5 V RMS. Active internal protection opens all inputs.

Differential Delay – 200 ps maximum between the four input channels.

Trigger View or External Clock View – Trigger View is within 3 ns. External Clock View is within 5 ns.

TRIGGER SYSTEM

External Clock Input – +5 to -5 V (dc + peak ac). Pulse Width: TTL level is 20 ns min, either pulse transition selected. ECL level is 5 ns min, leading edge or 10 ns min, trailing edge.

Channel-Edge Sensitivity – 5 ns min.

Trigger Out Connector – 1 V into 50 Ω. Toggle Frequency: 125 MHz max.

Reset Input – Maximum Input Voltage: +5 to -5 V (dc + peak ac). Input Impedance: ≈ 50 Ω. Event recognition must lead the Reset pulse by 10 ns to guarantee trigger output.

BATTERY BACK-UP

Ni-Cad Battery (3.75 V) – Saves front-panel control status a minimum of 200 hours while power is off.

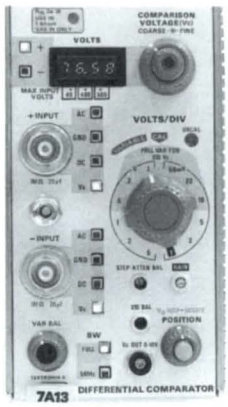
- *DC to 105-MHz Bandwidth*
- *1-mV to 5-V/Div Calibrated Deflection Factors*
- *1-MΩ Input Switchable to ∞*
- *20,000:1 CMRR*
- *10,000 Divisions Effective Screen Height*

The 7A13 has features that are useful in combination with other plug-ins.

The 7A13 has constant bandwidth over the 1 mV to 5 V/div deflection-factor range. Bandwidth is selectable to Full or 5 MHz for best displayed noise conditions in low-frequency applications.

As a differential amplifier, the 7A13 provides a balanced (+ and -) input for applications requiring rejection of a common-mode signal. The CMRR is 20,000:1 from dc to 100 kHz, derating to 200:1 at 20 MHz. The unit can reject up to 10 V of common-mode signal at a deflection factor setting of 1 mV/div, increasing to 100 V at 10 mV/div (X10 Vc pulled) and 500 V at 0.1 V/div.

As a comparator amplifier, the 7A13 provides an accurate (0.1%) positive or negative internal offsetting voltage of up to 10 V. This precision offset voltage effectively provides a screen height of 10,000 div at 1 mV/div. The offset voltage is also available as an output for external monitoring.



CHARACTERISTICS

Bandwidth – DC Coupled: 105 MHz. See page 83.

Input R and C – 1 MΩ within 0.15%; ≈ 20 pF. R ≈ ∞ is available in the 1 mV to 50 mV/div range, selectable by an internal switch.

Deflection Factor – Calibrated: 1 mV to 5 V/div in 12 steps (1-2-5 sequence). Accuracy is within 1.5% with gain adjusted at 1 mV/div. Uncalibrated: Variable continuously between steps to a maximum of at least 12.5 V/div.

Maximum Input Gate Current – 0 to +35°C: 0.2 nA or less. + 35 to + 50°C: 2 nA or less.

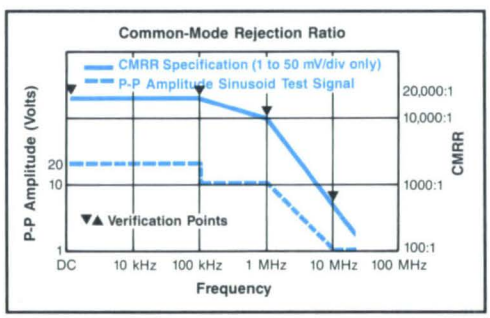
DC Stability – Drift with Ambient Temperature (Line Voltage Constant): 2 mV/10°C to 0.2 div/10°C or less (whichever is greater). Drift with Time (Ambient Temperature and Line Voltage Constant): Short term is 1 mV p-p or 0.1 div or less (whichever is greater) over any one-minute interval after 20-minute warm-up. Long term is 1 mV p-p or 0.1 division or less (whichever is greater) during any one-hour interval after 20-minute warm-up.

Overdrive Recovery – 1 μs recovery to within 2 mV after a pulse of ±10 V.

Displayed Noise (Tangentially Measured) – With X10 Vc In: 400 μV (200 μV RMS) or less at 1 mV/div; 0.2 div or less at 2 to 5 mV/div; 0.05 div or less at 10 mV to 5 V/div. With X10 Vc Out: 0.4 div or less at 10 mV to 0.5 V/div.

Internal Comparison Voltage – Range: 0 to ±1 0 V. Vc Output R: ≈15 kΩ

Common-Mode Rejection Ratio – At least 2000:1, 10 mV to 50 mV/div (X10 Vc out) and 0.1 to 5 V/div. AC coupled input at least 500:1 at 60 Hz.



Signal Range –

Deflection Factor	1 mV to 50 mV/div	10 mV to 50 mV/div (x10 Vc out) and 0.1 V to 0.5 V/div	0.1 V to 0.5 V/div (X10 Vc out) and 1 V to 5 V/div
Common-Mode Signal	±10 V	100 V	500 V
Maximum DC Coupled Input (dc+ peak ac)	40 V	400 V	500 V
Maximum AC Coupled Input (dc voltage)	—	500 V	—

ORDERING INFORMATION

7A13 Differential Comparator Amplifier **$3,874**
Includes: Instruction manual (070-1948-00).

ACCESSORIES

Isolator A6902B – See page 97.
P6055A – See pages 96-97.

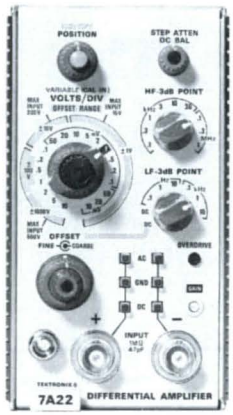
7A22 *PLUG-IN DIFFERENTIAL AMPLIFIER*

- *DC to 1-MHz Bandwidth*
- *10-μV to 10-V/Div Calibrated Deflection Factors*
- *1-MΩ Input*
- *100,000:1 CMRR*
- *Selectable Upper and Lower – 3 dB Points*
- *DC Offset*
- *10-μV/hr DC Drift*

ORDERING INFORMATION

7A22 Differential Amplifier **$2,260**
Includes: Instruction manual (070-0931-00), High CMRR Differential Probes

ACCESSORIES
P6055A – See pages 96-97.



The 7A22 is a high-gain differential amplifier well suited for low-amplitude, low-frequency measurements. Selectable high- and low-pass filters reduce noise and drift from the display and from the triggering signal.

CHARACTERISTICS

Bandwidth – 3 dB point selectable in nine steps (1-3 sequence) from 100 Hz to 1 MHz. Accuracy is within 10% of selected frequency. Rise time is 350 ns ±9% in 1-MHz position. LF: – 3 dB point selectable in six steps (1-10 sequence) from 0.1 Hz to 10 kHz. Accuracy is within 12% of selected frequency. The switch also contains dc and dc with Offset positions. AC coupled at input, 2 Hz or less. See page 83.

Deflection Factor –
Calibrated: 10 μV to 10 V/div in 19 steps (1-2-5 sequence). Accuracy is within 2% with gain adjusted at 1 mV/div.

Uncalibrated: Variable continuously between steps to a maximum of at least 25 V/div.

Input R and C – 1 MΩ within 1%; ≈ 47 pF.

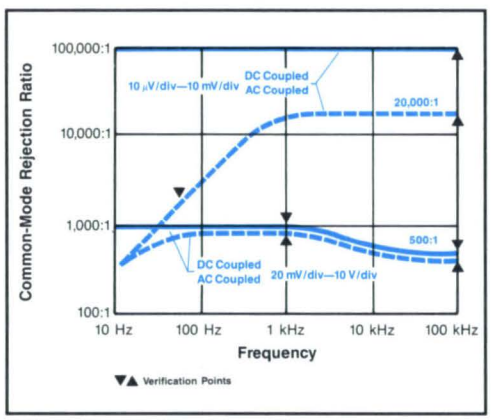
Maximum Input-Gate Current (Differentially Measured) – 10 μV to 10 mV/div: 40 pA at + 25°C; 200 pA at + 50°C. 20 mV to 10 V/div: 10 pA at + 25°C; 20 pA at + 50°C.

Single ended, one-half the differential measurement. Display shift (10 μV/div, ac coupled) is ±4 divisions at +25°C; ±20 divisions at +50°C.

DC Stability – (Line Voltage Constant): ≤ 50 μV/°C. Drift with Time (Ambient Temperature and Line Voltage Constant): Short term is 5 μV p-p or 0.1 div or less (whichever is greater) over any one-minute interval after one-hour warm-up. Long term is 10 V p-p or 0.1 div or less (whichever is greater) in any one-hour interval after one-hour warm-up.

Displayed Noise – 16 μV or 0.1 div (whichever is greater) at maximum bandwidth. Source resistance, 25 Ω or less, measured tangentially.

Overdrive Recovery – 10 μs or less to recover within 0.5% of zero level after removal of a test signal applied for 1 s (signal amplitude not to exceed differential dynamic range). Front-panel Overdrive light indicates that an overdrive condition is being approached.



Common-Mode Rejection Ratio (for signals not exceeding common-mode signal range)

Signal and Offset Range –

Deflection-Factor Settings	10 V to 10 mV/div	20 mV to 0.1 V/div	0.2 V to 1 V/div	2 V to 10 V/div
Common-Mode Signal	±10 V	±100 V	±500 V	±500 V
Maximum DC Coupled Input (dc + peak ac at 1 kHz or less)	±15 V	±200 V	±500 V	±500 V
Maximum AC Coupled Input (dc voltage)	±500 V, dc rejection; at least 4 x 10^5:1			
DC Offset	+1 to –1V	+10 to –10 V	+100 to –100 V	+1000 to –1000 V

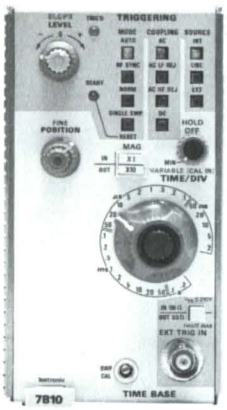
- *0.2-ns to 0.2-s/Div Calibrated Time Bases*
- *Triggering to 1-GHz*
- *Variable Trigger Holdoff*
- *Auto Triggering*
- *ΔTime Measurements With CRT Readout (7B15)*
- *Delayed Time Measurements With CRT Readout (7B15)*
- *Vertical Trace Separation Between Two Delayed Sweeps (7B15)*

The 7B10 and 7B15 are horizontal time bases designed for use with the 7100-Series mainframes to provide optimum bandwidth/sweep-speed compatibility, but may also be used with the 7800- and 7900-Series mainframes.

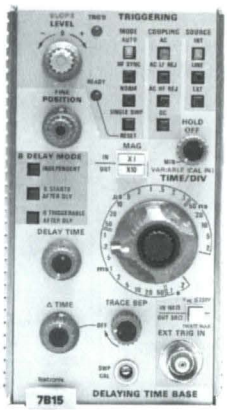
Either plug-in can be used as a single time base, or they can be combined in any mainframe with two horizontal compartments for delaying and delayed operation.

The 7B10 and 7B15 provide time measurement in addition to the standard delay-time display.

Delta time measurement is made by positioning two intensified zones on the waveform. The time difference between the two zones is displayed in the CRT readout. Expansion and overlapping of the two intensified zones is possible to allow precise setting of the zones to the desired points on the displayed waveform.



7B10 Time Base



7B15 Δ Delaying Time Base

CHARACTERISTICS

MAIN SWEEP

Sweep Rates – Calibrated: 0.2 s/div to 2 ns in 25 steps (1-2-5 sequence). X10 Magnifier extends fastest calibrated sweep rate to 0.2 ns/div. Uncalibrated: Variable is continuous to at least 2.5 times the calibrated sweep.

Sweep Accuracy – Measured over the center eight divisions, +15 to +35°C, in a 7100-, 7800-, or 7900-Series mainframe. Derate accuracies by an additional 1% for 0 to +50°C.

Time/Div –

	Unmagnified	Magnified
0.2 s to 10 ns/div	2%	3%
5 and 2 ns/div	3%	4%

Trigger Holdoff Time –

	Minimum	Maximum With Variable
0.2 s to 50 ms/div	40 ms	400 ms
20 ms to 2 μs/div	2 xTime/Div Setting	20 x Time/Div Setting
1 to 0.5 μs/div	2 μs	20 μs
0.2 μs to 2 ns/div	2 μs	6 μs

Delay Time Range – (7B15 only) 0.2 or less to at least 9.0 times time/div setting.

Delay Time Jitter – (7B15 only) 0.02% of time/div setting up through 50 μs/div. 0.03% of time/div setting plus 0.1 ns for sweep speeds of 20 μs through 100 ns/div.

Delay Accuracy – (7B15 only) 0.2 s/div to 10 μs/div. Within (0.5% of Delay + 5% of time/div setting).

ΔTime Range – (7B15 only) 0 to at least 9.0 times time/div setting.

ΔTime Accuracy – 20 ms to 100 ns/div. Within 0.5% of reading + 3 counts.

Trace Separation Range – (7B15 only) Functional only in Time mode. The second delayed-sweep display can be vertically positioned at least three divisions below the first delayed-sweep display.

Internal Trigger Jitter – 30 ps or less at 1 GHz.

HF Sync Mode – 250 MHz to 1 GHz, 0.3 div Internal and 0.75 mV External.

External Trigger Input – Maximum Input Voltage: 250 V (dc + peak ac) for 1 MΩ input, 1 W average for 50 Ω input. Input R and C: 1 MΩ within 5% and 20 pF within 10%; for 50-Ω input, 50 Ω within 2%. Level Range: At least ±3.5 V in Ext÷1.

Triggering Sensitivity for Repetitive Signals –

Coupling	Triggering Frequency Range*1	Min Signal Required Int	Min Signal Required Ext
AC	30 Hz to 250 MHz	0.5 div	50 mV
	250 MHz to 1 GHz	1.5 div	150 mV
AC LF Rej *2	50 kHz to 250 MHz	0.5 div	50 mV
	250 MHz to 1 GHz	1.5 div	150 mV
AC HF Rej	3 Hz to 40 kHz	0.5 div	50 mV
DC*3	DC to 250 MHz	0.5 div	50 mV
	250 MHz to 1 GHz	1.5 div	150 mV

**1 The triggering frequency ranges given here are limited to the –3 dB frequency of the oscilloscope vertical system when operating in the Internal mode.*

**2 Will not trigger on sine waves at or below 60 Hz when amplitudes are less than eight divisions Internal or 3 V External.*

**3 The Triggering Frequency Range for DC Coupling applies to frequencies above 30 Hz when operating in the Auto Trigggering Mode.*

ORDERING INFORMATION

7B10 Time Base **$3,100**
Includes: Instruction manual (070-2316-00).

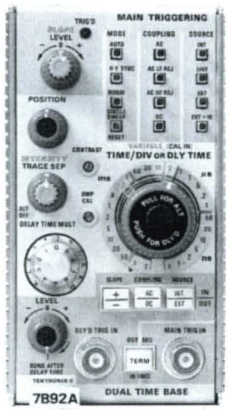
7B15 ΔDelaying Time Base **$3,330**
Includes: Instruction manual (070-2318-00).

7B92A *PLUG-IN DUAL TIME BASE*

- *0.5-ns to 0.2-s/Div Calibrated Time Base*
- *Triggering to 500-MHz*
- *Alternate Display of Intensified Delaying and Delayed Sweeps*
- *Contrast Regulation Between Delaying and Delayed Sweeps*

ORDERING INFORMATION

7B92A Dual Time Base **$4,300**
Includes: Instruction manual (070-1751-02).



The 7B92A Dual Time Base is recommended for use in the 7100-, 7800-, and 7900-Series mainframes. (The 7B92A may be used in all other mainframes at slower sweep speeds.)

There are four display modes: normal sweep, intensified delaying sweep, delayed sweep, and alternate sweep. When operating in the Auto mode of main triggering, a bright base line is displayed in the absence of a trigger signal.

CHARACTERISTICS

MAIN AND DELAYED SWEEP

Sweep Rate – 0.2 s to 0.5 ns/div in 27 steps (1-2-5 sequence). Uncalibrated: Variable continuously between steps to at least 2.5 times the calibrated sweep rate. The variable control is internally switchable between delaying and delayed sweeps.

Sweep Accuracy – Measured over the center eight divisions in a 7900-Series mainframe:

Time/Div –

	+15 to +35°C	0 to +50°C
0.2 s to 20 ns/div	Within 2%	Within 3%
10 ns/div	Within 3%	Within 4%
1 to 2 ns/div	Within 4%	Within 5%
0.5 ns/div	Within 5%	Within 6%

Delay Time Multiplier Range – 0 to 9.8 times the Delay Time/Div setting from 0.2 s to 10 ns/div (0 to 1.96 s).

HF Sync – Triggering sensitivity is 0.5 div Int or 100 mV Ext, from 100 to 500 MHz for any coupling except AC HF Rej.

Single Sweep – Triggering requirements are the same as normal sweep. When triggered, time base produces one sweep only until reset.

Delay Time Multiplier Range – 0 to 9.8 times the Delay Time/Div setting from 0.2 s to 10 ns/div (0 to 1.96 s).

Delay Time Jitter*[1] –

0.2 to 50 µs/div	0.02% of main sweep time/div switch setting or less
20 µs to 10 ns/div	0.03% of the main sweep time/div switch setting or less

[1] Not applicable for the first 2% of the maximum available delay time. Maximum available delay time is ten times the time/div or delay time switch setting.

Internal Trigger Jitter – 50 ps or less at 500 MHz.

External Trigger Input – Selectable 50 Ω or 1 MΩ inputs (1 MΩ is paralleled by ≈ 20 pF). Maximum Input Voltage: 250 V (dc + peak ac) for 1 MΩ input and 1 W average for 50 Ω input. Level Range: At least ±35 V in Ext÷10.

Triggering Sensitivity Auto and Norm Modes –

Coupling	Triggering Frequency Range	Min Signal Required Int	Ext
AC	300 Hz to 20 MHz	0.5 div	100 mV
	20 to 500 MHz	1.0 div	500 mV
AC LF Rej*[2]	30 kHz to 20 MHz	0.5 div	100 mV
	20 to 500 MHz	1.0 div	500 mV
AC HF Rej*[2]	30 Hz to 50 kHz	0.5 div	1.2 V
DC	DC to 20 MHz	0.5 div	100 mV
	20 to 500 MHz	1.0 div	500 mV

[2] Not applicable in Delayed Sweep mode.

Differential Delay-Time Measurement Accuracy Sweep Speed –

0.2 s to 0.1 µs/div	Both dials set at 0.5 or greater	± (0.75% of reading +0.25% or greater of full scale*[3]
	Either dial set at less than 0.5	± (0.75% of reading +0.5% of full scale*[3] + 5 ns)
50 to 10 ns/div	Both Delay Times ≥25 ns	± (1% of reading +0.5% of full scale*[3])
	One or both Delay Times <25 ns	± (1% of reading +1% of full scale*[3] + 5 ns)

[3] Full scale is ten times the time/div or delay time setting. Accuracy applies over the center eight divisions from +15 to +35°C.

The 7B80 and 7B85 are horizontal time bases recommended for use with the 7800- or 7900-Series mainframes to provide optimum bandwidth/sweep-speed compatibility.

Each plug-in can be used as a single time base, or combined in any mainframe with two horizontal compartments for delaying and delayed operation.

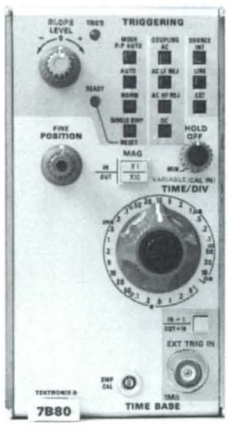
Option 02 is appropriate where Y-T and X-Y measurements are made.

7B80

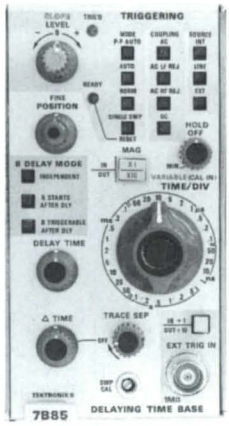
- *1-ns to 5-s/Div Calibrated Time Bases*
- *Triggering to 400 MHz*
- *Variable Trigger Holdoff*
- *Peak-to-Peak Auto Triggering*

7B85

- *1-ns to 5-s/Div Calibrated Time Bases*
- *Triggering to 400 MHz*
- *Variable Trigger Holdoff*
- *Peak-to-Peak Auto Triggering*
- *ΔTime Measurements with CRT Readout*
- *Delayed-Time Measurements with CRT Readout*
- *Vertical Trace Separation Between Two Delayed Sweeps*



7B80 Delayed Time Base



7B85 ΔDelaying / Time Base

CHARACTERISTICS

MAIN SWEEP

Sweep Rates – Calibrated: 5 s to 10 ns/div in 27 steps (1-2-5 sequence). X10 Magnifier extends fastest calibrated sweep rate to 1 ns/div. Uncalibrated: Variable is continuous to at least 2.5 times the calibrated sweep rate.

Sweep Accuracy – Measured over the center eight divisions, +15 to +35°C, in the 7800- or 7900-Series mainframe. Derate accuracies by an additional 1% for 0 to 50°C.

Time/Div –

	Unmagnified	Magnified
5 to 1 s/div	4.0%	Unspecified
0.5 s to 50 ns/div	1.5%	2.5%
20 to 10 ns/div	2.5%	4.0%

Trigger Holdoff Time – Minimum holdoff setting: 2 times Time/Div setting or less for sweep rates 5 s to 1 μs/div; 2 μs or less for sweep rates 0.5 μs to 10 ns/div. Variable extends holdoff through at least 2 sweep lengths for 20–ms/div or faster sweep rates.

ΔTime Range – (7B85 only) 0 to at least 9.0 times the time/div setting.

Triggering Sensitivity from Repetitive Signals (Auto and Norm Modes) –

Coupling	Triggering Frequency Range*1	Min Signal Required Int	Ext
AC	30 Hz to 50 MHz	0.3 div	50 mV
	50 to 400 MHz	1.5 div	250 mV
AC LF Rej*2	30 kHz to 50 MHz	0.3 div	50 mV
	50 to 400 MHz	1.5 div	250 mV
AC HF Rej	30 Hz to 50 kHz	0.3 div	50 mV
DC*3	DC to 50 MHz	0.3 div	50 mV
	50 to 400 MHz	1.5 div	250 mV

*1 *Triggering frequency ranges are limited to the frequency of the vertical system when operating in the Internal mode.*

*2 *Will not trigger on sine waves of less than eight divisions Internal, or 3 V External, at or below 60 Hz.*

*3 *Triggering Frequency Range for dc coupling applies to frequencies above 30 Hz when operating in the Auto Triggering mode.*

ΔTime Accuracy (+15 to +35 °C) – (7B85 only) 0.5 s to 50 ms/div: Within (0.5% of reading +0.1% full scale +1 count)*4 1. 20 ms to 100 ns/div: Within (0.5% of reading + 0.03% full scale +1 count).

Trace Separation Range – Functional only in ΔDelay Time mode when alternating or chopping between time-base units. The second delayed sweep display can be vertically positioned at least three divisions below the first delayed-sweep display.

Delay Time Range – 0.2 or less to at least 9.0 times time/div setting.

Delay Time Jitter – 0.02 or less of time/div setting plus 0.1 ns.

*4 *Full scale equals ten times thet tme/div switch setting.*

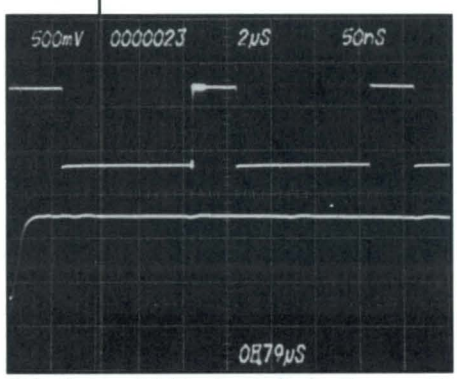
TRIGGERING

External Trigger Input – Maximum Input Voltage: 250 V (dc + peak ac). Input R and C: 1 MΩ within 5% and 20 pF within 10%. Level Range (Excluding P-P Auto): At least ±1.5 V in Ext÷1, at least ±15 V in Ext÷10.

7B80 Option 02, X-Y Display Capability – A front-panel switch selects either normal-sweep displays or X-Y displays. In the X-Y mode, the X and Y signals are applied to the inputs of a dual-trace vertical amplifier or two single-trace vertical amplifiers. The X signal is routed via the amplifier/main-frame trigger path to the 7B80 Option 02, and then to the mainframe horizontal amplifier for display.

Single Sweep – Requirements are the same as for repetitive signals.

Internal Trigger Jitter – 0.1 ns or less at 400 MHz.



Delaying and delayed sweeps are shown with the mainframe selecting Alt sweep modes. The delay time to the start of the delayed sweep is shown at the bottom of the CRT.

ORDERING INFORMATION

7B80 Delayed Time Base **$2,080**
Includes: Instruction manual (070-1959-00).

INSTRUMENT OPTION
Opt. 02 – X-Y Display Capability **+$130**

7B85 ΔDelaying Time Base **$2,400**
Includes: Instruction manual (070-1961-01).

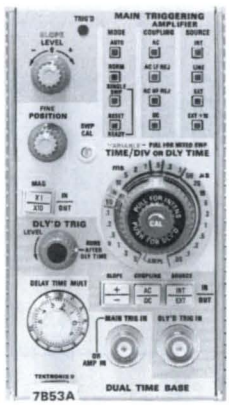
7B53A *PLUG-IN DUAL TIME BASE*

- *5-ns to 5-s/Div Calibrated Time Base*
- *Triggering to 100-MHz*
- *Single-Sweep Operation*
- *Calibrated Mixed Sweep*
- *TV Sync Separator Triggering (Option 05)*

ORDERING INFORMATION

7B53A Dual Time Base **$2,500**
Includes: Instruction manual (070-1342-01).

INSTRUMENT OPTION
Opt. 05 – TV Triggering **+$180**
Includes: Instruction manual (070-1471-00).



The easy-to-use 7B53A Time Base is recommended for use with 7600-Series mainframes to provide optimum bandwidth/sweep-speed compatibility.

The 7B53A provides normal, intensified delaying, delayed, and mixed sweeps.

CHARACTERISTICS

DELAYING SWEEP

Sweep Rate – Calibrated: 5 s/div to 50 ns in 25 steps (1-2-5 sequence). 5 ns/div, the fastest calibrated sweep rate, is obtained with the X10 Magnifier. Uncalibrated: Variable continuously between steps to at least 2.5 times the calibrated sweep rate.

Delay Time Multiplier Range – 0 to 10 times the Delay time/div setting from 5 s to 1 µs/div.

Differential Delay-Time Measurement Accuracy – 5 to 1 s/div: ±1.4% of measurement +0.3% of full scale. 0.5 s to 1 µs/div: ± 0.7% of measurement +0.3% of full scale. Full scale is ten times the Delay time/div setting. Accuracy applies over the center 8 delayed divisions from +15 to +35°C

Delay Time Jitter – 0.05% or less of time/div setting at 1 ms/div or slower, 0.2% at 20 µs/div.

Single Sweep – When triggered, sweep generator produces one sweep only, until reset.

Internal Trigger Jitter – 1 ns or less at 75 MHz.

Sweep Accuracy – Measured over center eight divisions, +15 to +35°C, with any 7000-Series mainframe. Derate accuracies by an additional 1% each for 0 to +50°C; 1.5% in magnified mode.

External Trigger Input – Maximum Input Voltage: 500 V (dc + peak ac), 500 V p-p ac at 1 kHz or less. Input R and C: 1 MΩ within 2% and 20 pF within 2 pF. Level Range: At least +1.5 to -1.5 V in Ext, at least +15 to -15 V in Ext÷10.

External Trigger Input – Maximum Input Voltage: 500 V (dc + peak ac), 500 V p-p ac at 1 kHz or less. Input R and C: 1 MΩ within 2% and 20 pF within 2 pF. Level Range: At least +1.5 to -1.5 V in Ext, at least +15 to -15 V in Ext÷10.

DELAYED SWEEP

Sweep Rate – Calibrated: 0.05 µs to 0.5 s/div in 22 steps (1-2-5 sequence). 5 ns/div, the fastest calibrated sweep rate, is obtained with the X10 Magnifier. Uncalibrated: Variable continuously between steps to at least 2.5 times the calibrated sweep rate. The variable control is internally switchable between main, delayed sweep, and variable main sweep holdoff.

Internal Trigger Jitter – 1 ns or less at 75 MHz.

Delayed Sweep Gate – Output Voltage: ≈ +3.5 V into at least 10 kΩ shunted by 100 pF or less, or 0.5 V into 50 Ω. Rise time: 50 ns or less. Output R is 350 Ω within 10%. Gate is available at the Dly'd Trig In connector when the delayed-sweep-source switch is set to Int.

Trigger Sensitivity –

Coupling	Trigger Frequency Range	Minimum Triggering Signal Required	
		Int*[1] (divisions)	Ext (millivolts)
AC	30 Hz to 10 MHz	0.3	100
	10 MHz to 100 MHz	1.5	500
DC	DC to 10 MHz	0.3	100
	10 MHz to 100 MHz	1.5	500

*[1] *The triggering frequency ranges given here are limited to the -3 dB frequency of the oscilloscope vertical system when operating in the Internal mode.*

MIXED SWEEP

Sweep Accuracy – Within 2% plus measured main-sweep error. Exclude the following portions of mixed sweep: First 0.5 div after start of main sweep display and 0.2 div or 0.1 µs (whichever is greater) after transition of main to delayed sweep.

EXT HORIZONTAL INPUT

Deflection Factor – 10 mV/div within 10% when in Ext, Mag X10; 100 mV/div within 10% when in Ext; 1 V/div within 10% when in Ext÷10. TV SYNC

TV Sync Separator Triggering – Available as Option 05.

Sweep Accuracy Time/Div –

	Delaying Sweep		Delayed Sweep	
	Unmagnified	Magnified	Unmagnified	Magnified
5 to 1 s/div	3%	N/A	4%	4.5%
50 ms to 0.5 µs	2%	2.5%	3%	3.5%
0.2 to 0.05 µs/div	3%	3.5%	—	—

7T11A SAMPLING SWEEP UNIT

The 7T11A Sampling Sweep Unit provides equivalent- and real-time horizontal deflection for single- or dual-trace sampling. Timing accuracy is within 3% and nonlinearity is below 1%. Triggering range is from approximately 10 Hz (sequential mode) to above 12.4 GHz. The 7T11A is a companion unit to the 7S11.

CHARACTERISTICS

Time/Division Range – 10 ps to 5 ms/div (1-2-5 sequence) directly related to time position ranges.

Time Position Range – Equivalent time is 50 ns to 50 µs in four steps; real time is 0.05 ms to 50 ms in three steps.

Time/Division Accuracy – Within 3% for all time/division settings over center 8 cm.

TRIGGERING

External 50-Ω Input – Frequency range: dc to 1 GHz in X1 Trig Amp mode. Sensitivity range: 12.5 mV to 2 V p-p (dc to 1 GHz) in X1 Trig Amp, 1.25 mV to 2 V p-p (1 kHz to 50 MHz) in X10 Trig Amp. Input R: 50 Ω within 10%. Maximum input voltage: 2 V (dc + peak ac).

External 1-MΩ Input – Frequency range is dc to 100 MHz in X1 Trig Amp mode. Sensitivity range is 12.5 mV to 2 V p-p (dc to 100 MHz) in X1 Trig Amp, 1.25 mV to 2 V p-p (1 kHz to 50 MHz) in X10 Trig Amp. Input R is 1 MΩ within 5%. Maximum input voltage is 100 V p-p to 1 kHz (derating 6 dB per octave to a minimum of 5 V p-p).

External HF Sync –
Frequency range: 1 to 12.4 GHz.

Sensitivity range: 10 to 500 mV p-p up to 1 GHz; 200 mV to 500 mV from 1 GHz to 12.4 GHz.

Input R: 1 MΩ. Maximum input voltage: 2 V p-p.

Internal Trigger Source (Sine Wave Triggering) – Frequency range is 500 kHz to 500 MHz in X1 Trig Amp: 500 kHz to 50 MHz in X10 Trig Amp. Sensitivity range is 125 mV to 1 V p-p (referred to the vertical input) in X1 Trig Amp; 12.5 mV to 1 V p-p (referred to the vertical input) in the X10 Trig Amp.

Random Mode Trigger Rate – 1 kHz min.

Display Jitter –

Time Pos Range	Sequential Mode	Random Mode
50 µs to 500 ns	0.4 div or less	1 div or less
50 ns	10 ps	30 ps

Pulse Out – Positive pulse amplitude at least 400 mV (into 50 Ω) with 2.5-ns rise time or less.

Trigger Kickout – 4 mV or less into 50 Ω (except HF Sync).

Display Scan Rate – Continuously selectable from at least 40 sweeps/s to < 2 sweeps/s.

External Scan – Deflection factor is continuously variable from 1 to 10 V/div. Input R is 100 kΩ within 10%. Maximum input voltage is 100 V (dc + peak ac).

Sweep Out – 1 V/div within 2%. Source R is 10 kΩ within 1%.

7T11A Sampling Sweep Unit

7S11 SAMPLING UNIT

The 7S11 single-channel sampling unit uses plug-in heads ranging in bandwidth from 1 to 14 GHz. Single-channel sampling uses one 7S11 with a 7T11A. Two 7S11s and one 7T11A provide dual-trace sampling. Two 7S11s can be used for X-Y operations.

CHARACTERISTICS

Deflection Factor – 2 to 200 mV/div in seven steps (1-2-5 sequence), accurate within 3%.

Bandwidth and Input Impedance – Determined by the sampling head used, see page 94.

DC Offset – Range, +1 to -1 V or more.

Delay Range – At least 10 ns for comparing two signals in a dual-trace application.

Vertical Signal Out – 200 mV per displayed division within 3% (source is 10 kΩ).

7S11 Sampling Unit

Tektronix offers service training classes on the 7T11A/7S11. For further training information, contact your local Sales Office and request a copy of the Tektronix Service Training Catalog.

7T11A

- *10-ps to 5-ms/Div Calibration Time Base*
- *Random or Sequential Sampling*
- *Equivalent- or Real-Time Sampling*
- *No Pretrigger Required*

ORDERING INFORMATION

7T11A – Sampling Sweep Unit **$5,400**
Includes: 42-inch BNC 50-Ω cable (012-0057-01); 3-mm SMA male-to-BNC adaptor (015-1018-00); 3-mm SMA male-to-GR874 adaptor (015-1007-00); 10X 50-Ω attenuator (011-0059-02); instruction manual (070-6176-00).

OPTIONAL EQUIPMENT
7M11 – 75 ns Delay Line **$1,920**

7S11

- *2- to 200-mV/Div Calibrated Deflection Factors*
- *Plug-In Sampling Heads*

ORDERING INFORMATION

7S11 – Sampling Unit w/o Sampling Head **$2,215**
Includes: Instruction manual (070-0985-00).

SAMPLING HEADS

S-4

- *<5-mV Displayed Noise (Unsmoothed)*
- *25-ps Rise Time*
- *Internal Trigger Pickoff*

S-6

- *30-ps Rise Time*
- *< 5-mV Displayed Noise (Unsmoothed)*
- *Loopthrough Input*

S-42

- *Optical Sampling Head*
- *55-ps Optical Pulse Response (FWHM)*
- *DC to 6.4-GHz Equivalent Bandwidth (0.35/55-ps)*
- *1000 to 1700-nm Spectral Response*
- *Mean Optical Power Monitor Function*

S-52

- *25-ps Rise Time*
- *200 mV Into 50 Ω*
- *50-Ω Source*
- *Pretrigger Output*

ORDERING INFORMATION

S-4 Sampling Head **$2,750**
Includes: 10X, 50 Ω SMA attenuator (015-1003-00); 2-ns cable with SMA connectors (015-1005-00); GR874-to-SMA male adaptor (015-1007-00); SMA male-to-male adaptor (015-1011-00); 5/16-inch wrench (003-0247-00); instruction manual (070-0896-01).

S-6 Sampling Head **$2,100**
Includes: 50-Ω termination (015-1022-00); 1-ns, 50-Ω cable (015-1019-00); SMA (3 mm) female-to-female adaptor (015-1012-00); combination wrench (003-0247-00); SMA male-to-GR874 adaptor (015-1007-00); instruction manual (070-1128-01).

S-42 Optical Sampling Head **$3,250**
Includes: 2 multimeter connection cables (012-1286-00 and 012-1287-00); instruction manual (070-7191-00).

S-52 Pulse-Generator Sampling Head **$1,650**
Includes: 1 ns, 50 Ω semirigid coaxial delay line (015-1023-00); instruction manual (070-1101-01).

S-4 SAMPLING HEAD

The S-4 Sampling Head is a 25-ps rise time unit with a 50-Ω input impedance.

CHARACTERISTICS

Rise Time – 25 ps or less.

Bandwidth – Equivalent to dc to 14 GHz at 3 dB down.

Transient Response – Aberrations in the first 400 ps following a step from an S-52 Pulse Generator Head are -10%, +10% or less, total of 20% or less p-p. From 400 ps to 25 ns following a step from a 284 Pulse Generator, -0%, +10% or less, total of 10% or less, p-p with 284 pulse displayed; after 25 ns, ±2% or less, total of 4% or less p-p.

Displayed Noise – 5 mV or less, measured tangentially.

Signal Range – Variable dc offset allows signals between +1 and -1 V limits to be displayed at 2 mV/div. For best dot-transient response with random-sampling sweep unit, signal amplitude should be less than 500 mV p-p.

Input Characteristics – Nominally 50 Ω. Safe overload is ±5 V. SMA (3 mm) input connector.

S-6 SAMPLING HEAD

The S-6 Sampling Head is a 50-Ω feedthrough unit for high-speed applications.

CHARACTERISTICS

Rise Time – 30 ps or less. 35 ps or less as observed with S-52 Pulse Generator.

Bandwidth – Equivalent to dc to 11.5 GHz at 3 dB down.

Transient Response – Pulse aberrations following the steps are +7%, -7%, total of 10% p-p within 1.8 ns of step with reference point at 1.8 ns from step; ±2%, total of 4% p-p after first 2.5 ns with reference point at 300 ns from step.

Displayed Noise – 5 mV or less, measured tangentially.

Signal Range – ±1 V (dc + peak ac). 1 V p-p. DC offset allows any portion of input signal to be displayed.

Input Characteristics – Nominally 50 Ω, loop-through system, unterminated. SMA (3 mm) connectors. Safe overload is ±5 V.

S-42 OPTICAL SAMPLING HEAD

The S-42 is an optical-to-electrical sampling head for use with 7000-Series Oscilloscopes equipped with a 7S11 Sampling Unit.

CHARACTERISTICS

Pulse Response – 55 ps max FWHM (Full Width Half Maximum).

Bandwidth (Equivalent) – 6.4 GHz (0.35/55 ps).

Spectral Response – 1000 to 1700 nm.

Noise Equivalent Power – 125 µW or less.

Pulse Response Aberrations (first 400 ps following setup) – ≤ 30% p-p.

Linear Response – Linear up to 25 mW peak, 5 mW mean-optical-power input.

Mean-Power Meter Dynamic Range – 1 nW to 5 mW (60 dB).

S-52 PULSE-GENERATOR SAMPLING HEAD

The S-52 Pulse-Generator Sampling Head is a tunnel-diode step generator.

CHARACTERISTICS

Pulse Output – Rise time is 25 ps or less. Amplitude into 50 Ω is at least 200 mV, positive going. Pulse duration when used with the 7S12*[1] in the TDR mode is typically 750 ns. Pulse duration when powered by the 7S11 is > 800 ns. Pulse period 16 µs within 2 µs. Pulse aberrations following the step are ±7%, total of 10% p-p within 1.8 ns of step with reference point at 1.8 ns from step, +2%, -2%, total of 4% p-p after first 2.5 ns with reference point at 350 ns from step.

Pretrigger Output – Amplitude into 50 Ω is at least 1 V, positive going, and rises at 600 mV/ns. Pretrigger pulse duration is 4 ns. Pretrigger occurs 85 ns (within 5 ns) before the pulse output. Pretrigger-to-pulse output jitter is 10 ps or less. Pretrigger output is also available at rear connector for internal triggering of the sampling sweep unit.

Output Connectors – Pulse output uses an SMA (3 mm) connector. Pretrigger output uses a BSM connector.

**[1] Not available*

7CT1N CURVE TRACER

7CT1N Curve Tracer

The 7CT1N displays characteristics of small-signal devices to power levels up to 0.5 W.

CHARACTERISTICS

Collector/Drain Supply –

	X1		X10	
Horizontal Volts/Div	0.5	2	5	20
Voltage Range (V)	0 to 7.5	0 to 30	0 to 75	0 to 300
Max. Current (mA)	240	60	24	6

Maximum Open-Circuit Voltage – Within 20%.
Maximum Short-Circuit Current – Within 30%.

Series Resistance – Automatically selected with horizontal V/div switches. Peak Power: 0.5 W or less.

High-Voltage Warning – A flashing warning light appears on the front panel indicates that dangerous voltages may exist at the test terminals.

STEP GENERATOR

Transistor Mode – Step-Amplitude Range: 1 μA to 1 mA/step, 1-2-5 sequence. Maximum Current (Steps Plus Aiding Offset): X15 amplitude setting. Maximum Voltage (Steps Plus Aiding Offset): At least 13 V. Maximum Opposing Offset Current: At least X5 amplitude setting.

FET Mode – Step-Amplitude Range: 1 mV to 1 V/step, 1-2-5 sequence. Voltage Amplitude (Steps Plus Aiding Offset): X15 amplitude setting, 13 V maximum. Source Impedance: 1 kΩ ±1%.

Accuracy – Incremental: Within 3% between steps.

Step Polarity – Same as the collector/drain supply in the transistor mode and opposing in the FET mode.

Offset – 0 to 5 steps, ± polarity.

Vertical-Deflection Factors – 10 μA to 20 mA/div in the X1 mode.

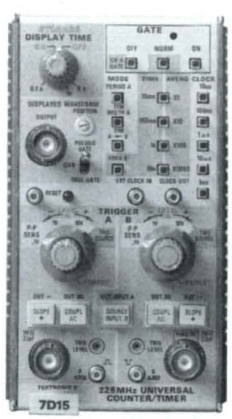
Vertical-Display Accuracy – Within 5% ±0.2 nA per displayed horizontal V when in the ÷1000 mode.

Horizontal-Deflection Factors – Selectable, 0.5, 2, 5, or 20 V.

Horizontal-Display Accuracy – 5% plus the deflection-factor accuracy of the plug-in being driven. The plug-in should be a vertical or horizontal amplifier with a 100 mV/div deflection factor and an input R of at least 50 kΩ.

7D15 UNIVERSAL COUNTER-TIMER

The 7D15 is used in all 7000-Series mainframes having CRT readout. The 7D15 can be completely controlled by the oscilloscope's delayed gate. Arming inputs are provided for each channel. By using the delayed B gate to control the start and stop count points, measurements can be made between any two points on the CRT display.



7D15 225-MHz Counter-Timer

CHARACTERISTICS

INPUT SIGNAL CH A & B

Frequency Range (CH B Only) – DC Coupled: DC to 225 MHz. AC Coupled: 5 Hz to 225 MHz .

Sensitivity (CH A and B Inputs) – 100 mV p-p. Trigger Source: 0.5 division to 50 MHz, 1.0 division up to 225 MHz.

Input R and C – 1 MΩ and 22 pF.

Triggering (Preset Position) – Triggers at 0 V.

Arming Inputs – Input R and C: 10 kΩ and 20 pF.

External Clock-In – 20 Hz to 5 MHz.

INTERNAL TIME BASE

Crystal Oscillator – Accuracy: Within 0.5 ppm. Temperature compensated.

OUTPUT SIGNALS

Clock Out – Logical 1 ≥ + 0.5 V into 50 Ω.

A and B Trigger Level – Zout ≈1 kΩ, Vout ±0.5 V into 1 MΩ.

Display-Mode Switch – 0.1 s to 5 s; preset position for infinite display time.

Readout – Eight-digit display. Overflow indicated by a ">" symbol.

7CT1N

- *Tests Semiconductor Devices to 0.5 Watts*
- *10-nA to 20-mA/Div Vertical-Deflection Factors*
- *0.5-V to 20-V/Div Horizontal-Deflection Factors*
- *Operates in 7000-Series Vertical or Horizontal Mainframe*

ORDERING INFORMATION

7CT1N Curve Tracer **$2,100**
Includes: Test adapter with two sets of test terminals, one with TO5 basing and the other with TO18 basing (013-0128-00); instruction manual (070-1247-00).

7D15

- *Oscilloscope-Controlled Time and Frequency Measurements*
- *10-ns Single-Shot Time-Interval Measurement Resolution*
- *Time-Interval Averaging*
- *10-ps Period-Averaging*
- *Frequency Measurements Directly to 225-MHz*
- *Signal Conditioning via Mainframe Trigger Source*

ORDERING INFORMATION

7D15 Universal Counter-Timer **$4,400**
Includes: Two 44-inch Selectro-to-BNC connector cables (012-0403-00); instruction manual (070-1433-00).

7000-SERIES PROBE SELECTION GUIDE

All bandwidths given in MHz*1

		Passive 1-M Ω Input Probes					Low-Z, 50-Ω Input Probes		Active 50-Ω / 1-M Ω Input Probes			Differential Probes		High-Voltage Probes	
	Plug-in	P6062B*2 (6 ft.)	P6101A, Opt. 01 (1 m)	P6105A (2 m)	P6130, Opt. 01 (1.5 m) P6106A, Opt. 01 (1 m)	P6131 (1.3 m)	P6156, 10X (1.5 m)	P6156, Opt. 25, 100X (1.5 m)	P6201*3 (6 ft.)	P6202A*3 (2 m)	P6230*3 (1.5 m)	P6046 (6 ft.)	P6055A	P6009 (9 ft.)	P6015 (10 ft.)
7100 Family	7A19	NC	NC	NC	NC	NC	550	550	430	300	480	100	NC	NC	NC
	7A24	NC	NC	NC	NC	NC	375	375	310	300	350	100	NC	NC	NC
	7A26	—	34	100	175	NC	NC	NC	195	185	200	90	—	125	75
	7A29	NC	NC	NC	NC	NC	950	925	660	450	800	100	NC	NC	NC
	7A42	—	34	100	250	300	350	350	300	280	350	100	—	130	80
7900 Family	7A13	—	34	75	105	NC	NC	NC	105	105	105	70	90	85	—
	7A18A	75	34	75	75	NC	NC	NC	75	75	75	60	—	70	60
	7A19	NC	NC	NC	NC	NC	500	500	430	300	480	95	NC	NC	NC
	7A22	1	1	NC	NC	NC	NC	NC	—	—	—	—	1	—	—
	7A24	NC	NC	NC	NC	NC	350	350	310	290	350	90	NC	NC	NC
	7A26	—	34	100	175	NC	NC	NC	185	185	190	85	—	125	75
	7A29	NC	NC	NC	NC	NC	500	500	450	350	500	700	—	NC	NC
	7A42	—	34	100	250	300	300	300	300	300	300	90	—	130	80
7800 Family	7A13	—	34	100	100	NC	NC	NC	100	100	100	70	90	85	60
	7A18A	85	34	85	85	NC	NC	NC	90	75	90	65	—	80	60
	7A19	NC	NC	NC	NC	NC	400	400	360	320	400	95	NC	NC	NC
	7A22	1	1	1	NC	NC	NC	NC	—	—	—	—	1	1	1
	7A24	NC	NC	NC	NC	NC	300	300	280	270	300	90	NC	NC	NC
	7A26	—	34	100	145	NC	NC	NC	155	150	180	85	—	105	75
	7A29	NC	NC	NC	NC	NC	400	400	400	350	400	100	—	NC	NC
	7A42	—	34	100	200	275	275	275	260	260	275	90	—	110	75
7600 Family	7A13	70	34	70	75	NC	NC	NC	75	75	75	55	65	65	55
	7A18A	70	34	70	70	NC	NC	NC	75	75	75	55	—	65	55
	7A22	1	1	1	NC	NC	NC	NC	—	—	—	—	1	—	—
	7A26	95	34	95	95	NC	NC	NC	100	100	100	70	—	85	65
	7A42	95	34	95	95	100	100	100	100	100	100	70	—	85	65

*1 *The values in the top table represent the approximate useful frequency response for the measurement systems at the probe tip. NC = Not Compatible.*

If there is no bandwidth specified, the probe/plug-in combination is compatible but not recommended.

*2 *Bandwidths given for 10X switch position.*

*3 *Requires 1101/1101A Power Supply or other external source of power when used with 7854, 7603, 7633, or 7623.*

7000-SERIES CAMERA SELECTION GUIDE

Mainframe	Camera/Features			
	C-51 High Writing Rate	C-53 General Purpose	C-59 General Purpose	C-5C Low Cost
7104/R7103	no	yes	no	yes
7934	no	yes	no	yes
7904A/R7903	yes	yes	no	yes
R7844	yes	yes	no	yes
R7854 Opt. 05	yes	yes	no	yes
7633/R7633, 7623A/R7623A, 7613/R7613	no	yes	no	yes
7603/R7603	no	no	yes	yes

ORDERING INFORMATION

Accessory	Key Characteristics *[The following accessories are compatible with 7000-Series amplifiers/mainframes, unless specified otherwise. For complete specifications refer to the corresponding page(s) listed in this table.]*	Page	Order	Price
Probes				
Passive Probes (1-MΩ Inputs)	10X, 200 MHz, w/readout and identify, miniature tip	411	P6053B	**$165**
	10X, 100 MHz, w/readout	411	P6062B	**$190**
	1X, 34 MHz, miniature tip	410	P6101A, Opt. 01	**$65**
	10X, 100 MHz, w/readout and ground ref, miniature tip	410	P6105A	**$100**
	10X, 250 MHz, w/readout and ground ref, miniature tip	410	P6106A, Opt. 01	**$155**
	10X, 150 MHz, w/readout, miniature tip	410	P6109	**$63**
	10X, 100 MHz, w/readout, miniature tip	412	P6121	**$120**
	10X, 250 MHz, w/readout, subminiature tip	413	P6130, Opt. 01	**$155**
	10X, 300 MHz, w/readout, subminature tip (7A42)	413	P6131	**$160**
Low- Z Probes (50-Ω Inputs)	10X, 9.0 GHz, ≤ 0.15 pF/500 Ω (S-4, S-6, S-52 only) (adapters required for use on other than SMA inputs)	419	P6150	**$1,260**
	10X, 3.5 GHz, ≤ 1 pF/500 Ω (100X attenuator with Opt. 25), compact tip (other options available)	419	P6156	**$240**
Active Probes	1X, 900 MHz, ≤ 1.5 pF/100 kΩ FET probe, (includes 10X and 100X attenuators)	417	P6201	**$1,350**
	10X, 500 MHz, ≤ 2 pF/10 MΩ FET probe, miniature tip (optional 10X attenuator provides 100X)	417	P6202A	**$780**
	10X, 1.5 GHz, ≤ 1.3 pF/450 Ω, Bias/Offset probe, subminiature tip	417	P6230	**$475**
Differential Probes	1X, 100 MHz, CMRR-10,000:1, 10 pF/1 MΩ FET probe, (includes 10X attenuator)	418	P6046	**$2,000**
	10X, 90 MHz, CMRR-20,000:1, 10 pF/1 MΩ, compact tip (7A13, 7A22 only)	418	P6055A	*2
Current Probes	DC - 50 MHz, 0-20 A (dc + peak ac), w/A6302 probe	425	AM503S	**$2,200**
	DC - 15 MHz, 0-100 A (dc + peak ac), w/A6303 probe	425	AM503S, Opt. 03	**$2,750**
	25 kHz - 1 GHz, max current of 0.5 A RMS	427	CT-1	**$260**
High-Voltage Probes	100X, 120 MHz, w/readout	420	P6009	**$230**
	1000X, 75 MHz,	420	P6015	**$780**
Optical-to-Electrical Converters	DC - 6.4 GHz, 1000-1700 nm (7S11 only)	372	S-42	**$6,040**
	DC - 1 GHz, 1100-1700 nm*1	371	P6703	**$2,750**
	DC - 700 MHz, 450-1050 nm*1	371	P6701	**$2,000**
	DC - 500 MHz, 1000-1700 nm*1	371	P6702	**$2,095**
Voltage Isolator	500 V max	421	A6902B	**$2,070**
Carts	Tilt tray, locking drawer, plug-in storage cabinet, power strip, and brakes	401	K213, Opt. 12	**$800**
	Tilt tray, drawer, power strip, and brakes (7000-Series rackmount instruments only)	400	K217	**$570**
Cameras	Fast writing speed, adjustable f-stop and shutter speed	394	C-51P	**$2,680**
	Medium writing speed, adjustable f-stop and shutter speed	394	C-53P	**$2,220**
	Medium writing speed (7603/R7603 only)	394	C-59AP	**$1,560**
	Light weight, fixed focus	392	C-5C	**$530**
Digitizing Camera	Digitizing Camera System (R7103, 7104 only)	172	DCS 01, Opt. 1A	**$6,645**
Plotter	HC100 (7854, 7D20 only)	384	HC100, Opt. 01	**$990**
Blank Panels	Plug-in chassis with PC board	440	040-0553-03	*2
	Plug-in panel	440	016-0155-00	**$65**
Rack Adapters	(7104, 7854, 7904A, 7934 only)	440	040-0611-01	**$645**

*1 *Requires 1103 TekProbe™ Power Supply*
*2 *Contact your local sales representative*

Note: Other available accessories can be found on pages 383-446

Complementary Modular Test Instruments available on page 243.

PRODUCT LITERATURE/ APPLICATION NOTES AND SOFTWARE

PRODUCT LITERATURE AND APPLICATION NOTES

Tektronix product literature is readily available from your local Tektronix Sales Office.
For data sheets and product brochures, just ask for literature on the specific instrument.
Additional related publications also available are listed below.

Product	Title	Description	Order
7D20	7D20 Programmable Digitizer: Digitizing Performance and Versatility in a Power Plug-in	Discusses, in-depth, the features, functions, and capabilities of the 7D20	42W-5079-1
7D20	The 7D20 Programmable Digitizer: Performing a Wide Range of Measurement Tasks Easier, Faster, and More Accurately	Gives 7D20 application examples including ultrasonic testing, monitoring nerve activity, measuring pulse jitter, and SOA analysis of power devices	42W-5085
7603 7A22/7A18A/7A13 7B53A 7D15	Pulse Echo Measurements with Digital Accuracy	Describes timing measurements, pulse echo measurements, measurements between nonadjacent pulses, and ultrasonic transducers	42W-3681-1
7A42	Advanced Trigger Techniques	Demonstrates how the 7A42 measures complex signals easily	42W-5588
7A42	Viewing Low Amplitude Pulses	Describes how to check logic levels	42W-5629
7A42	Displaying Bus Contention	Discusses microprocessor bus contention measurements	42W-5630
7A19/7626 7B80/7B85	Pulse and Digital Timing Measurements – A Better Technique	Gives a general overview of using the the 7A19/7A26 and 7B80/7B85	42AX-3379-1
7D15	Measuring Disc Drive Time and Access Voltages	Describes how the 7D15 uses a single CRT display to perform both digital and analog analysis of complex waveforms	42W-2687-2

Software Packages for the 7854/7D20

7854/IBM PC Time and Amplitude Measurement Software *[1]* – Pulse parametrics, prop delay, cursors, and waveform operations. Order S42P202.

EZ-TEST – Provides a simple means to specify high-level test functions using instruments in an online learning mode. Test procedures include instrument control, measurements, pass/fail, waveform acquisition and pulse parameter analysis, and more. Order S45F030.

SPD Signal Processing & Display Software – A library of 196 signal processing, analysis and display routines callable from Microsoft C or BASIC. SPDMENU lets you interactively control instruments and analyze data using a convenient system of menus and graphical displays of data. Order S3FG130.

ASYST ™ – Sophisticated scientific software for the personal computer. Interactive or fully programmable operation for integrated data acquisition, analysis and display. Supports RS-232-C, GPIB, or A/D acquisition boards. Order S42P301 for ASYST Modules 1, 2, and 4.

Digitizer Driver for ASYST – Menu-driven package written in the ASYST language for mainframe control, waveform acquisition, pulse parametrics, graphing, and FFT analysis. Order S47P302.

ASYSTANT ™ ***GPIB*** – Fully integrated, completely menu-driven environment, designed for data acquisition and instrument control via IEEE Standard 488/GPIB interface coupled with a broad range of statistical and numerical analysis and waveform processing operations. Order S47P311.

LabWindows ™ – An integrated software system that supports rapid prototyping, development, and operation of test and measurement applications in either C or BASIC programming languages. Order S3FG910.

DADiSP – An interactive technical worksheet for scientists and engineers. Over 160 functions can be applied to waveforms; including signal arithmetic, waveform generation, frequency domain analysis, and statistical routines. Order S3FG916 or S3FG918.

For Macintosh users, virtual instrument panels and icons are available for the LabView ™ instrumentation software from National instruments.

See page 342 for a complete description of the software packages available.

[1] This package supports the 7854 only.

IMPRESSIVE VERSATILITY

The Tektronix 5000-Series offers the broadest selection of low-cost measurement capability available today. The modular design concept enables you to choose the exact waveform measurement equipment you currently need: one-channel to eight, real-time or CRT storage, dual or single beam, standard or differential, and then easily reconfigure it later to meet changing requirements. Below are some key evaluation criteria to consider when deciding which 5000-Series configuration will best meet your needs.

DIVERSE APPLICATIONS

For product evaluation and test, you can configure 5000-Series modules for benchtop or rackmount. 5000-Series are also used extensively in numerous biophysical applications and biomedical research. Engineering applications include electromechanical design, amplifier design and evaluation, vibration analysis, and ultrasonics research.

BANDWIDTH AND RISE TIME

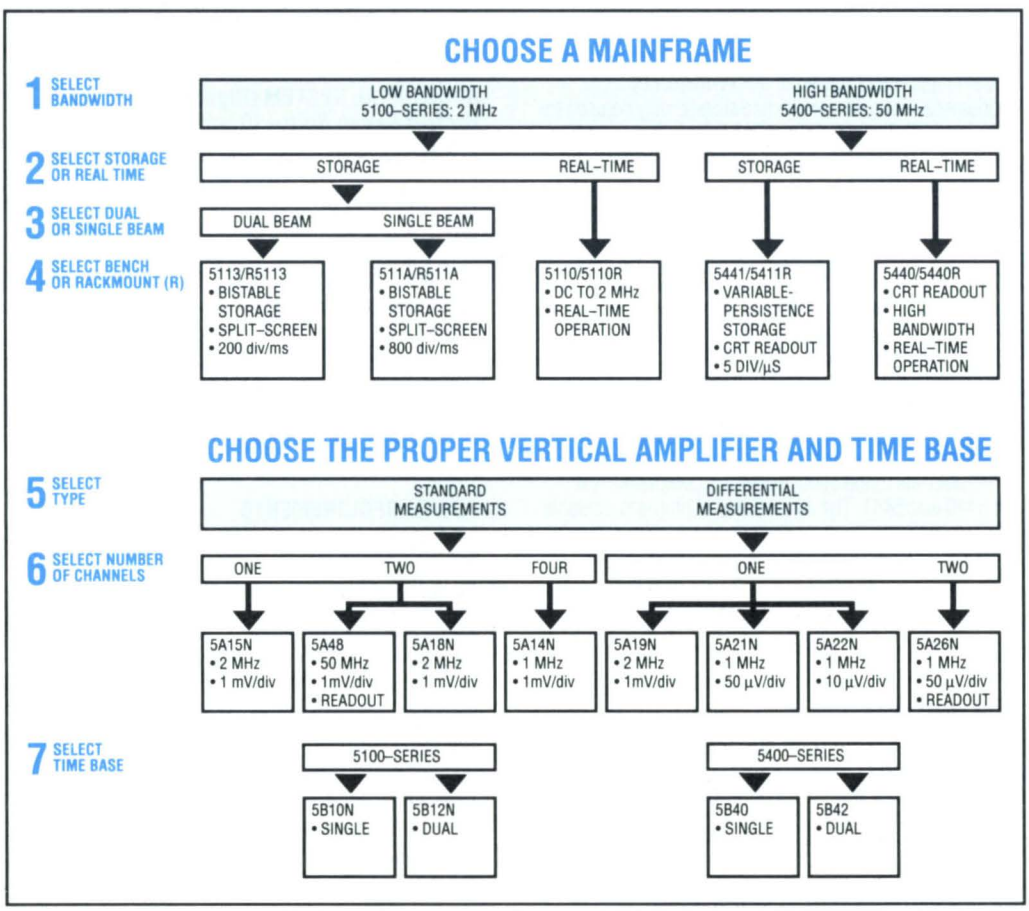
The scope you choose should be about three to five times faster than the signal being measured in order to provide an error of less than three percent.

REAL-TIME OR CRT STORAGE

Choose a real-time scope for applications not requiring waveform storage, or when viewing repetitive signals greater than 50 Hz. CRT storage, on the other hand, is essential for displaying low repetition rate or slowly varying signals. Capturing transient or one-time events also requires a storage scope.

VARIABLE PERSISTENCE OR BISTABLE STORAGE

The 5000-Series offers two types of CRT storage: variable persistence or bistable. The first, variable persistence, provides a continuous gradation between the waveform and background. This is helpful when you want to suppress random noise or flicker, or when you need to compare repetitive signals or produce bright, high contrast displays of fast signals occuring at slow periodic rates. If, on the other hand, you need to store and view events over longer periods of time, bistable storage is probably the right choice for your application.



To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

The Broadest Selection of Low-Cost Measurement Capability in Your Choice of Real-Time or CRT Storage

- *Up to Eight Fully Independent Channels. With two 5A14N vertical amplifier plug-ins the 5000-Series can provide an ideal multi-channel analysis or storage system.*
- *High Sensitivity vs. Bandwidth. 1 mV/div at 25 MHz standard 10 μV/div at 1 MHz differential, mandatory for faithful reproduction of low-level signals.*
- *High CMRR. A high Common Mode Rejection Ratio of 100,000:1 enables you to easily see signals buried in noise. Even low-level signals with a large dc offset can be easily recovered and displayed.*
- *CRT Readout of Amplifier Scale Factors. Provides quick and easy verification of control settings.*
- *Modular Amplifiers and Time Bases. Choose between one-, two-, and four-channel high and low bandwidth vertical amplifiers, differential amplifiers, single and dual time bases.*
- *X-Y Display. A third amplifier plug-in, used in place of a time base enables operation to the full sensitivity of the chosen amplifier.*
- *Fully Independent Dual X-Y Displays. Available when using 5A18N dual-channel amplifier in place of a time base.*
- *High Resolution CRT. 6 1/2" (diagonal) screen offers 1.27 cm/div for easy viewing and more accurate measurements.*
- *Dual Beam Storage. Only Tek offers Two-Gun CRT to eliminate 'dead time' between channels.*

Contents

5441/5440 100
5A48/5A42/5A40 101
5113/5111A/5110 102
5A18N/5A15N/5A14N 103
5A22N/5A21N/5A19N 104
5A26/5B12N/5B10N 105
Accessories 106

5441/R5441 5440/R5440 — 50 MHz MAINFRAME OSCILLOSCOPES

High Bandwidth Real-Time and Storage Mainframes

- *DC to 50 MHz Bandwidth*
- *CRT Readout*
- *5 div/μs Stored Writing Speed*
- *Variable-Persistence Storage*
- *Dual X-Y Operation*
- *Wide Choice of Plug-Ins*

ORDERING INFORMATION

5441/R5441 50 MHz Storage Oscilloscope Mainframe*[1] Includes: Instruction manual (070-2140-01); 1 year warranty; Power cord (see page 106 for type).

5441	**$6,875**
R5441	**$6,975**

5440/R5440 50 MHz Oscilloscope Mainframe*[1] Includes: Instruction manual (070-2139-01); 1 year warranty; Power cord (see page 106 for type).

5440	**$4,430**
R5440	**$4,530**

Note: 'R' prefix indicates rackmount version.

INSTRUMENT OPTIONS

Opt. 01 – Without CRT Readout	**NC**
Opt. 03 – User-Addressable Readout	**+$160**
Opt. 04 – Panel Cover	**+$45**

CONVERSION KITS

CRT Readout – Order 040-0691-02	**$580**
Cabinet to Rack – Order 040-0583-03	**$260**
Rack to Cabinet – Order 040-0584-04	**$280**

INTERNATIONAL POWER PLUG OPTIONS

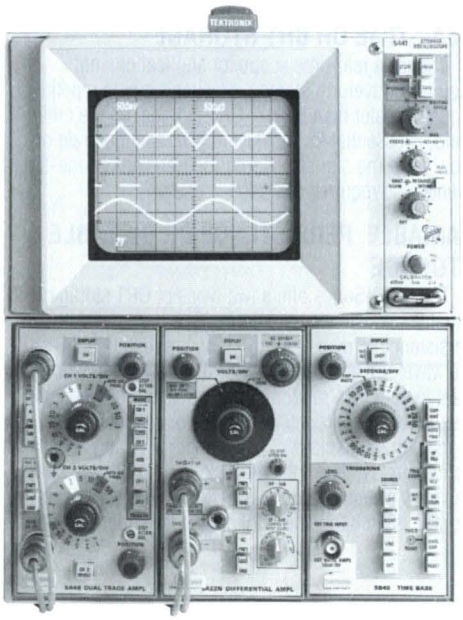
Opt. A1 - Opt. A5 – Power Plugs	**NC**

See page 106 for description.
See page 106 for recommended accessories.

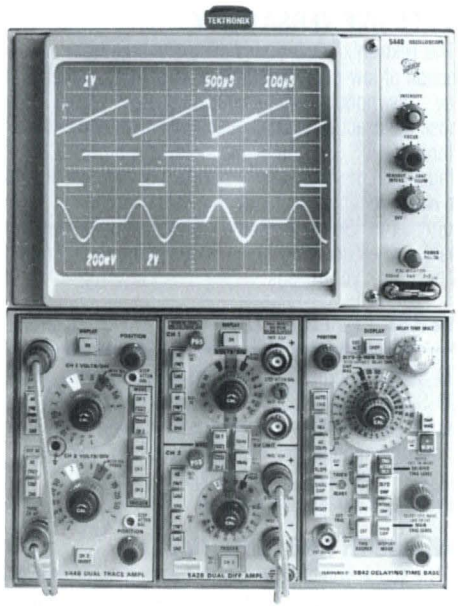
[1] Plug-ins not included.

PHYSICAL CHARACTERISTICS

	Cabinet		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in**
Width	213	8.4	483	19.0
Height	302	11.9	135	5.3
Depth	518	20.4	483	19.0
Weight	**kg**	**lb**	**kg**	**lb**
Net	10.4	23.0	10.9	24.0
Shipping	14.5	32.0	19.5	43.0



5441



5440

5441

The 5441 adds variable-persistence storage, providing the ideal means of viewing hard-to-observe signals such as fast single-shot transients, or low-frequency phenomena. Variable-persistence storage may be used to completely eliminate the flicker inherent in low repetition rate traces. The viewing time at normal intensity for any trace can be varied from a fraction of a second to more than five minutes. At lowered intensity (SAVE mode), signals may be viewed for up to an hour.

5440

The 5440 combines versatility and low cost in a 50 MHz general-purpose, plug-in scope. Plug-in scale factors are displayed on the CRT*[1], so measurement time and operator errors are reduced. It can also be accessed externally with Option 03 User Addressable CRT Readout.

PLUG-INS

All plug-ins in the 5000-Series are compatible with the 5440 and 5441. The wide variety of plug-ins available lets you configure your oscilloscope to meet your need.

[1] Plug-ins with a suffix N (5A18N, etc. do not provide CRT readout. The 5B10N and the 5B12N Time Bases do not permit viewing the leading edge of a triggered waveform when used in the 5400-Series.

CHARACTERISTICS

VERTICAL SYSTEM (Left and Center Compartments)

Bandwidth and Rise Time (–3dB) – 50 MHz and 7 ns, determined by plug-in unit.

Chop Mode – The oscilloscope will chop between channels at 25 kHz to 100 kHz, depending on plug-ins and operating modes.

Alt. Mode – Each plug-in is swept twice before switching to the next. A single-channel amplifier is swept once before switching to the second amplifier.

HORIZONTAL SYSTEM (Right Compartment)

Fastest Sweep Rate – 10 ns/div (x10).

X-Y Phase Shift – ≤ 2° from dc to 20 kHZ.

CRT AND DISPLAY FEATURES

CRT – 8 x 10 div (0.9 cm/div), (1.27 cm/div 5440), illuminated graticule.

Persistence – Continuously variable, may be turned off.

Maximum Stored Writing Speed – Writing speed 5 div/μs for a view time of 15 seconds.

Storage View Time – The view time is the amount of time the stored signal can be viewed before it fades away. Adjusting the stored intensity CCW will reduce the stored writing speed, but view time can be increased up to five minutes.

POWER REQUIREMENTS

Line Input – 90 V to 250 Vac, internally selected, 48 Hz to 440 Hz max.

Power Consumption – 100 W.

ENVIRONMENTAL

Ambient Termperature – Operating: 0°C to +50°C; Nonoperating: –40°C to +70°C.

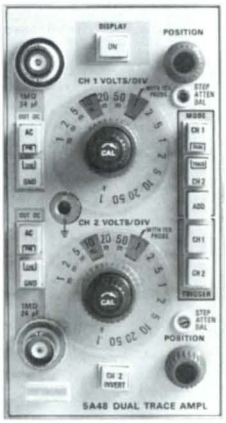
Altitude – Operating: 5000 m (15,000 feet); Nonoperating: 15,000 m (50,000 feet).

Option 03 Characteristics

User Addressable Readout – Up to 20 characters, programmed by external resistors and switches.

Warranty – One year. See page 106 for *Warranty-Plus* options.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.



5A48 50 MHz DUAL TRACE AMPLIFIER

The 5A48 is a dual-trace, 50 MHz plug-in amplifier with five operating modes used in 5400-Series mainframes. The 5A48 features selectable trigger source and CRT readout.

CHARACTERISTICS

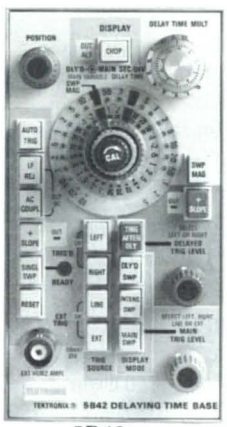
Bandwidth and Rise Time (–3 dB) – 50 MHz and 7 ns at 5 mV to 10 V/div; 25 MHz and 14 ns at 1 mV and 2 mV/div.

Deflection Factor and Accuracy – ≤ 3% at 5 mV to 10 V/div, 15°C to 35°C; ≤ 4% at 5 mV to 10 V/div, 0°C to 50°C; ≤ 5% at 1 mV and 2 mV/div.

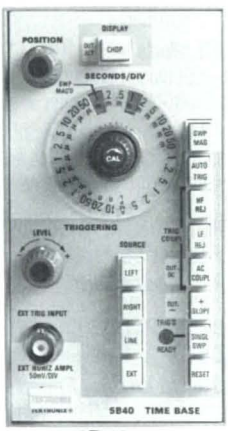
Input R and C – 1 MΩ, ≈24 pF.

Maximum Input Voltage – dc coupled: 250 V (dc + peak ac). AC coupled: 500 V (dc + peak ac). 500 V p-p.

Display Modes – CH1, CH2, CH2 Invert, Add, Alt, Chop.



5B42



5B40

5B42/5B40 HORIZONTAL TIME BASES

The 5B40/5B42 Time Bases are designed for use in 5400-Series mainframes. They feature sweep rates from 10 ns to 5 s/div and CRT readout of the sweep rate selected. Trigger coupling modes included are: ac, dc, HF reject, and LF reject. There is even an external amplifier input for X-Y measurements.The 5B42 also features delayed-sweep rates up to 10 ns/div. The delayed sweep feature allows very accurate (≈1%) timing measurements to be made.

CHARACTERISTICS

HorizontalSweep Rate – 0.1 µs to 0.5 s/div, 10 ns/ div (X10).

Sweep Accuracy –

	Unmagnified		Magnified	
Time/Div 0.5 µs to	15°C to 35°C	0°C to 50°C	15°C to 35°C	0°C to 50°C
1 s/div	3%	4%	4%	5.5%
0.1 µs, 0.2 µs, 2 s, and 5 s/div	4%	5%	5%	6.5%

Ext Horizontal Input – Deflection Factor: 50 mV/div ± 3%. Input R and C: 1 MΩ, ≈24 pF. Bandwidth: 2 MHz.

DELAYED SWEEP (5B42)

Differential Time Measurement Accuracy – ≤ 1% + 0.2% of full scale from 1µs to 0.5 s delay time.

Jitter – ≤ 0.05% of one division of delayed sweep selected.

Multiplier Range – 0.2 to 10 times the time/div setting.

Trigger Sensitivity –

Mainframe	Frequency	Internal	External
5400	DC to 10 MHz	0.4 div*1 0.4 div*2	60 mV*1 100 mV*2
5400	10 MHz to 60 MHz	1.0 div*1 1.0 div*2	150 mV*1 400 mV*2
5100	DC to 2 MHz	0.4 div*2	100 mV*2

*1 5B40 only. *2 5B42 only.

Trigger Operating Modes – Auto, Norm, Single Sweep.

Trigger Coupling – AC, DC, LF REJ (Atten below 2.5 kHz), HF REJ (Atten above 50 kHz).

Ext. Trigger Level Range – ±1.5 V (5B40) and ±2.5 V (5B42).

High Performance Amplifier and Time Bases

5A48

- *DC to 50 MHz Bandwidth*
- *1 mV to 10 V/div Sensitivity*
- *Add and Invert Modes*

ORDERING INFORMATION

5A48 Dual Trace Amplifier **$1,450**
Includes: Instruction manual (070-1450-00), 1 year warranty

5B40/5B42

- *Single Sweep*
- *10 ns to 5 s/div Sweep Rates*
- *Triggering to 50 MHz*
- *HF/LF Reject Coupling*
- *External Horizontal Amplifier*
- *Delayed Sweep (5B42)*

ORDERING INFORMATION

5B42 Dual Time Base **$1,825**
Includes: Instruction manual (070-1447-00), 1 year warranty
5B40 Single Time Base **$1,030**
Includes: Instruction manual (070-1742-00), 1 year warranty

5113/5111A 5110A 2 MHz MAINFRAME OSCILLOSCOPES

Low Cost Real Time and Storage Mainframes

- *DC to 2 MHz Bandwidth*
- *Dual X-Y Operation*
- *Single- and Dual-Beam Bistable-Storage Mainframes*
- *Split-Screen Display*
- *High Speed Storage (Option 03)*
- *Two Independent Verticals (5113)*

ORDERING INFORMATION

5113/R5113 2 MHz Storage Oscilloscope Mainframe*[1] Includes: Instruction manual (070-2137-01).

5113	**$5,055**
R5113	**$5,155**

5111A/R5111A 2 MHz Storage Oscilloscope Mainframe*[1] Includes: Instruction manual (070-3934-00).

5111A	**$3,610**
R5111A	**$3,710**

5110A/R5110A 2 MHz Oscilloscope Mainframe*[1] Includes: Instruction manual (070-2137-01).

5110	**$2,420**
R5110	**$2,520**

[1] "R" prefix indicates rackmount version.

INSTRUMENT OPTIONS

Opt. 02 – Protective Cover (5113/5111A/5110A)	**+$45**
Opt. 03 – Fast-Write CRT (5113)	**+$160**
Opt. 03 – Fast-Write CRT (5111A)	**+$215**
Opt. 07 – Rear Panel Outputs	**+$135**

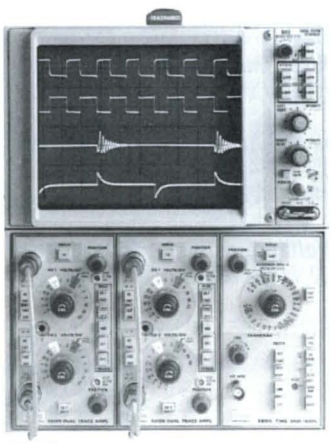
INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 - A5 – Available	**NC**

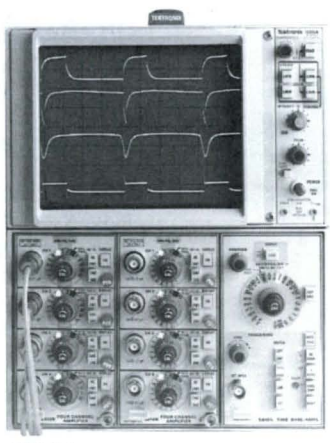
See page 106 for description.
See page 106 for recommended accessories.

PHYSICAL CHARACTERISTICS

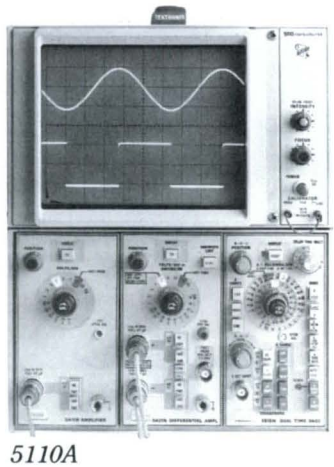
	Cabinet		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	213	8.4	483	19.0
Height	302	11.9	135	5.3
Depth	518	20.4	483	19.0
Weight	**kg**	**lb**	**kg**	**lb**
Net	10.4	23.0	10.9	24.0
Shipping	14.5	32.0	19.5	43.0



5113



5111A



5110A

5113

The 5113 is a dual-beam, bistable-storage oscilloscope featuring split-screen storage. Stored writing speed is at least 20 div/ms (200 div/ms with Option 03). View times of one to ten hours are possible.

The 5113 can display two simultaneous events, either single-shot or repetitive, against a common time base.

5111A

The 5111A is a single-beam, split-screen, bistable-storage oscilloscope. The 5111A extends measurement capability into areas requiring retention of single and multitrace displays for long-term examination and/or photography.

The standard 5111A provides writing speeds to 50 div/ms; Option 03 extends the writing speed to 800 div/ms, suitable for capturing a single-shot display of a four-division 60 kHz sine wave.

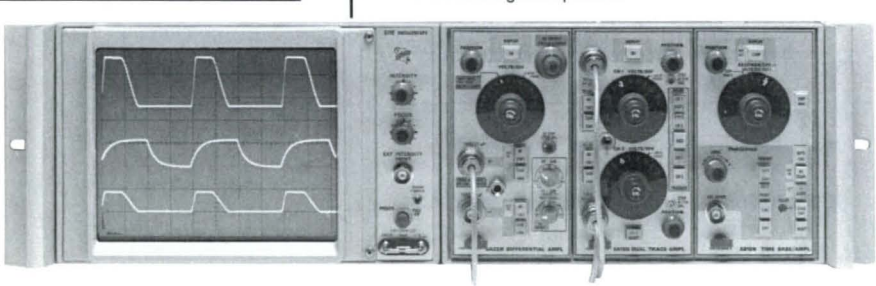
5110

The 5110 is a single-beam real time oscilloscope featuring a large 6 1/2-inch diagonal (1.27 cm/div) CRT.

PLUG-INS

Tailor your measurement needs with the appropriate plug-in units to obtain a high-gain differential display (10 µV/div), four-channel differential display, or eight-channel display. You can also choose from single-trace or dual-trace basic amplifiers and time-bases to suit the special needs of industry and education.

When using two amplifiers and the 5B12N in the dual-sweep mode, the two sweeps are slaved individually to the left and right amplifiers.



5000-Series mainframes also come in low-profile (5 1/4") rackmounts.

CHARACTERISTICS

VERTICAL SYSTEM (Left and Center Compartments)

Bandwidth & Rise Time (–3 dB) – 2 MHz & 175 ns.

Chop Mode – (5110/5111A): The vertical amplifier will chop between left and center plug-ins, and/or between two or more channels. (5113): The left and right vertical amplifiers are dedicated to the left and center compartments, respectively. Each vertical amplifier will chop between two or more channels in their associated plug-in compartments.

Alt Mode – (5110/5111A): Each amplifier plug-in is swept twice before switching to the next. Each channel of a multi-trace amplifier is swept once.

(5113): Single-trace amplifiers are swept full time. Each channel of a multi-trace amplifier is swept once before switching to the next channel.

HORIZONTAL SYSTEM (Right Compartment)

Fastest Sweep – 0.1 µs/div (x10).

X-Y Phase Shift – ≤ 1° from dc to 100 kHz.

CRT AND DISPLAY FEATURES

CRT – 8x10 div, nonilluminated.

Stored Writing Speed – 5111A: ≥ 20 div/ms (Normal) and 50 div/ms (Enhanced). 5113: ≥ 20 div/ms.

Opt. 03, Fast-Writing-Speed CRT – ≥ 200 div/ms (Normal) and 800 div/ms (Enhanced – 5111A only).

Opt. 07, Rear-Panel Signal Outputs – Vertical Sensitivity: 0.5 V/div., Sweep Sensitivity: 0.5 V/div., Gate: TTL level.

POWER REQUIREMENTS

Line Input – 90 Vac to 250 Vac internally selected. 48 Hz to 440 Hz.

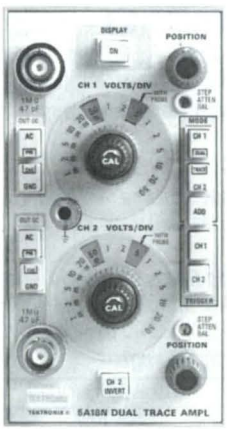
Max Power Consumption – 110 W.

ENVIRONMENTAL CHARACTERISTICS

Ambient Temperature – Operating: 0°C to +50°C; Nonoperating: -40°C to +70°C.

Warranty – One Year. See page 106 for *Warranty-Plus* options.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.



5A18N

5A18N

The 5A18N is a two-channel amplifier that delivers bandwidth of dc to 2 MHz at sensitivities to 1 mV/div. To provide difference measurements of two signals in the ADD mode, simply invert the Channel 2 signal. You can select the internal trigger signal from either Channel 1 or Channel 2. For dual-trace X-Y operation, just plug the amplifier into the right plug-in compartment.

CHARACTERISTICS

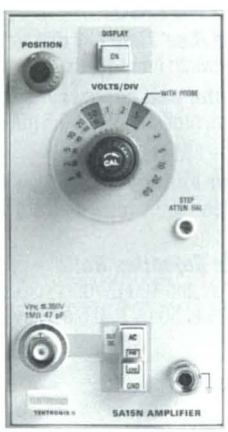
Bandwidth and Rise Time (–3 dB) – dc to 2 MHz and 175 ns.

Deflection Factor and Accuracy – ≤ 2% at 1 mV to 5 V/div.

Input R and C – 1 MΩ, ≈47 pF.

Maximum Input Voltage – 350 V (dc + peak ac).

Chop Rate – 25 kHz to 100 kHz depending upon plug-in combinations and number of channels displayed.



5A15N

5A15N

A single-channel amplifier, the 5A15N provides bandwidth of dc to 2 MHz at sensitivities to 1 mV/div. Two 5A15Ns may be used in a mainframe to provide dual-channel operation, or to provide 1 mV/div X-Y operation if one of the amplifiers is inserted in the right plug-in compartment.

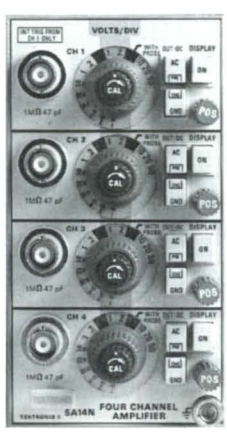
CHARACTERISTICS

Bandwidth and Rise Time (–3 dB) – dc to 2 MHz and 175 ns.

Deflection Factor and Accuracy – ≤ 2% at 1 mV to 5 V/div.

Input R and C – 1 MΩ, ≈47 pF.

Maximum Input Voltage – 350 V (dc + peak ac).



5A14N

5A14N

The 5A14N is a four-channel amplifier that provides 1 MHz bandwidth and sensitivity to 1 mV/div. Each channel may be displayed separately, or the channels may be alternated or chopped in any combination. Channel 1 provides the triggered signal for the unit. In addition, you can combine two 5A14Ns to provide eight-channel operation in any mainframe.

CHARACTERISTICS

Bandwidth and Rise Time (–3 dB) – dc to 1 MHz and 350 ns.

Deflection Factor and Accuracy – ≤ 2% at 1 mV to 5 V/div.

Input R and C – 1 MΩ, ≈47 pF.

Maximum Input Voltage – 350 V (dc + peak ac).

Chop Rate – 25 kHz to 100 kHz depending upon plug-in combinations and number of channels displayed.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.

Versatile 5000-Series Amplifiers with One to Four Channels

5A18N

- *DC to 2 MHz Bandwidth*
- *Invert and Add Modes*
- *1 mV to 5 V/div*

ORDERING INFORMATION

5A18N Two-Channel Amplifier **$975**
Includes: Instruction manual (070-1137-00).

5A15N

- *DC to 2 MHz Bandwidth*
- *1 mV to 5 V/div*

ORDERING INFORMATION

5A15N Single-Channel Amplifier **$465**
Includes: Instruction manual (070-1136-00).

5A14N

- *DC to 1 MHz Bandwidth*
- *Four Independent Channels*
- *1 mV to 5 V/div*

ORDERING INFORMATION

5A14N Four-Channel Amplifier **$1,950**
Includes: Instruction manual (070-1229-00).

DIFFERENTIAL AMPLIFIERS

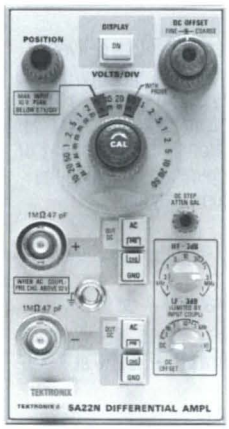
Wide Range of Differential Amplifiers Add Capability for Ultra Low-Level or Noisy Signal Applications

5A22N

- *DC to 1 MHz Bandwidth*
- *10 μV to 5 V/div*
- *100,000:1 CMRR*
- *Selectable Bandwidth Limits*
- *Variable DC Offset*

ORDERING INFORMATION

5A22N Differential Amplifier **$1,430**
Includes: Instruction manual (070-1230-00).



5A22N

5A22N

The 5A22N is a versatile differential amplifier featuring selectable bandwidth filtering and dc offset.

CHARACTERISTICS

Bandwidth (–3 dB) – HF Point: 100 Hz to 1 MHz (9 steps). LF Point: 0.1 Hz to 10 kHz (6 steps).

Deflection Factor and Accuracy – ≤ 3% at 10 μV to 5 V/div.

Input R and C – 1 MΩ, ≈47 pF.

Maximum Input Voltage – 10 V (dc + peak ac) from 10 μV to 50 mV/div. 350 V (dc + peak ac) from 0.1 V to 5 V/div.

Common-Mode Rejection Ratio – dc Coupled: 100,000:1 at 10 μV to 100 μV/div (≤ 30 kHz). AC Coupled: 10,000:1 at 10 μV to 0.5 mV/div (≥ 5 kHz).

Signal and Offset Range –

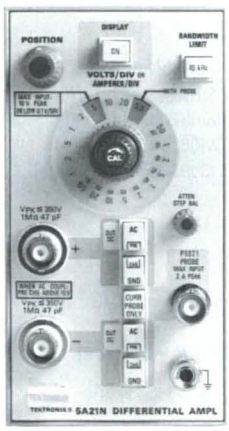
Deflection Factor	10 μV to 50 mV/div	0.1mV to 5V/div
Common-Mode Range	±10 V	±350 V
DC Offset Range	+ 0.5 to - 0.5 V	+ 50 to - 50 V

5A21N

- *DC to 1 MHz Bandwidth*
- *10 kHz Bandwidth Limiter*
- *50 μV to 5 V/div*
- *100,000:1 CMRR*
- *Current-Probe Input*

ORDERING INFORMATION

5A21N Differential Amplifier **$760**
Includes: Instruction manual (070-1139-01), Opt. 01–P6021 current probe.



5A21N

5A21N

A dc to 1 MHz differential amplifier, the 5A21N provides a current-probe input. The voltage mode provides sensitivities to 50 μV/div; with the optional P6021 current probe, sensitivities range from 0.5 mA to 0.5 A/div.

CHARACTERISTICS

Bandwidth and Rise Time (–3 dB) – dc to 1 MHz and 350 ns. Bandwidth limit: 10 kHz.

Deflection Factor and Accuracy – ≤ 2% at 50 μV to 5 V/div. Current probe: ≤ 3% at 0.5 mA to 0.5 A div.

Input R and C – 1 MΩ, ≈47 pF.

Maximum Input Voltage – 10V (dc + peak ac) from 50 μV to 50 mV/div. 350 V (dc + peak ac) from 0.1 V to 5 V/div.

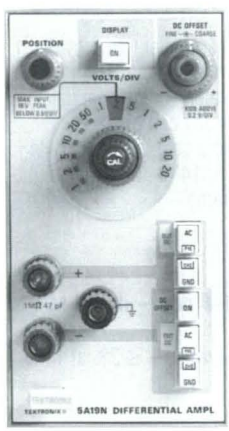
Common-Mode Rejection Ratio – dc coupled: 100,000:1 at 50 μV and 100 μV/div (≤ 30 kHz). ac Coupled: 10,000:1 at 50 μV to 0.5 mV/div (≥ 5 kHz).

5A19N

- *DC to 2 MHz Bandwidth*
- *1 mV to 20 V/div*
- *1000:1 CMRR*
- *Variable DC Offset*

ORDERING INFORMATION

5A19N Differential Amplifier **$575**
Includes: Instruction manual (070-1328-00).



5A19N

5A19N

The 5A19N is a low-cost differential amplifier featuring variable dc offset. It operates in the left or center compartment for Y-T displays, or in the right compartment for X-Y displays.

CHARACTERISTICS

Bandwidth and Rise Time (– 3 dB) – dc to 2 MHz and 175 ns.

Deflection Factor and Accuracy – ≤ 2% at 1 mV to 20 V/div.

Input R and C – 1 MΩ, ≈47 pF.

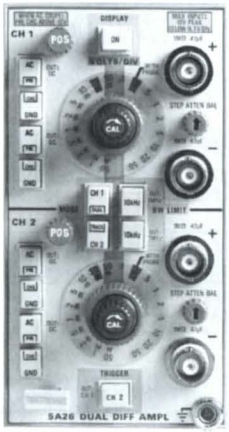
Maximum Input Voltage – 350 V (dc + peak ac).

Signal and Offset Range –

DeflectionFactor	1 mV to 200 mV/div	500 mV to 20 V/div
Common-Mode Range	±16 V	±350 V
DC Offset Range	+15 to -15	+350 to -350 V

Common-Mode Rejection Ratio – 1000:1 at 1 mV to 200 mV/div (≤10 kHz), 100:1 at 0.5 V to 20 V/div.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.



5A26

5A26

The 5A26 combines two independent differential amplifiers in one unit. It provides 50 µV/div sensitivity at 1 MHz, high common-mode-rejection ratio, trigger-source selection and independent bandwidth limits.

With two 5A26s, it is possible to observe up to four differential channels.

CHARACTERISTICS

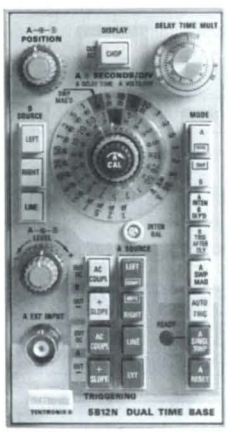
Bandwidth and Rise Time (–3 dB) – dc to 1 MHz and 350 ns. Bandwidth limit: 10 kHz.

Deflection Factor and Accuracy – ≤ 2% at 50 µV to 5 V/div.

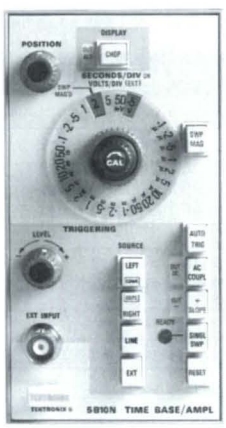
Input R and C – 1 MΩ, ≈47 pF.

Maximum Input Voltage – 10 V (dc + peak ac) from 50 µV to 50 mV/div. 350 V (dc + peak ac) from 0.1 V to 5 V/div.

Common-Mode Rejection Ratio – dc coupled: 100,000:1 at 50 µV to 50 mV/div; 300:1 at 0.1 V to 5 V/div (≤ 30 kHz). AC coupled: 20,000:1 at 50 µV to 50 mV/div (≥ 5 kHz).



5B12N



5B10N

5B10N/5B12N

The 5B10N is an easy-to-use single time base. The 5B12N is a dual time base that provides both delayed and dual sweeps. The dual sweep mode enables two sweeps to be slaved individually to the left and center compartments. Both units also offer left and right source selection, auto and normal trigger modes, plus single sweep. The external input amplifier provides either 50 mV or 0.5 V/div for X-Y type measurements.

CHARACTERISTICS

HORIZONTAL

Sweep Rates – 1 µs to 5 s/div. 100 ns/div (X10); B Sweep: 0.2 µs to 0.5 s/div.

Sweep Accuracy – ≤ 3% from 1 µs to 1 s/div. ≤ 4% at 2 s and 5 s/div. Add 1% for X10 mag. B Sweep: ≤ 3% from 1 µs to 0.1 s/div. ≤ 4% at 0.2 µs, 0.5 µs, 0.2 s, and 0.5 s/div.

DELAYED SWEEP (5B12N)

Delay Time – Accuracy: ≤ 1% from1 µs 1 s/div. ≤ 2% from 1 s to 5 s/div. Multiplier range: 0.2 to 10.2 times the time/div setting.

Differential Time Measurement Accuracy – ≤ 1% + 0.2% of full-scale from 1 µs to 0.5 s delay time.

Jitter – ≤ 0.05% of one division of the delayed sweep selected.

TRIGGER SYSTEM

Trigger Sensitivity –

	1 MHz	2 MHz
Internal	0.4 div	0.6 div
External	200 mV	200 mV

Trigger Operating Modes – Auto, Norm, Single Sweep.

Trigger Coupling – ac, dc.

Ext Trigger Level Range – ±5 V.

External Horizontal Input – Deflection Factor and Accuracy: ≤ 3% at 50 mV and 500 mV/div.

Bandwidth (–3 dB) – dc to 1 MHz.

Input R and C – 1 MΩ, ≈70 pF.

Maximum Input Voltage – 350 V (dc + peak ac).

Dual Differential Amplifier and 5100-Series Time Bases

5A26

- *DC to 1 MHz Bandwidth*
- *50 µV to 5 V/div Sensitivity*
- *100,000:1 CMRR*
- *CRT Readout (5400-Series)*

ORDERING INFORMATION

5A26 Dual Differential Amplifier **$1,600**
Includes: Instruction manual (070-1947-00).

5B10N/5B12N

- *100 ns to 5 s/div Sweep Rates*
- *Alternate and Chopped Displays*

ORDERING INFORMATION

5B10N Single Time Base **$740**
Includes: Instruction manual (070-1141-00).

5B12N Dual Time Base **$1,560**
Includes: Instruction manual (070-1141-00).

MODULAR OSCILLOSCOPE ACCESSORIES AND OPTIONS

Accessories and Options to Enhance Your 5000-Series Instruments

- *Application Notes for a Variety of Measurements*
- *Cameras for Waveform Documentation*
- *Recommended Probes for All Types of Applications*
- *Recommended Accessories*
- *Warranty-Plus Options Reduce Your Cost of Ownership*

ORDERING INFORMATION

RECOMMENDED CAMERAS

C-59AP – High Performance (5400 and 5100-Series) **$1,560**
C-53P – High Performance (5441 only) **$2,220**
C-7 Opt. 30 – Motorized, General Purpose **$668**
C-5C – General Purpose **$530**
C-4 Opt. 02[*1] – Low-Cost **$430**

RECOMMENDED CART

K213 – Lab Instrument Cart
For bench models. Plug-in storage available as Option 12. **$660**

OPTIONAL ACCESSORIES

Blank Plug-In Kit – Order 040-0818-03 **$140**
Blank Panel – Order 016-0452-00 **$33**
Viewing Hoods –
(Standard) Order 016-0154-00 **$49**
(Folding) Order 016-0260-00 **$30**
Protective Cover for Bench Version – Order 016-0544-00 **$18**
Ground Isolation Monitor – A6901 **$830**
Isolation Amplifier – A6902B **$2,070**

For more information on accessories see pages 383 to 443.

*[*1] C4 should be used with illuminated graticule only.*

ACCELEROMETERS

TAK500 – Modally Tuned Hammer Kit **$1,750**
TAK501 – General-Purpose Kit **$599**
TAK502 – Low-Mass **$450**
TAK503 – Triaxial Kit **$1,735**
TAK50 – High-Sensitivity Kit **$530**
TAK5 – Ultra-Sensitive **$650**

For more information on accelerometers see page 430.

APPLICATION NOTES

Title	Description	Order No.
Interpreting mechanical measurements with the plug-in oscilloscopes	5111/5A22N/5A18N Transducer measurements and storage	52-A-3533-1
Simultaneous display of two independent X-Y signal pairs	5111/5A14N/5A15N/5A18N. Dual X-Y techniques, engine analysis.	52-AX-4114
Simultaneous X-Y, Y-T displays	5111/5A14N/5A15N/5B12N. X-Y, Y-T techniques. Biomedical application.	52-AX-4113
Custom plug-in ideas for 5000-Series scopes	Recommended starter note for customers considering custom plug-in project.	52-AX-3758
A high resolution 60 Hz notch filter	Construction project using a commercial module in our plug-in kit. Pre-conditions signals by removing 60 Hz hum.	52-AX-4031

INTERNATIONAL POWER PLUG OPTIONS

Option	Type	Description	Part Number
Opt. A1	Universal Europe	220V, 50 Hz	(020-0859-00)
Opt. A2	United Kingdom	240V, 50 Hz	(020-0861-00)
Opt. A3	Australian	240V, 50 Hz	(020-0861-00)
Opt. A4	North American	240V, 60 Hz	(020-0862-00)
Opt. A5	Switzerland	220V, 50 Hz	(020-0863-00)

PROBES

Probe	Attenuation	Features
P6101A	1X	To 34 MHz bandwidth
P6102A	10X	Modular; ground-reference button
P6062B	1X/10X	Switchable; ground-reference button
P6015	1000X	High voltage
P6021		Current
P6007	100X	High voltage
P6109	10X	Low Cost, full bandwidth
P6202A	10X	FET (requires 1101A power supply)
P6055A	10X	Var Atten for high CMRR
P6105A	10X	Full bandwidth

See pages 403-435 for additional information.

WARRANTY-PLUS PACKAGES

In addition to the one year product warranty, the following optional warranty packages are available:

M1 – Additional 2 years service and 2 calibrations
M2 – Additional 4 years service
M3 – Additional 4 years service and 4 calibrations
M4 – Additional 2 years service and 4 calibrations
M5 – Additional 4 years service and 8 calibrations
M6 – Additional 1 year service and 1 calibration
M7 – Additional 2 calibrations
M8 – Additional 4 calibrations
M9 – Additional 2 years service

Mainframes	M1	M2	M3	M4	M5	M6	M7	M8	M9
5441	$345	$485	$690	$480	$910	*1	$110	$215	$245
5440	$325	$470	$650	$450	$855	*1	$100	$200	$235
5113	$265	$360	$530	$385	$725	*1	$ 90	$180	$180
5111A	$255	$340	$510	$375	$705	*1	$ 90	$180	$170
5110	$205	$270	$405	$295	$560	*1	$ 70	$140	$135
Vertical Plug-ins									
5A18N	$115	$125	$230	$180	$340	*1	$ 55	$110	$ 65
5A15N	$115	$160	$230	$165	$315	*1	$ 35	$ 70	$ 80
5A14N	$175	$215	$350	$260	$490	*1	$ 70	$140	$110
5A26	$165	$200	$330	$260	$485	*1	$ 70	$140	$100
5A22N	$175	$215	$350	$260	$490	*1	$ 70	$140	$110
5A21N	$150	$180	$300	$230	$430	*1	$ 65	$125	$ 90
5A19N	$125	$160	$245	$180	$335	*1	$ 45	$ 90	$ 80
Time Base									
Plug-ins									
5B42	$185	$230	$370	$280	$525	*1	$ 70	$140	$115
5B40	$150	$180	$300	$230	$430	*1	$ 65	$125	$ 90
5B12N	$175	$215	$350	$270	$505	*1	$ 70	$140	$110
5B10N	$120	$125	$240	$205	$375	*1	$ 65	$125	$ 65

*[*1] Contact your local sales representative*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

2400 SERIES OSCILLOSCOPES

The Tektronix 2400-Series Portable Oscilloscopes represent the most widely used and accepted line in the industry:

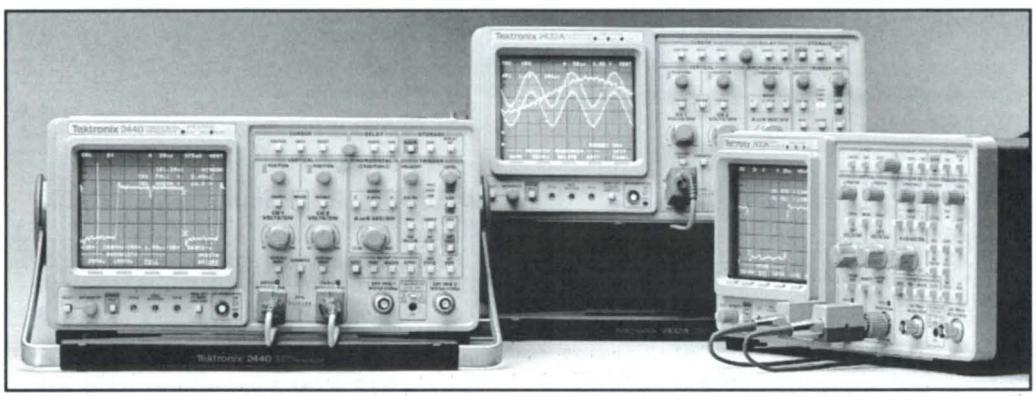
- The 2440 features the highest sample rate available in a portable scope.
- The 2467B "BrightEye" offers unsurpassed writing rate for the ultimate in fast event capture.
- The 2465B sets the standard against which other general-purpose portable scopes are measured.

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.

Full programmability through the IEEE 488.1 interface bus (GPIB) is available, and measurement results can be communicated over the bus from both digital and analog scope models. In addition, waveforms can be transmitted from the digital oscilloscopes to a computer or directly to a printer or plotter.

For specialized needs in applications including digital design and troubleshooting, video waveform measurements, benchtop automated testing, remote-site monitoring, and telecommunications testing, a selection of options and software is available to extend instrument capabilities.

The 2402 TekMate™ Instrument Extension expands 2400-Series digitizing oscilloscopes' capabilities for waveform storage, analysis, and pass/fail testing.



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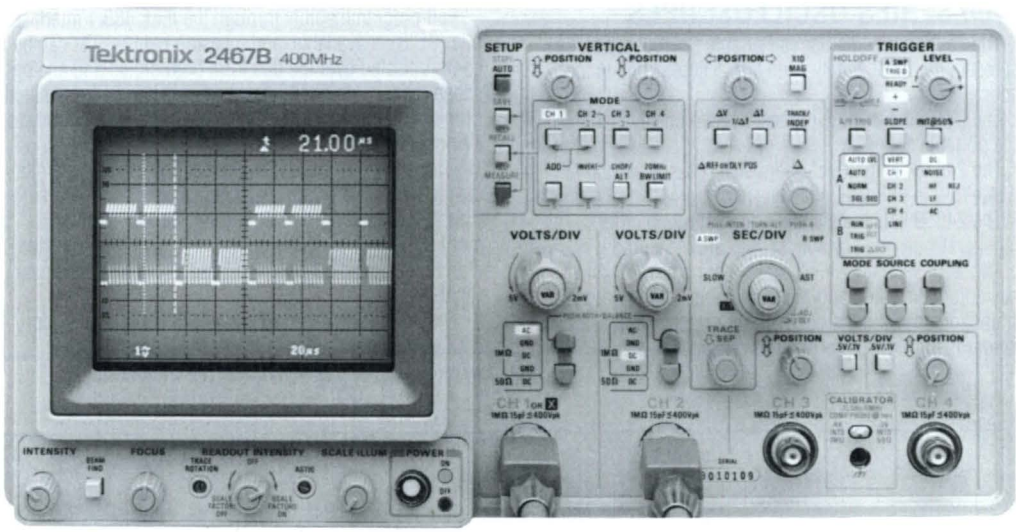
The 2467B Shows Fast, Random Events in Normal Room Light.

- *Highlights Intermittent Glitches Instantly*
- *Brightly Displays Single Lines of Video Waveforms*
- *4 cm/ns Visible Writing Speed*
- *400-MHz Bandwidth, Single-Shot and Repetitive*
- *Automatic Push-Button Setup and Measurements*
- *4 Channels*
- *Lightweight and Rugged*

APPLICATIONS

- *Digital Circuit Troubleshooting*
- *Laser and Radar Pulses*
- *Video Equipment Design*
- *Disk Drive Testing*



2467B 400-MHZ OSCILLOSCOPE

A VISIBLE DIFFERENCE

The 2467B instantly displays signals that other analog scopes can't show and digital scopes spend minutes (or hours) waiting to capture. The visible writing speed of the 2467B allows users to see single-shot traces from lasers and ESD (electro-static discharge) pulses. Random noise and infrequent or intermittent faults are clearly visible within repetitive signals.

Low repetition-rate signals, such as a line of raster-scan video, are easy to see without a viewing hood on the 2467B. The fast update rate inherent in analog oscilloscopes allows you to see *real-time* changes in your waveforms, allowing you to make circuit adjustments and giving you confidence that critical events are consistently captured and displayed, even if they occur intermittently.

TEK'S EXCLUSIVE MICRO-CHANNEL PLATE (MCP) CRT

This unique crt amplifies the intensity of infrequent signals while limiting the intensity of high-repetition rate signals. You can see everything that happens in your circuitry, whether it occurs once or repetitively. The 2467B displays glitches that remain invisible on analog scopes with conventional crts. Digital oscilloscopes may fail to discover these infrequent transients if they are buried within a repetitive signal. Being able to see unexpected faults makes the critical difference in troubleshooting.

The 2467B combines with the DCS02 Digitizing Camera System. The result is a 400 MHz single-shot waveform digitizing system with up to 10 ps/point digitizing.

AUTOMATIC SETUPS AND PUSH-BUTTON MEASUREMENTS

You can measure risetime, falltime, frequency, pulse width, voltage, and time interval A to B at the push of a button. Auto Setup is another time-saving feature of the 2467B. Attach up to four probes to your signal points, press AUTO SETUP, and within seconds the scope presents a stable, automatically-triggered, scaled, and positioned display of your waveforms. Fast and easy !

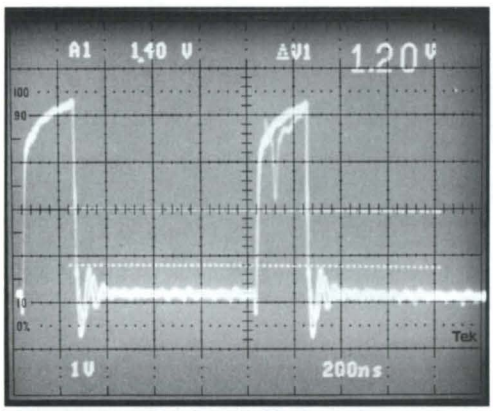
WHAT IS VISIBLE WRITING SPEED ?

Writing speed has traditionally been a measure of crt performance. The usual specification was *photographic writing speed*, representing the point at which phosphor luminance is adequate to record a waveform using a camera and high-speed film–but still *invisible* to the eye. The 2467B specifies a *visible writing speed* 100 times faster than any other portable oscilloscopes. Its CRT emits enough light at 4 cm/ns for the eye to discern in normal room light without a viewing hood.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

FINDING FAULTS WITH THE 2467B

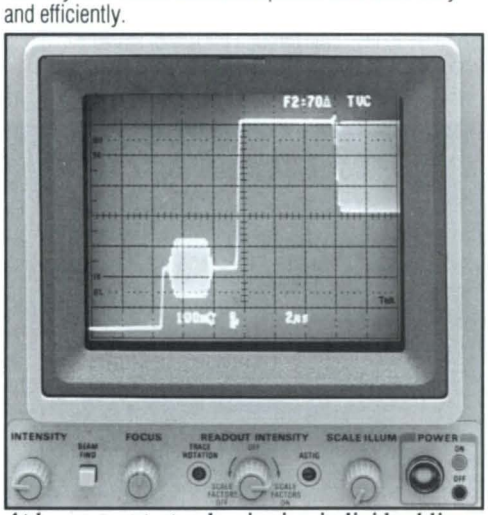
The 2467B is an effective tool for digital design and test engineers and a perfect companion for logic analyzers in troubleshooting a digital system. The 2467B's high writing rate MCP display immediately shows faults caused by asynchronous noise, crosstalk, bus contention, marginal timing, and metastability.



The 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.

MEASURE TO THE LIMITS

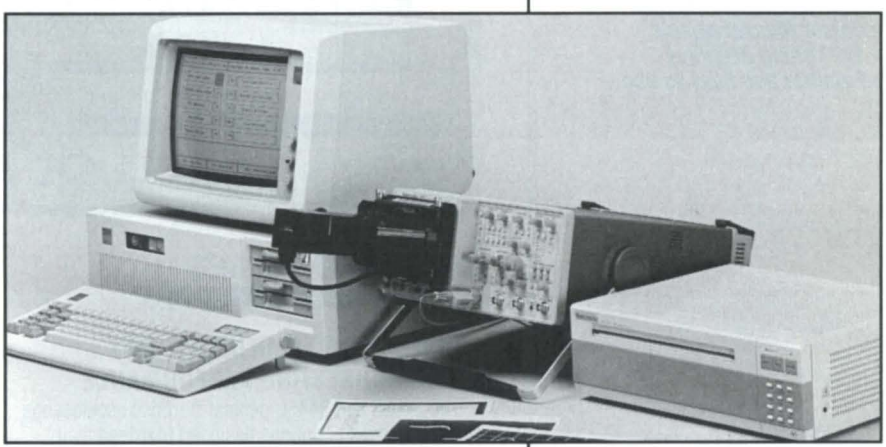
Because the 2467B shows *every* signal, you can see and measure maximum and minimum voltage excursions and timing jitter. In telecommunications applications, the 2467B provides distinct eye patterns for verification and qualification of transmission systems and equipment. Time jitter is displayed clearly for disk drive testing, and using the optional Counter/Timer's Delay by Events allows you to count down to a specific track accurately and efficiently.



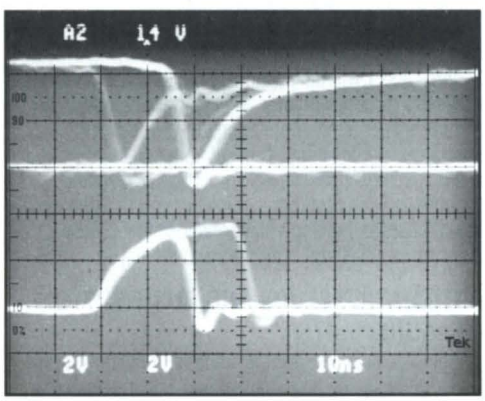
At lower sweep speeds, viewing individual lines of a video signal is difficult with conventional crts. This MCP crt displays the line brightly, even with its intensity control set to a low level.

SCAN THE LINES IN A VIDEO SIGNAL

The Video Waveform Measurement System can be added to the 2467B to create an ideal match for quality-sensitive environments, including video design, manufacturing, service, broadcast, and high-resolution raster-scan applications. The combination of fast visible writing speed and 2400-Series high performance optimizes this instrument for showing the signal details from video systems of any protocol. Any line number can be selected from Field 1, Field 2, or Field 1 alternating with Field 2, and its trace easily viewed in room light.



The 2467B and Tek DCS02 Digitizing Camera System combine to give you 400 MHz single-shot capability along with up to 10 ps/point digitizing. *See page 172.*



In this display, the data transition (upper trace) occasionally coincides with the rising edge of the clock (lower trace), violating the timing margin. Also note the infrequent change in clock pulse width.

See pages 113-114 for specifications and ordering information.

2465B/2455B/ 2445B — 150 TO 400-MHz AUTO-MEASURING OSCILLOSCOPES

The Highest Performance and Automation Available in Portable Analog Scopes.

- *400-MHz Bandwidth (2465B)*
- *500-ps/div Time Base (2465B)*
- *Automatic Push-Button Setup and Measurements*
- *4 Channels*
- *SAVE, RECALL, and SEQUENCE of Setups*
- *Lightweight and Rugged*
- *Cursor Measurements*
- *1% Timing Accuracy*
- *Familiar and Easy to Use*

2465B/2445B 400 AND 150 MHz OSCILLOSCOPES

CONVENIENCE, FAMILIARITY, AND STANDARD-SETTING PERFORMANCE

The 2465B and 2445B general-purpose oscilloscope models, a series of options designed to extend their measurement capabilities, and three specially-configured packages combine convenience and familiarity with leading-edge performance. These instruments bring proven reliability and efficiency to your design lab, production/test line, or field service site.

400-MHz bandwidth, sweep speed to 500 ps/div (250 MHz and 1ns/div for 2455B, 150 MHz and 1 ns/div for 2445B), and 1% timing accuracy offer the performance needed to display with high fidelity the wide range of signals encountered in both general-purpose and specialized applications. The fast update rate inherent in analog oscilloscopes allows you to see *real-time* changes in your waveforms, allowing you to make circuit adjustments and giving you confidence that critical events are consistently captured and displayed.

AUTOMATIC SETUPS AND PUSH-BUTTON MEASUREMENTS

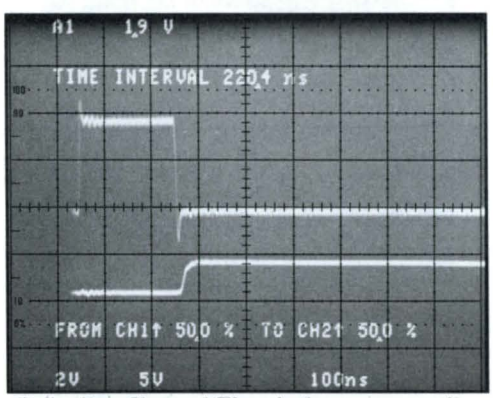
You can measure risetime, falltime, frequency, pulse width, voltage, and time interval A to B at the push of a button. Auto Setup is another time-saving feature of the 2465B/2455B/2445B. Attach up to four probes to your signal points, press AUTO SETUP, and within seconds the scope presents a stable, automatically-triggered, scaled, and positioned display of your waveforms. The quickest way to get your job done.

ADVANCED, EASY-TO-USE TRIGGERING

2400-Series scopes can trigger from any one of the four input channels, or on up to four asynchronous signals. Tek's AutoLevel Trigger keeps your scope triggered even as the input signals change. Trigger signal conditioning choices include dc, ac, LF Reject, HF Reject, and Noise Reject, ensuring the ability to trigger stably on virtually any signal. On-screen readout of the trigger level voltage saves time and eliminates trial-and-error frustration. Pressing the INIT@50% button automatically sets the trigger level to the 50% voltage on your signal, further increasing ease and reliability of triggering.

INSTANT ACCESS TO COMPLEX SETUPS

For closer examination of your signals and for specialized setups–such as those incorporating the extended measurement options–manually setting front-panel controls is still necessary. But now you need set them only *once*. Non-volatile memory for 30 setups stores all front-panel information, including intensity, cursor locations, and control settings for the measurement options. And each setup can be labeled with a descriptive name. Prototype verification can be accomplished quickly without manual control adjustments. Field service procedures are executed more effectively in less time through the use of stored setups for common tests and measurements.

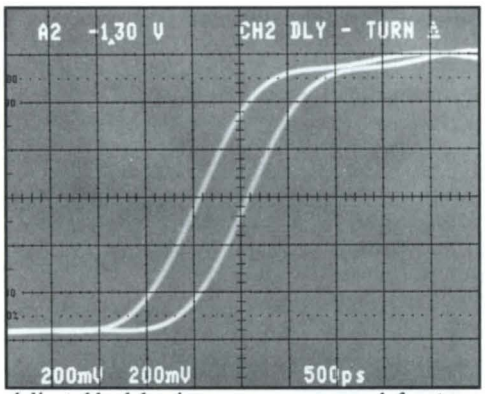


Channel-to-Channel Time is the most versatile of the push-button measurements. Start and stop events can be set in % or in volts–on rising or falling edges of CH1 and CH2.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

AUTOMATIC SEQUENCES WITHOUT AN EXTERNAL CONTROLLER

2400-Series oscilloscopes offer built-in sequencing capabilities for building and running semi-automated tests. Systematic verification procedures for design engineering, production test, or field service can be developed without writing a single line of code. To sequence through up to 30 setups, press the STEP button once for each step, or plug a foot switch into the rear-panel jack for hands-free operation. Seven-character labels for each setup can act as test titles or operator prompts.



Adjustable delay increases accuracy. A front-panel knob adjusts the CH2 delay to exactly match the CH1 delay from the probe tip.

SPECIAL PACKAGES PROVIDE A BROAD RANGE OF FUNCTIONS.

These models include multi-instrument capabilities while reducing rack or bench space, equipment cost, and programming complexity. As preconfigured packages, they offer significant savings over the cost of combining individual options. Any of these three packages make a good choice for your system, as all include the GPIB interface and the extended Counter/Timer/Trigger (CTT) measurements.

2465BCT PRECISION TIMING SCOPE

The *2465BCT Precision Timing Scope*, which includes the CTT/Word Recognizer and GPIB, is ideal for making the precise timing measurements needed for communications, office, and computer-related equipment, or in microprocessor-controlled systems.

2465BDM MULTIFUNCTION SCOPE

The *2465BDM Multifunction Scope* includes a GPIB-controllable digital multimeter in addition to the CTT/WR and GPIB. Its applications as a self-contained, multi-purpose instrument extend into government/military electronics, avionics, depot service, and ATE.

2465BDV FULL-FEATURED OSCILLOSCOPE

For even more varied applicability, the *2465BDV Full-Featured Oscilloscope* adds Video Waveform Measurement capability as well as providing GPIB, CTT/WR, and DMM. It is especially suited to the design, manufacture, and service of raster-scan devices and high-resolution video equipment.

PRODUCT CONFIGURATION GUIDE

	Standard Models			Preconfigured Special Packages		
Features	**2465B**	**2455B**	**2445B**	**2465BDV**	**2465BDM**	**2465BCT**
Bandwidth	400 MHz	250 MHz	150 MHz	400 MHz	400 MHz	400 MHz
General Purpose Interface Bus	Opt 10	Opt 10	Opt 10	Included	Included	Included
Counter/Timer/Trigger Word Recognizer	Opt 09	Opt 09	Opt 09	Included	Included	Included
Digital Multimeter	Opt 01	Opt 01	Opt 01	Included	Included	—
Video Measurement System	Opt 05	Opt 05	Opt 05	Included	—	—
Two additional probes	Opt 22	Opt 22	Opt 22	Included	Included	Included
Rackmount	Opt 1R*[1]	Opt 1R*[1]	Opt 1R	Opt 2R	Opt 2R	Opt1R
Probe Power	Opt 11	Opt 11	—	—	—	—
Warranty	3 years, parts and labor			3 years, parts and labor		

*[1] *Specify Opt 2R if Opt 01 (DMM) is ordered.*

ORDERING INFORMATION

See page 114 for ordering information.

2465BDV/ 2465BDM/2465BCT

OPTIONS FOR THE 2467B, 2465B, 2455B AND 2445B

DIGITAL MULTIMETER (OPT 01)
- *4.5 Digit Autoranging DMM*
- *True RMS ac Volts from 20 Hz to 100 kHz*
- *True RMS ac Current from 20 Hz to 10 kHz*
- *10 μV Resolution on dc Volts*
- *Continuity Beeper*
- *Temperature Probe –62° C to +230° C*

VIDEO WAVEFORM MEASUREMENT SYSTEM (OPT 05)
- *Selectable Triggering on Any Line within a Field with Line-Number Readout*
- *Selectable System-M and Nonsystem-M Protocols*
- *Compatible with Composite Video Having 13.1 to 77 kHz Line Rates (50/60 Hz)*
- *TV Blanking-Level Clamp (Back-Porch)*
- *Optimized Vertical Response Comparable to High-Performance TV Waveform Monitors*

COUNTER/TIMER/TRIGGER AND WORD RECOGNIZER (OPT 09)
- *Crystal-Controlled Time Base*
- *0.001% Accuracy*
- *Count up to 9,999,999 Events*
- *Delay-by-Events Triggering*
- *Boolean Logic Triggering on Digital and Analog Signals*
- *17-Bit Word Recognizer Probe*

GPIB INTERFACE (OPT 10)
- *Remote Control of Front Panel*
- *Device Address, Talk/Listen, and Message Terminator Selectable at Front Panel*
- *Compatible with all Other 2467B/2465B/2445B Options*
- *User-Generated SRQs to Controller During Program*
- *RQS Control: Optional Enable or Disable of SRQ Reporting*

DIGITAL MULTIMETER (OPT 01)

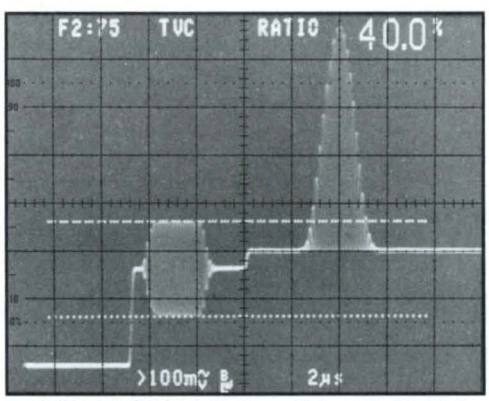
The integral, fully programmable autoranging DMM averages and smoothes DC and AC (RMS) volts and current, dBm, dBv, resistance, and temperature measurements for crt display or GPIB transmission. You can set a reference function to compare deviations from a norm and display minimum and maximum values.

The audible continuity check is especially useful in troubleshooting. Circuit board hot spots can be quickly located with the temperature probe, which registers temperature variations with a resolution of 0.1° C. GPIB programmability extends measurements, prompting, and calibration into system applications.

VIDEO WAVEFORM MEASUREMENT SYSTEM (OPT 05)

Option 05 extends the 2467B/2465B/2445B's versatility to meet the challenges in broadcast and cable television, graphics displays, and raster-scan systems. With CRT readout of the line number and field selected for triggering, an operator knows exactly what the display represents. Any line can be selected from Field 1, Field 2, or Field 1 alternating with Field 2. Or all lines in both fields can be superimposed.

The back-porch clamp locks the video black level to a fixed point, so the display is stable and clean, even when the composite video contains low-frequency hum or the average picture level changes with ac coupling. Option 05 delivers excellent step response and overdrive recovery, and controls are provided for a wide variety of system protocols.



2445B high-fidelity display of Line 75, Field 2 of an NTSC signal with the television blanking-level clamp (TVC) engaged. The cursor readout of 40% is interpreted as 40 IRE with appropriate adjustment of the vertical gain.

COUNTER/TIMER/TRIGGER AND WORD RECOGNIZER (OPT 09)

Designed to optimize the 2400 Series for a range of digital applications, the CTT applies time interval averaging to precise time and frequency measurements with up to 10 parts-per-million accuracy.

The unique Boolean trigger lets you combine any two channels using either AND or OR, allowing isolation of complex events. The 17-bit parallel Word Recognizer can be applied to a variety of TTL-compatible logic families. Operable to 20 MHz with an external clock, and 10 MHz without, the WR allows triggering either sweep on word occurrences to measure frequency and period of words, or to delay the A or B sweep by a selectable number of words.

The CTT is available without Word Recognizer as Opt 06. Word Recognizer capability cannot be added to Opt 06 later; it must be included at purchase.

External Clock (Opt 1E, available only with Opt 09 or Opt 06.)

The External Frequency Reference option offers frequency measurements with eight-digit resolution. Accuracy is equal to the external reference or one count in the least-significant digit of the eight-digit readout, whichever is greater.

Option 1E automatically accepts any of the following frequencies as the external reference:

1.000000 MHz
3.579545 MHz (color burst)
4.433185 MHz
5.000000 MHz
10.000000 MHz

GPIB INTERFACE (OPT 10)

The GPIB interface, a talker/listener, provides remote programmability for your scope and all its options. Contents of setup memory can be transferred between 2467B/2465B/2445B units without an external controller, or a host controller can be used to assist in performing a series of checks and measurements. Front-panel settings can be remotely set or changed, and the results of measurements communicated back over the bus to a computer.

The GBIP message structure of the 2400B-Series conforms to Tektronix Standard Codes and Formats, ensuring that all GPIB messages are "human-readable" and consistent in format. The ability to select message termination characters allows scope use with most types of controllers.

SOFTWARE FOR 2400-SERIES ANALOG OSCILLOSCOPES

Tektronix software development packages provide an environment to quickly and easily generate automated and semiautomated tests for your GPIB-equipped instruments. EZ-Tek™2400 PC is a basic test procedure generator specific to 2400-Series analog scopes. Other compatible software packages are described in the "Test and Measurement Software" section of this catalog, pages 342–358.

EZ-TEK 2400 PC

EZ-Tek 2400 PC is a test procedure generator for the non-programmer who wants to concentrate on measurements, rather than learning a programming language. It provides a foundation upon which to develop procedures for Tektronix 2400-Series analog oscilloscopes and the Tektronix PEP controllers (or other IBM PC-compatible controllers). EZ-Tek 2400 PC software also sends commands to IEEE Standard 488 (GPIB) stimulus instruments, such as the Tektronix FG 5010 Function Generator and the CG 5010 Calibration Generator.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

CHARACTERISTICS

Characteristics are common to the 2467B, 2465B, 2455B, 2445B and 2465B Special Packages except where indicated. For complete specifications, refer to product data sheets available from your local Tektronix sales office or the Tek National Marketing Center – toll-free: 1-800-426-2200, Ext. 99.

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 setting with a 4- to 5-div signal, centered on screen; CH 1 and CH 2); ±10% (CH 3 and CH 4).

Bandwidth Limit – 20 MHz

AC-Coupled Lower –3dB Point – 10 Hz or less.

Input Coupling and Max Voltage – (1 MΩ) ac, dc, GND; Max input voltage: 400 V (dc + peak ac)(50Ω); Max input voltage: 5 V RMS

Input R and C –1 MΩ and 15 pF or 50Ω (nominal)

Channel Isolation – ≥100:1 at 100 MHz, ≥ 50:1 at nominal bandwidth (CH1, CH2), ≥ 50:1 at 100 MHz (CH3, CH4).

Frequency Response (-3 dB Bandwidth)

Instrument	+15°C to 35°C	–15°C to +15°C, +35°C to 55°C
2467B	400 MHz (≥5 mV/div)	300 MHz
2465B	350 MHz (2 mV/div)	—
2455B	250 MHz	200 MHz
2445B	150 MHz	150 MHz

Measured with standard accessory probe or internal 50 Ω termination.

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 – 2467B/2465B: 500 ms/div to 5 ns/div (X10 magnification extends fastest sweep rate to 500 ps/div.); 2455B/2445B: 500 ms/div to 10 ns/div (X10 mag extends fastest sweep rate to 1 ns/div).

B Sweep Time Base Range – 2467B/2465B: 50 ms/div to 5 ns/div (to 500 ps/div with X10 mag); 2455B/2445B: 50 ms/div to 10 ns/div (to 1 ns/div with X10 mag).

Variable Timing Control – continuously variable and calibrated between sec/div settings. Extends slowest A Sweep to 1.5 s/div.

ACCURACY SPECIFICATIONS FOR AUTOMATIC MEASUREMENTS

+15°C to + 35°C, Specifications based on noise less than 0.1% of peak-to-peak input signal.

Period – 0.9% + 500 ps

Volts – (5% + 5 mV + 1 LSD + 0.5 mV x probe attenuation) to 1 MH

Rise Time, Fall Time – 5% + 3 ns (for transition times >10 ns). These rise and fall times are based on measurements of 20% and 80% extrapolated to 10% and 90%. Pulse overshoot, undershoot < 5% of pk-pk signal.

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 and 5% of stop event transition times. Voltages must not be within 10% of either peak.

Time A-B **(from % to %)** – 0.9% (+ 3 ns if measuring from CH1 to CH2) + 5% of start event and 5% of stop event transition times.

Pulse Width – 0.9% + 1 ns (transition times < 10% of measured interval)

TIMING ACCURACY

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 sweep delay	±(0.3% of time interval + 0.1% of full scale) + 200 ps
Delay from A trig to B sweep	±(0.3% of delay setting + 0.6% of full scale) +(0 to –25 ns)

For 100 ms/div and faster settings, +15°C to + 35°C, X 10 mag not enabled

TRIGGERING

Triggering Sensitivity from Ch 1 or CH 2 Source

DC Coupled – 0.35 division

Noise Reject Coupled – ≤ 1.2 divisions

HF Reject Coupled – 0.5 division from dc to 30 kHz.

LF Reject Coupled – 0.5 division from 80 kHz

AC Coupled – 0.35 division from 60 Hz

Trigger Level Range – ±18 x V/div setting (CH 1 and CH 2); ±9 X V/div setting (CH 3 and CH 4)

Jitter –2467B – ≤ 100 ps with five divisions of 350 MHz at 500 ps/div.

2465B – ≤ 50 ps with five divisions of 300 MHz at 500 ps/div.

2445B – ≤ 100 ps with five divisions of 150 MHz at ns/div.

OTHER SIGNAL INPUTS AND OUTPUTS

Z-Axis Input, CH 2 Signal Out, A Gate Out and B Gate Out

DISPLAY

Graticule Size – 8 x 10 cm (2465B/2455B/2445B); 6.8 x 8.5 cm (2467B).

Visible Writing Speed – (2467B) ≥ 4 cm/ns, at maximum INTENSITY control setting with 20 lux = illumination normal to crt faceplate (typical room light).

Photographic Writing Speed – (2467B) ≥ 10 div/ns with C-30 Series camera and ISO 3000 film, without prefogging. (A single-shot trace of instrument rise time at 500 ps/div is recorded with high contrast at f/1.9.)

Cursors – Volts, Time, 1/TIme.

CHARACTERISTICS FOR THE 2467B, 2465B, 2455B AND 2445B

POWER REQUIREMENTS

Line Voltage Ranges – 115 V: 90 to 132 V ac; 230 V: 180 to 250 V AC.

Line Frequency – 48 to 440 Hz.

Maximum Power Consumption – 120 W (180 VA) for fully-optioned instrument.

ENVIRONMENTAL AND SAFETY

See page 142.

PHYSICAL CHARACTERISTICS

	2467B		2465B/2455B/2445B		Rackmount	
Dimensions	**mm**	**in**	**mm**	**in**	**mm**	**in**
Width w/handle	338	13.3	338	13.3	483	19.0
Height w/feet, pouch	190	7.5	190	7.5		
w/o pouch	160	6.3	160	6.3	178	7.0
Depth w/front cover	472	18.6	434	17.1	419	16.5
handle extended	533	21.0	508	20.0		
Weight ≈	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**
Net w/accessories and pouch	10.9	24.0	10.2	22.4		
w/o accessories and pouch	9.7	21.3	9.3	20.5	4.0*1	8.8*1
Shipping	14.6	32.1	12.8	28.2	6.3*1	13.8*1

*1 *Weight of conversion kit only. Rear support kit weight is an additional 6.3 kg (13.8 lb).*

ORDERING INFORMATION

2467B 400-MHz, High Writing Speed Oscilloscope **$13,045**
Includes: same as 2465B (except operators' manual is 070-6861-00), plus two additional P6137 probes (Opt 22).

2465B 400-MHz Auto-Measuring Oscilloscope **$6,060**
Includes: two P6137 10X probes (1.5 m) with accessories, fuse (159-0021-00), snap accessory pouch (016-0692-00), front cover, power cord (161-0104-00), operators' manual (070-6860-00), pocket guide (070-7148-01).

2465BCT 400-MHz Precision Timing Oscilloscope **$7,975**
Includes: same as 2465B, plus CTT/WR (Opt 09), GPIB (Opt 10), and two additional probes (Opt 22). Most cost-effective combination of these options.

2465BDM 400-MHz Multifunction Oscilloscope **$9,325**
Includes: same as 2465B, plus DMM (Opt 01), CTT/WR (Opt 09), GPIB (Opt 10), and two additional probes (Opt 22). Most cost-effective combination of these options.

2465BDV 400-MHz Full-Featured Oscilloscope **$10,255**
Includes: same as 2465B, plus Video Waveform Measurement System (Opt 05), DMM (Opt 01), CTT/WR (Opt 09), GPIB (Opt 10), and two additional probes (Opt 22). Most cost-effective combination of these options.

2455B 250-MHz Auto-Measuring Oscilloscope **$5,545**
Includes: same as 2465B.

2445B 150-MHz Auto-Measuring Oscilloscope **$3,995**
Includes: same as 2465B, except two P6133 Opt. 25 10X probes (1.3 m).

INSTRUMENT OPTIONS

Opt 01 – Digital Multimeter **+$1,640**
Includes: same as standard instruments, plus probe set (ALM 01), temperature probe (P6602), and probe set accessories (020-0087-00). Opt 01 not available for 2467B.

Opt 05 – Video Waveform Measurement System **+$1,255**
Includes: same as standard instruments, plus CCIR graticule filter, NTSC graticule filter, and polarized, collapsible viewing hood (016-0180-00).

Opt 06 – Counter/Timer/Trigger **+$1,180**
Includes: same as standard instruments, plus 20 grabber tips (206-0222-00), and two ten-wide combs with 10-inch leads (012-0747-00).

Opt 09 – Counter/Timer/Trigger with Word Recognizer **+$1,610**
Includes: same as Opt 06, plus Word Recognizer Probe (010-6407-00). Includes Opt 06.

Opt 1E – External Clock for Counter/Timer/Trigger only available with Opt 06 or Opt 09. **+$210**

Opt 10 – GPIB Interface (IEEE-488) **+$980**
Includes: same as standard instruments, plus Instrument Interfacing Guide (070-6859-00).

Opt 11 – Rear Panel Probe Power **+$220**
Not available with 2445B, 2465BCT, 2465BDM, 2465BDV, or any 2467B/2465B instrument equipped with Opt 09 Word Recognizer.

Opt 22 – Two Additional Matching Probes
(2445B) **+$240**
(2455B) **+$320**
(2465B) **+$335**
(2467B) **+$340**

Opt 46 – Commercial Version of Air Force 2465B Opt 10, Opt 22 (National Stock Number 6625-01-272-8054) **+$1,320**

Opt B1 – Service Manual **+$55**
For standard 2467B/2465B/2455B scopes (070-6863-00) and standard 2445B (070-6862-00)

Opt B2 – Options Service Manual for Special Packages and instruments equipped with any of the options listed above (080-6864-00). Options Service Manual is in addition to the standard service manual. **+$30**

Opt 1R – Rackmount for 2467B, 2465BCT, and 2445B/2455B/2465B instruments not equipped with Opt 01 DMM. Includes rackmount hardware and slide-out assemblies, deletes snap pouch. **+$320**

Opt 2R – Rackmount for 2465BDV, 2465BDM, and any 2445B and 2465B instruments equipped with Opt 01 DMM. Includes: same as Opt 1R. **+$450**

Opt 1T – Transit Case with telescoping handle and retractable wheels. **+$450**

Note: Instrument options are not retrofittable after purchase.

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

WARRANTY

Three years covering parts and labor, includes crt, excludes probes. Coverage can be extended to five years through the optional *Warranty-Plus* service plans.

WARRANTY-PLUS SERVICE PLANS

Opt M2 – Remedial Coverage in years 4 and 5
2467B **+$435**
2465B **+$358**
2445B **+$302**
2465BCT **+$374**
2465BDM **+$387**
2465BDV **+$374**

Opt M3 – 4 calibrations (in years 2 through 5), Remedial Coverage for years 4 and 5
2467B **+$1,001**
2465B **+$646**
2445B **+$590**
2465BCT **+$708**
2465BDM **+$768**
2465BDV **+$755**

Opt M4 – 5 calibrations (in years 1 through 3)
2467B **+$663**
2465B **+$338**
2445B **+$338**
2465BCT **+$393**
2465BDM **+$448**
2465BDV **+$488**

Opt M5 – 9 calibrations (in years 1 through 5), Remedial Coverage for years 4 and 5
2467B **+$1,621**
2465B **+$962**
2445B **+$906**
2465BCT **+$1,076**
2465BDM **+$1,188**
2465BDV **+$1,175**

Opt M7 – 2 calibrations (in years 2 and 3)
2467B **+$283**
2465B **+$144**
2445B **+$144**
2465BCT **+$167**
2465BDM **+$191**
2465BDV **+$191**

Opt M8 – 4 calibrations (in years 2 through 5)
2467B **+$565**
2465B **+$288**
2445B **+$288**
2465BCT **+$335**
2465BDM **+$382**
2465BDV **+$382**

DIGITIZING CAMERA SYSTEM

For additional information, see page 172.

DCS01 Opt 2A – Digitize and analyze waveforms from scope screen **$6,655**

DCS02 Opt 2A – High resolution, fast throughput **$8,105**

S58DC02 – 2467B/DCS Interface GPIB Driver **$340**

OPTIONAL ACCESSORIES

For other recommended accessories see page 122.

Viewing Hood – Polarized Collapsible 016-0180-00 **$60**

DC Power Supply – 1105 **$2,690**

Battery Pack – 1106 **$2,030**

DC Inverter – 1107 **$1,530**

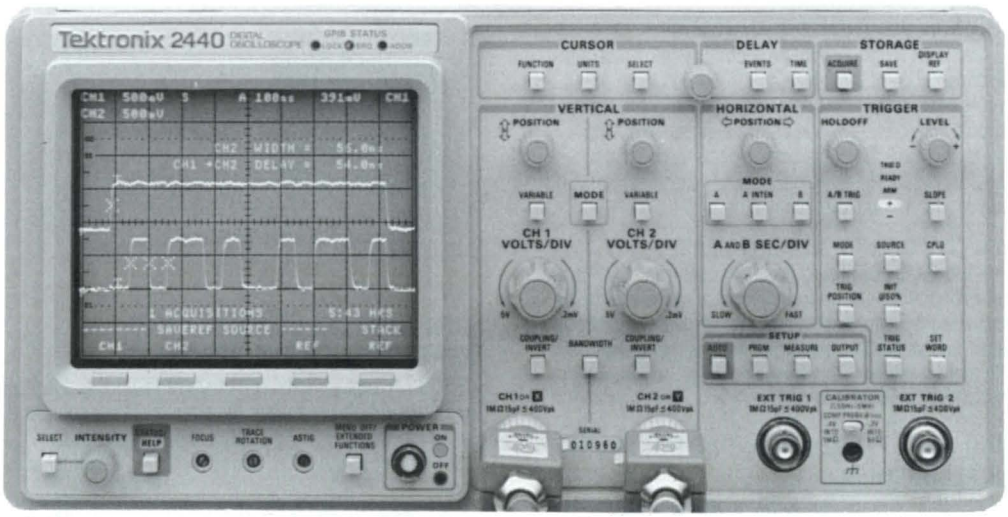
Temperature Probe for DMM, Opt 01 – P6602 **$275**

SOFTWARE FOR 2400-SERIES ANALOG OSCILLOSCOPES

For additional software packages, see the "Test and Measurement Software" section, pages 342–358.

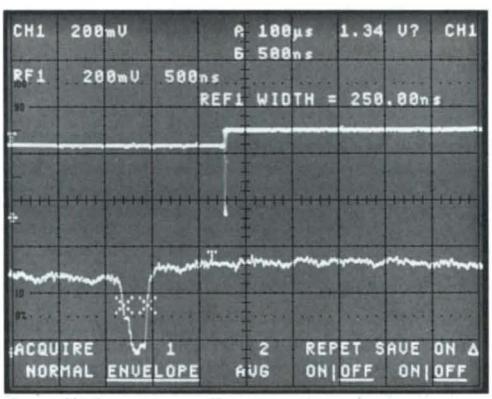
EZ-Tek 2400 PC Test Program Generator **$500**
S38A101 requires GPIB-equipped instruments; used with Tektronix PEP 301 or IBM PC/XT/AT and compatibles (computer also requires GPIB).

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.



THE HIGHEST PERFORMANCE IN COMPACT DIGITIZING SCOPES

The 2400-Series Digitizing Oscilloscopes combine high bandwidth and sampling rates with powerful automation features and waveform processing capabilities. Measurement accuracy is enhanced by 8-bit vertical resolution (11 bits with averaging), user-selectable Auto Setup and Measurement methods, selectable interpolation, and high-fidelity signal acquisition.



2-ns glitch capture allows you to see narrow events, for troublesome design problems.

Advanced triggering is provided so you are sure to display a stable waveform, even in the presence of noise. The 2440, 2432A, and 2430A all capture glitches as narrow as 2 ns – a tremendous aid in troubleshooting. Fast update rate (due to Tek's proprietary Waveform Processor) insures near-real-time display response to changes in your signal and increases the probability that infrequent events will be captured and displayed.

FEATURES TO SPEED MEASUREMENTS, SIMPLIFY SETUPS, & AUTOMATE TESTING

- **Auto Setup** – At the push of a button, the scope displays automatically scaled and triggered signals. The P6137 autoprobe supplied with the 2440 and 2432A extends this capability to its probe-tip button.
- **Auto Measure** – 21 waveform measurements are available for CRT readout and over the GPIB. Up to 4 may be selected for live (3 Hz) update, along with measurement aids and user-definable algorithms.
- **Auto Pass/Fail Testing** – Use this special feature to compare incoming signals against reference waveforms. If the signal is out of limits, the scope time stamps it, alerts the operator or controller, or sends the offending waveform to a printer/plotter. References can be previously-acquired waveforms or templates transferred from a computer.
- **Auto Sequence** – Routines built from the front panel (without writing code!) can include steps to make measurements, compare live waveforms against references, and send data to a printer or plotter automatically. Eliminates or decreases the need for a computer/controller for many repetitive tests. Stores typically 50 to 200 setups and actions in up to 40 named sequences.

SAVE TIME AND REDUCE COST IN SYSTEMS OF ALL SIZES

In large systems, 2400-Series Digitizing Scopes cut controller time and bus traffic to increase throughput. Averaging, smoothing, measuring, and pass/fail testing can all be done by the scope upon a simple command by the controller.

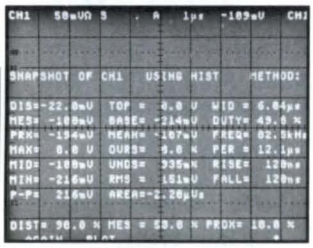
Tektronix PEP 301/PEP 303 Controllers, running programs developed with Tektronix EZ-TEST™ Test Program Generator software, drive systems incorporating scopes, printers, signal sources, and other test equipment. See pages 319-323 for information about PEP IBM-compatible controllers. Other compatible sotware is described in "Test and Measurement Software," pages 342-358.

The 2400-Series Digitizing Scopes Offer a Well-Balanced Combination of Performance, Automation, and Convenience Features.

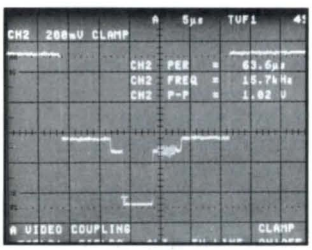
- *500 MS/s Digitizing (250 MS/s: 2432A and 2431L, 100 MS/s: 2430A)*
- *300 MHz Bandwidth (150 MHz: 2430A)*
- *2 ns Glitch Capture (except 2431L)*
- *8-Bit Vertical Resolution (Single-shot and Repetitive)*
- *0.0015% Crystal-Controlled Time Base*
- *Simultaneous Two-Channel Sampling*
- *Auto Pass/Fail Testing*
- *Fast, Reliable Automatic Measurements*
- *Fast Update Rate*
- *Extensive Triggering Capabilities*
- *Direct Printer/Plotter Output*
- *Disk storage available with 2402 TekMate*
- *On-Screen "HELP" for All Functions*
- *MATE/CIIL versions available – 2440M, 2432M, 2430M*

100 TO 500-MS/s DIGITIZING OSCILLOSCOPES

NEW 2431L



SNAPSHOT capability freezes all 20 automatic single-channel measurements, or up to four measurements can be selected for continuous update with waveform displays.



The Option 05 Video Measurement System allows selection of individual lines and fields. Here, Line 49 from Field 1 is selected.

The 2402 TekMate enhances 2400-Series digitizing scopes with extended capabilities for waveform storage, FFT waveform processing, and test procedure execution.

STAND-ALONE OPERATION IN LOW-VOLUME OR SHORT-RUN TESTS

The 2402 TekMate™ Instrument Extension extends the capabilities of the 2440, 2432A, 2430A and 2431L. During execution, TekMate displays instructions on the scope's screen, sets scope controls, makes measurements and pass/fail decisions, and stores over 300 waveforms. 2402 TekMate functions, specifications, and ordering information are located on pages 120–121.

NEW TEK SECURE MEMORY ERASE

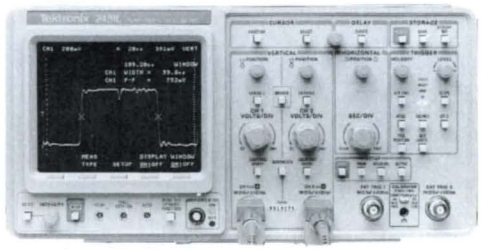
2400-Series Digitizing Oscilloscopes can be instantly declassified for removal from secure areas. Invoking the TekSecure™ feature completely erases waveform, front-panel, and sequence memories, restarts the instrument with factory settings, then gives positive indication that erasure has been accomplished.

SOFTWARE FOR 2400-SERIES DIGITIZING OSCILLOSCOPES

Powerful, off-the-shelf software packages that run on the IBM PC, XT, AT or compatibles like the Tektronix PEP 301 are available.

The **2410 Digital Interface Test System** is a fully integrated hardware and software package. It quickly and accurately tests digital carriers to ANSI or CCITT specifications. Its features, specifications, and ordering information are located with Telecom/Datacom Testers on page 455. **TGEN**, specific to 2400-Series Digitizing Scopes, is described on page 117. Other **Test and Measurement Software** is located on pages 342-358.

NEW 2431L



LOW-COST SOLUTION TO HIGH-PERFORMANCE REQUIREMENTS

300-MHz bandwidth, 250 MS/s digitizing, and built-in automation features answer the need for lower costs and faster measurements. The 2431L offers entry-level performance to the 2400-Series Digitizing Oscilloscope family.

Software written for the 2431L is fully compatible with other, higher performance 2400-Series Digitizing Scopes: 2440, 2432A, and 2430A.

MATE/CIIL CAPABILITY

The 2440M, 2432M, and 2430M include Control Intermediate Interface Language (CIIL) capability. This is essential for operation in Modular Automatic Test Equipment (MATE) used in testing military avionics and weapons systems.

2400 Series Digitizing Oscilloscopes Performance

	Sampling Rate	Bandwidth (Repetitive)	Bandwidth (Single-Shot)	Vertical *1 Resolution	Glitch Capture	Time Bases
2440/2440M	500 Ms/s	300 MHz	200 MHz	8 bits	2 ns	Main, Dly
2432A/2432M	250 MS/s	300 MHz	100 MHz	8 bits	2 ns	Main, Dly
2431L	250 Ms/s	300 MHz	100 MHz	8 bits	No	Main
2430A/2430M	100 MH/s	150 MHz	40 MHz	8 bits	2 ns	Main, Dly

**1 Digitizer resolution for single-shot acquisition. Averaging of repetitive signals increases resolution to as much as 11 bits.*

2400 Series Digitizing Oscilloscopes Features

	Auto Setup	Auto Measure	Auto Pass/Fail	Auto Sequencing	Auto Probe
2440/2440M	View, Period, Pulse, Edge	Live and Snapshot	Yes	200 steps (typical)	Yes
2432A/2432M	View, Period, Pulse, Edge	Live and Snapshot	Yes	200 steps (typical)	Yes
2431L	View only	Live only	Yes	50 steps (typical)	No
2430A/2430M	View, Period, Pulse, Edge	Live and Snapshot	Yes	200 steps (typical)	No*1

**1 AutoProbe facilities available with P6137 probe.*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

TGEN TEMPLATE GENERATOR

TGEN provides a fast and accurate method to create, edit, and store waveform templates for use with the Auto Pass/Fail feature of 2400-Series digitizing oscilloscopes.

TGEN is available on both 5.25 and 3.5 inch diskettes. Opt. 28 (U.S. only) adds Microsoft Windows and a serial interface Microsoft Mouse, allowing TGEN to run in the Microsoft 286 Windows environment on Tektronix PEP controllers, IBM PCs and compatiibles.

TGEN is included in the WaveWriter™ software package described in the Test and Measurement Software section. WaveWriter supports both acquisition and waveform generating instruments.

QUICKSTART OPERATOR'S TRAINING PACKAGE

COMPLETE WITH VIDEOTAPE, WORKBOOK, AND CIRCUIT BOARD

Proceed at your own pace through sections designed for users of various experience levels. The workbook offers an introduction to digitizing scope measurements, intermediate and advanced excercises, and procedures for calibration and diagnostics.

The QuickStart videotape previews measurement excercises and explains key points of the Workbook. All necessary signals are available on the QuickStart Circuit Board.

QuickStart is a complete and portable training package. It can serve several users for thorough self-study or as a quick, easy reference. QuickStart can be ordered as an option to your new scope or separately. See Ordering Information, pages 119 and 121.

CHARACTERISTICS

2400-Series Digitizing Oscilloscopes

Characteristics are common to the 2440 (2440M), 2432A (2432M), 2431L, and 2430A (2430M) except where indicated. For complete specifications, refer to product data sheets available from your local Tektronix sales office or the Tek National Marketing Center – toll-free: 1-800-426-2200, Ext. 99.

VERTICAL SYSTEM

Channels – two, simultaneous acquisition

Bandwidth Limit – selectable 20 MHz or 100 Mhz (2440), 20 MHz or 50 MHz (2432A, 2431L, 2430A)

Vertical Sensitivity – 2 mV/div (200 µV/div with expansion or averaging) to 5 V/div, continuously variable between ranges

Vertical Accuracy – ±2% + 1 digitizing level (25 digitizing levels per CRT division), includes amplifier accuracies and A/D converter resolution

AC-Coupled Lower –3dB Point – 10 Hz or less

Frequency Response (–3 dB Repetitive Bandwidth)

Instrument	–15°C to +30°C	+30°C to +55°C
2440, 2432A, 2431L	300 MHz	reduce bandwidth by 2.5 MHz for each °C above +30°C
2430A	dc to150 MHz	

Measured with standard accessory probe or internal 50Ω termination.

Input Coupling and Max Voltage – (1 MΩ) ac, dc, GND; Max input voltage: 400 V (dc + peak ac) (50Ω) ; Max input voltage: 5 V RMS

Input R and C – 1 MΩ and 15 pF or 50 Ω (nominal)

Vertical Position Range – ±10 div (nominal)

HORIZONTAL SYSTEM

Display Modes – A, A INTENsified, B (A only for 2431L)

Time Base Accuracy – 0.0015%

Maximum Time Base Resolution – 40 ps (2440, 2432A, 2431L), 100 ps (2430A)

A and B (Delayed) Sweep Time Base Range – 2 ns/div to 5 s/div (2440, 2432A, 2431L), 5 ns/div to 5 s/div (2430A)

External Clock Frequency – 1 MHz to 100 MHz

Delay by Events – Delays A or B sweep by user-selected number of B trigger events after the normal A trigger occurs, max number of events: 65,536

ACQUISITION SYSTEM

Single-Shot Bandwidth – 200 MHz (2440), 100 MHz (2432A, 2431L), 40 MHz (2430A) using internal Modified (sine x)/x interpolator with REPET mode OFF

Maximum Sample Rate – 500 MS/s (2440), 250 MS/s (2432A, 2431L), 100 MS/s (2430A) on both channels simultaneously

Update Rate – 30 Hz typical (100 Hz max with 50 kHz trigger, one channel selected, 100 µs/div)

Vertical Resolution – 8 bits or 0.39% (256 levels over 10.24 vertical divisions), 11 bits or 0.049% (2048 levels) with 64 or more averages

Record Length – 1024 points per channel (all modes)

Acquisition Modes – Normal (real-time sampling), Envelope (displays min and max waveform values over one or more sweeps), Average (effectively increases vertical resolution and sensitivity)

Glitch Capture – pulses 2 ns and wider are captured at > 50% amplitude with > 85% confidence (5 s/div to 5 ns/div, REPET mode OFF for 2430A; 5 s/div to 500 ns/div for 2440, 2432A)

TGEN Template Generator

- *Save and Recall an Unlimited Number of Waveform Templates*
- *Create New Templates, Modify Existing Templates*
- *Draw Templates with Mouse or Keyboard*
- *Perform Waveform Math*
- *Print Hardcopies of Templates*

QuickStart Operator's Training Package

- *Basic Training for First-Time Users*
- *Advanced Techniques for Experienced Operators*
- *Refresher for Occasional Users*

100 TO 500-MS/s DIGITIZING OSCILLOSCOPES

2440/2432A/ 2430A/2431L CHARACTERISTICS

MEMORY

Retention Time – > 3 years for calibration, setups, and sequences.

TRIGGERING

A Mode – Auto Level, Auto/Roll, Normal, and Single Sequence.

B Mode – Triggerable After Delay, Runs After Delay.

A and B Source – Vertical, CH1, CH2, Line (A only), Ext 1, Ext 2, A*B (A sweep only), Word (17-bit word recognizer probe optional accessory).

A and B Coupling – ac, dc, Noise Reject, HF Reject, LF Reject, (Video, A mode only with option 05).

A and B Trigger Position – 1/8 to 7/8 of acquisition record, user selectable in 1/8-1/4-1/2-3/4-7/8 sequence. User selectable in 32 sample Intervals (from 1/32 to 30/32) using GPIB.

Ext 1and Ext 2 Inputs –

Resistance: 1 MΩ ±1%.
Capacitance: 15 pF ±3 pF.
Maximum Input Voltage: 400 V (dc + peak ac), 800 V p-p ac at 10 kHz or less.

Trigger Level Control Range –

CH1 and CH2 Source: ±18 div x V/div.
Ext 1 and Ext 2 Source Gain ÷1: ±0.9 V.
Ext 1 and Ext 2 Source Gain ÷5: ±4.5 V.

OTHER SIGNAL OUTPUTS

CH2 Signal Out, A Trigger, Record Trigger, Word Recognizer Trigger – (signal outputs not available on 2431L).

POWER REQUIREMENTS

Line Voltage Ranges – 115 V: 90 V to 132 V ac; 230 V: 180 V to 250 V ac.

Line Frequency – 48 Hz to 440 Hz

Maximum Power Consumption – Typical:160 W (250 VA) for standard instrument, Maximum: 200 W (300 VA) for fully-optioned instrument.

AUTOMATIC MEASUREMENTS

21 Parameters – frequency, period, width, risetime, falltime, prop delay, duty cycle, overshoot, undershoot, RMS, area, minimum, maximum, mid, pk-to-pk, mean, base, top, proximal, mesial, and distal.

Thresholds – settable in percentage or volts Methods to determine 0%, 100% – Min/Max, Histogram, Cursors.

Windows – measurement windows defined by time cursors.

Indicators – extensive warning and error-flagging capabilities.

Cursors – Volts, Time, Volts at Time, 1/Time, Slope

GPIB PROGRAMMABILITY.

Compatibility – full talk/listen modes, control of all front panel settings, transmit/receive waveform data.

Data Transfer Rate – 30-40 waveforms/s typical.

Debug Mode – permits user to monitor bus traffic.

ENVIRONMENTAL AND SAFETY

ENVIRONMENTAL AND SAFETY SPECIFICATIONS FOR 2400-SERIES ANALOG AND DIGITIZING OSCILLOSCOPES

For complete Environmental and Safety specifications, refer to product data sheets available from your local Tektronix Sales Office or the Tek National Marketing Center – Toll free: 1-800-426-2200, Ext. 99.

Environmental Requirements –

- Meets requirements of MIL-T-28800D for Type III, Class 3, Style C equipment.
- Meets humidity and temperature requirements defined in paragraphs 3.9.2.2, 3.9.2.3, and 3.9.2.4.

Electromagnetic Interference (EMI) –

- Meets MIL-T-28800C.
- Meets MIL-STD-461B, Part 4 (CE-03 and CS-02), Part 5 (CS-06) and Part 7 (CS-01, RE-02, and RS-03), limited to 1 GHz.
- Meets VDE 0871, Category B, Part 15 of FCC rules and regulations, Subpart J, Class A.

Electrostatic Discharge Susceptibility – Meets Tektronix Standard 062-2862-00.

Radiation – Meets Tektronix Standard 062-1860-00.

Ambient Temperature – Operating: 15°C to +55°C. Nonoperating: -62°C to +85°C.

Humidity – Operating and nonoperating: stored at 95% relative humidity for five cycles (120 hours) at +30°C to +60°C with operational performance checks at +30°C and +55°C.

Altitude – Operating: to 4600 m (max operating temperature decreases above 1500 m), Nonoperating: to 15,000 m.

Shock – 50 g's.

Transit Drop – Meets MIL-T-288800C, paragraph 4.5.5.5.3.

Bench Handling – Meets MIL-STR-810C, Method 516.2, Procedure V (MIL-T-28800C, paragraph 4.5.5.4.3) with and without cabinet installed.

Safety – Certified by CSA (CSA 556B), and UL listed (UL 1244).

ENVIRONMENTAL SPECIFICATIONS FOR RACKMOUNTED OSCILLOSCOPES

Rackmounting changes temperature, vibration, and shock capabilities. The rackmounted scope meets or exceeds the requirements of MIL-T-18800C with respect to Type III, Class 5, Style C equipment, when installed as directed. It also meets or exceeds Tektronix Standard 062-2853-00, Class 5 requirements.

Ambient Temperature – Operating: -15°C to +55°C. Measured at the instrument's air inlet, fan exhaust should not exceed +65°C.

Vibration – Operating: same as standard instrument, except total displacement is 0.015 inch p-p (2.3 g's at 55 Hz).

Shock – Operating and nonoperating: same as standard instrument, except shocks are 30 g's.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

2440/2432A/2430A/2431L
PHYSICAL CHARACTERISTICS

	Cabinet		Rackmount	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width(with handle)	338	13.3	483	19.0
Height				
(with feet and pouch)	190	7.5		
(without feet and pouch)	160	6.3	178	7.0
Depth			419	16.5
(with front cover)	479	18.9		
(with handle extended)	563	22.2		
Weights	**kg**	**lb**	**kg**	**lb**
Net (with accessories and Pouch)	12.8	28.1		
(without accessories and Pouch)	10.9	23.9	4.0	8.8
Shipping	16.4	36.0		

ORDERING INFORMATION

2440 500-MS/s Digitizing Oscilloscope **$12,390**
Includes: two P6137 10X auto-probes (1.5 m) with accessories, fuse (159-0014-00), snap accessory pouch (016-0692-00), front cover (200-3199-01), power cord, Operators' Manual, Users' Reference Guide, Programmers Reference Guide, GPIB Pocket Guide

2440M 500-MS/s MATE/CIIL Digitizing Oscilloscope **$21,755**
Includes: same as 2440, plus MATE/CIIL Operators' Manual (070-6828-00)

2432A 250-MS/s Digitizing Oscilloscope **$10,335**
Includes: same as 2440

2432M 250-MS/s MATE/CIIL Digitizing Oscilloscope **$19,685**
Includes: same as 2440, plus MATE/CIIL Operators' Manual (070-6287-01)

2431L 250-MS/s Digitizing Oscilloscope **$1,750**
Includes: 2 P6136 10X probes (1.3 m) with accessories, fuse, power cord, Operators' Manual, Users' Reference Guide, Programmers' Reference Guide, GPIB Pocket Guide

2430A 100-MS/s Digitizing Oscilloscope **$8,235**
Includes: same as 2440, except 2 P6133 Opt. 25 10X (1.3 m) probes

2430M 100-MS/s MATE/CIIL Digitizing Oscilloscope **$18,080**
Includes: same as 2430A, plus MATE/CIIL Operators' Manual (070-6042-01)

INSTRUMENT OPTIONS

Opt. 03 – Word Recognizer Probe Pod (P6407) **+$480**
Opt. 05 – Video Waveform Trigger System **+$1,255**
Opt. 11 – Probe Power (not available for 2431L) **+$220**
Opt. 22 – Two Additional Matching Probes **+$340**
Opt. 25 – PEP 301 System Controller **+$8,395**
Opt. 26 – EZ TEST Test Generator Software **+$1,885**
Opt. 24 to Opt. 26 – Delete Microsoft QuickBASIC **–$105**
Opt. 27 – TGEN Template Generator Software (not available for 2431L) **+$285**
Opt. 28 – TGEN plus MicroSoft Windows and Mouse (not available for 2431L) ***1**
Opt. 29 – 2402 TekMate **+$3,140**
Opt. 46 – Commercial Version of ARMY OS-291/G (National Stock Number 6625-01-258-0022) ***1**
Opt. 2C – FeedThrough Cable Kit **+$220**
Opt. 2F – QuickStart Training Package (U.S. power) **+$199**
Opt. 3F – QuickStart Training Package (Euro power) **+$199**
Opt. 1P – HC100 Color Plotter (U.S. power) **+$990**
Opt. 2P – HC100 Color Plotter (European power) **+$965**
Opt. 1R – Rackmount **+$320**
Opt. 1T – Transit Case (telescoping handle, retractable wheels) **+$450**
Opt. 4D – Dutch HELP Text (not available for 2431L) **NC**
Opt. 4F – French HELP Text (not available for 2431L) **NC**
Opt. 4G – German HELP Text (not available for 2431L) **NC**
Opt. 4H – Italian HELP Text (not available for 2431L) **NC**
Opt. 4S – Spanish HELP Text (not available for 2431L) **NC**
Opt. B1 – Service Manual **+$55**

SOFTWARE FOR 2400-SERIES DIGITIZING OSCILLOSCOPES

For additional software packages, see the "Test and Measurement Software" section, pages 342-358.

TGEN Template Generator –
S37T100 or **$285**
S37T100 Opt. 28 (U.S. only) **$470**

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

WARRANTY

Three years covering parts and labor, includes crt, excludes probes. Coverage can be extended to five years through the optional *Warranty-Plus* service plans.

WARRANTY-PLUS SERVICE PLANS

Opt. M2 – Remedial Coverage in years 4 and 5
2440 **+$379**
2440M **+$417**
2432A/2431L **+$340**
2432M **+$351**
2430A/2430M **+$385**

Opt. M3 – 4 calibrations (in years 2 through 5), Remedial Coverage for years 4 and 5
2440 **+$826**
2440M **+$864**
2432A/2431L **+$768**
2432M **+$779**
2430A/2430M **+$903**

Opt. M4 – 5 calibrations (in years 1 through 3)
2440 **+$523**
2440M **+$523**
2432A/2431L **+$501**
2432M **+$501**
2430A/2430M **+$608**

Opt. M5 – 9 calibrations (in years 1 through 5), Remedial Coverage for years 4 and 5
2440 **+$1,316**
2440M **+$1,354**
2432A/2431L **+$1,235**
2432M **+$1,246**
2430A/2430M **+$1,472**

Opt. M7 – 2 calibrations (in years 2 and 3)
2440 **+$223**
2440M **+$223**
2432A/2431L **+$214**
2432M **+$214**
2430A/2430M **+$259**

Opt. M8 – 4 calibrations (in years 2 through 5)
2440 **+$446**
2440M **+$446**
2432A/2431L **+$428**
2432M **+$428**
2430A/2430M **+$518**

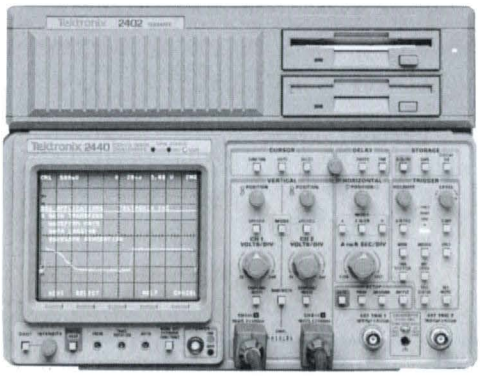
**1 Contact your local sales representative.*

Manuals

	2440/2440M	Price	2432A/2432M	Price	2431L	Price	2430A/2430M	Price
Operators' Manual	070-6599-00	**$35**	070-7272-00	**$35**	070-7701-00	**$15**	070-6286-01	**$25**
Programmers' Reference	070-6601-00	**$15**	070-7271-00	**$15**	070-7700-00	**$15**	070-6338-00	**$15**
GPIB Pocket Guide	070-6602-00	**$5.00**	070-7270-00	**$5.00**	070-7699-00	**$5.00**	070-6604-00	**$5.00**
Users' Reference Guide	070-6600-00	**$5.00**	070-7269-00	**$5.00**	070-7698-00	**$5.00**	070-6339-00	**$5.00**
Service Manual	070-6603-00	**$75**	070-7273-00	**$80**	070-7702-00	**$50**	070-6330-00	**$60**

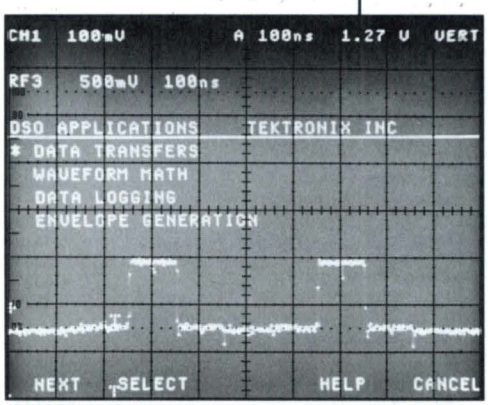
Extend, Expand and Enhance Scope Capabilities.

- *Stores over 300 Waveforms on a Single Disk*
- *Performs Complex Waveform Analysis (FFT, Correlation, Differentiation, Integration)*
- *Makes Automatic Waveform Pass/Fail Decisions*
- *Creates and Stores Templates for Waveshape Tests*
- *Logs Data with Date-Time Stamp for Unattended Data Collection and Remote Site Monitoring*
- *Uses Scope's Buttons and Display for Easy Control*
- *Mounts Quickly and Easily to 2400-Series Digitizing Oscilloscopes*



EXTEND SCOPE CAPABILITIES FOR WAVEFORM STORAGE, ANALYSIS, AND PASS/FAIL TESTING

With TekMate™ directing any 2400-Series Digitizing Oscilloscope, operators can perform complex tests accurately and repeatably with a minimum of training. Direct printer/plotter output provides waveform and measurememt-result screen displays that can be included in test reports and documentation.



TekMate displays its easy-to-use menus on the screen of its companion 2400-Series digitizing oscilloscope.

FASTER OFF-SITE TESTS

This one-handle system goes anywhere. Off-site users can:

- Carry disk files of known-good waveforms
- Compare live signals against stored waveforms
- Log waveform data for later analysis
- Perform signal analysis, such as FFTs, with simple menu selections

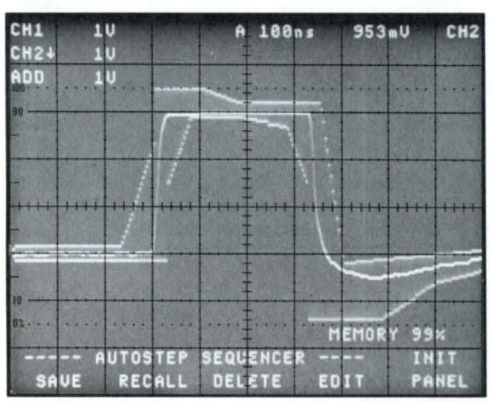
UNATTENDED MONITORING

Users need not watch their scopes while waiting for occasional events. The TekMate/scope team monitors signals, date- and time-stamps captured waveforms, and stores over 300 waveforms on a disk for later retrieval.

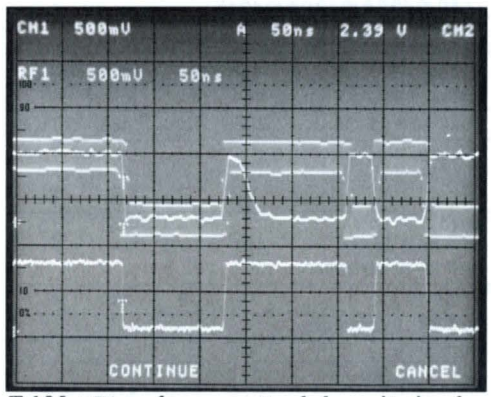
REPETITIVE AUTOMATIC PASS/FAIL TESTING

In applications where users need to compare incoming signals against a waveform template, TekMate and a 2400-Series digitizing oscilloscope offer greatly increased speed, accuracy, and repeatability. TekMate software includes utilities for easy creation of waveform templates, template test execution, and archiving of waveform and measurement results.

Performing waveform math functions – such as verifying the spectral density of a T-carrier pulse waveform – is as simple as selecting the FFT function. TekMate calculates the FFT and displays the results on the scope screen.



TekMate™ transfers templates from disk to the scope for template testing. A DS1 signal is shown here with a DS1 test template.



TekMate™ performs unattended monitoring for infrequent aberrant events and stores the failed waveforms.

SOFTWARE

DSO-Utility Software is included with every TekMate Option 01 and operates on all Tektronix 2400-Series Digitizing Oscilloscopes. It provides routines to:

- Save scope waveforms to disk
- Load disk waveforms to scope
- Log data upon a waveform pass/fail test failure, a scope trigger, or at the end of a test sequence
- Perform waveform math including add, subtract, multiply, divide, integrate, differentiate, and Fast Fourier Transform
- Generate waveshape templates
- Make direct hardcopies on HPGL, IBM Graphic, Epson, PostScript, and compatible devices

TekMate Option 41 Program Development System saves time and cuts program development costs. It runs on IBM-compatible computers, such as the Tektronix PEP 301 and includes:

- Menu Development System, Waveform Math and GPIB Control Functions libraries
- Disk, directory and file-management functions
- Template Generation Tools

The TekMate Program Development System also includes Microsoft Quick C and Quick BASIC programming languages and over 250 example programs.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

EZ-Test Software, Opt. 26, enables users to develop test procedures, without programming, on a Tektronix PEP 301 System Controller or other IBM-compatible controller. These procedures are then executed on the TekMate™, providing a quick, low-cost entry into automated testing.

CHARACTERISTICS

For complete specifications, refer to product data sheets available from your local Tektronix Sales Office or the Tek National Marketing Center – toll-free: 1-800-426-2200, Ext. 99.

Disk Drives – two 3.5 inch microfloppy disk drives, 720 kbytes formatted capacity each. IBM pc compatible floppy disk drive controller.

External Features and I/O Ports –

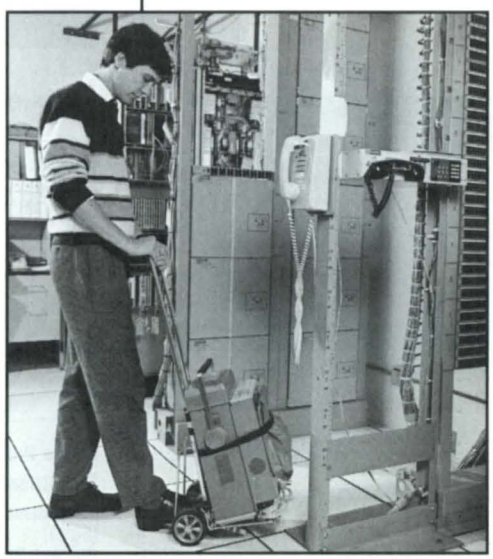
- Serial RS-232-C port (COMM-1) programmable to 19.2 baud
- Limited (COMM-4) RS-232-C port (one active handshaking signal in both directions, not useable in interrupt-driven mode)
- Centronics parallel printer port
- GPIB port with talker, listener, DMA, and controller capabilities
- Keyboard port (IBM compatible)
- Hardware reset button
- Audio speaker
- Power-on LED indicator

Display – uses the companion digitizing oscilloscope's screen.

Clock-calendar – built in, battery backup

Power Requirements – 90 to 250 VAC line voltage range, 48 to 440 Hz line frequency range, consumes 70 watts.

Operating System – MS-DOS 3.3



Transport options ease transport both for site-to-site portability and for safe air shipment of the 2402/scope team. Option 1C Travel Cart is shown here.

ORDERING INFORMATION

2402 TekMate™ Instrument Extension **$2,795**
This base unit includes: power cord, MS-DOS software, diagnostic software, 2402 Hardware Manual (070-6977-00), and MS-DOS Manual (070-7013-00).

2402 TEKMATE OPTIONS

Opt. 01 – DSO-Utility Kit **+$305**
Includes: 2402 TekMate base unit, DSO-Utility Software, DSO-Utility Manual (070-7015-00), GPIB cable, and 2400 DSO Mounting Kit and instructions.
2402 TekMate Option 01 is also available as an option (Opt. 29) to the 2440, 2432A, and 2430A Digitizing Oscilloscopes. See page 119.
Opt. 1R – Rackmount **+$200**
Opt. 1T – Transit Case (202-0302-00) **+$450**
Opt. 1C – Transit Cart (016-1013-00) **+$110**
Opt. 2F – QuickStart Operators' Training Package (U.S. power, 020-1747-00) **+$199**
Opt. 3F – QuickStart Operators' Training Package (Euro Power, 020-1748-00) **+$199**
Opt. 1P – HC100 Color Plotter with GPIB cable (U.S. power) **+$990**
Opt. 2P – HC100 Color Plotter with GPIB cable (Euro power) **+$990**
Opt. 26 – EZ-TEST PC Software **+$1,885**
Opt. 24 to Opt. 26 – Delete Microsoft QuickBASIC **+$1,695**
Opt. 41– DSO Program Development System **+$1,315**
Opt. 4X – Delete Microsoft DOS **–$25**
(where international licencing limitations require)
Opt. S9 – Software Subscription for Opt. 01 DSO-Utility Software *1
(extends software upgrades and product support to one full year for U.S. customers)
Opt. 42 – S9 Software Subscription for Opt. 41 DSO PDS **+$265**
(extends software upgrades and product support to one full year for U.S. customers)
Opt. 1S – Software Subscription for Opt. 01 DSO-Utility Software *1
(extends software upgrades and product support to one full year for international customers)
Opt. 42 – 1S Software Subscription for Opt. 41 DSO PDS *1
(extends software upgrades and product support to one full year for international customers)
Opt. 3S – Subscription Renewal for Opt. 01 (International only) *1
Opt. 5S – Subscription Renewal for Opt. 41 (Internationall only) *1
Opt. 4A – T-Carrier Trigger and 2410 Software (ANSI) **+$3,675**
Opt. 4B – T-Carrier Trigger and 2410 Software (ANSI and CCITT) **+$4,305**
Opt. 4C – 2410 Software (CCITT) **+$2,415**
For information on 2410 Software, see 2410 Digital Interface Test System, page 455.

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

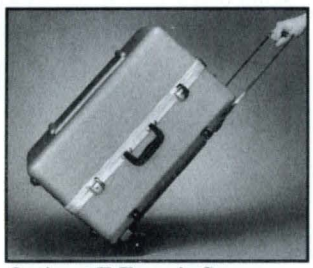
***WARRANTY PLUS* OPTIONS**

TekMate carries a one-year warranty covering all labor and parts. Warranty may be extended through the *Warranty Plus* options.
Opt. M2 – Remedial Coverage in years 2 through 5 **+$219**
Opt. M9 – Remedial Coverage in years 2 and 3 **+$109**

OTHER ACCESSORIES FOR 2402 TEKMATE

GPIB Cable – 1/2 meter Order 012-1282-00 **$100**
GPIB Cable – 1 meter Order 012-0991-01 **$140**
Microsoft Quick C – (5.25" media with manual) Order 062-9893-00 **$99**
Microsoft Quick BASIC – (5.25" media with manual) Order 062-9352-01 *1
2402/DSO System Training – Basic Order 068-9155-00 **$500**
2402/DSO SystemTraining – Advanced Order 068-9155-01 **$500**
2402/DSO System Training – Comprehensive Order 068-9155-02 **$750**
Lap Link Software – (3.5" and 5.25" media, RS-232 cable) Order 062-9976-00 **$110**
QuickStart Operators' Guide – (manual only) Order 070-7447-01 **$25**
2467 Mechanical Compatibility – Order 016-0991-00 **$40**
2400 DSO Mechanical Compatibility – Order 016-0978-00 **$40**
2445/2465 Mechanical Compatibility – Order 016-0990-00 **$40**

*1 *Contact your local sales representative.*



Option 1T Transit Case

ORDERING INFORMATION

2400 SERIES ANALOG AND DIGITIZING SCOPES

Accessory	Key Characteristics (for complete specifications refer to page(s) listed in table)	Page	Order	Price
Passive Probes (1 MΩ)	10X, 400 MHz, compact tip, (incl. with 2467B, 2465B, 2440, 2432A)	413	P6137	**$170**
	10X, 350 MHz, subminiature tip	413	P6136	**$160**
	10X, 350 MHz, compact tip (incl. with 2455B, 2431L)	413	P6136 Opt 25	**$160**
	10X, 150 MHz, subminiature tip	413	P6133	**$120**
	10X, 150 MHz, compact tip (incl. with 2430A, 2445B)	413	P6133 Opt 25	**$120**
	1X/10X Switchable, 300 MHz	411	P6127	*2
	Rugged 10X, 150 MHz	412	P6109	**$63**
Active Probe	10X FET Probe, 500 MHz	416	P6202A	**$780**
Bias/Offset Probe	10X Bias/Offset Probe, 1.5 GHz	416	P6230	**$475**
Low Impedance Probe (50 Ω)	10X Low Impedance, 3.5 GHz	414	P6156*1	**$240**
Current Probes	50 MHz, 20 Amps (dc + pk ac)	425	AM 503S	**$2,200**
	15 MHz, 100 Amps (dc + pk ac)	425	AM 503S Opt 03	**$2,750**
High Voltage Probes	120 MHz, 1500 V pk	420	P6009	**$230**
	75 MHz, 40 kV pk	420	P6015	**$780**
Optical to Electrical Converters	450-1050 nanometers, 700 MHz (requires 1103 Probe Power Supply)	371	P6701	**$2,000**
	1000-1700 nanometers, 500 MHz (requires 1103 Probe Power Supply)	371	P6702	**$2,095**
Power Supply	Power Supply for up to two probes	428	1103	**$375**
Isolator	Two independently-isolated channels, 20 MHz, 3000 V ac	421	A6902B Opt 02	**$2,650**
SMT Interconnects	Small grabber clips for surface-mount devices (requires 013-0202-02)	429	SMG50	**$89**
	SOIC Twin Pack for Small Outline Integrated Circuits (8,14,16, 20, 24 pins)	Refer to page 429		
	PLCC Twin Pack for Plastic Leader Chip Carriers (20, 28, 44, 52, 68 pins)	Refer to page 429		
Cameras	Low-cost, mountable film back camera	392	C-5C Opt 01$500	
	High Performance	396	C-30 BP Opt 01	**$1,760**
Carts	Portable Instrument Cart	399	K212	**$380**
	Cart with Plotter Shelf	399	K212 Opt 22	**$520**
Carrying Cases	Telescoping handle, retractable wheels	441	202-0302-00	**$450**
	Low-cost suitcase style	441	016-0792-01	**$280**
Carrying Strap	Over-the-shoulder	441	346-0119-00	*2
Swivel Base	Adjustable scope stand	399	K501	**$49**
Color Plotter	HC100 4-Pen Plotter	384	HC100 Opt 01	**$990**

**1 Optional 1X, 20X, and 100X tips available, see page 419.*

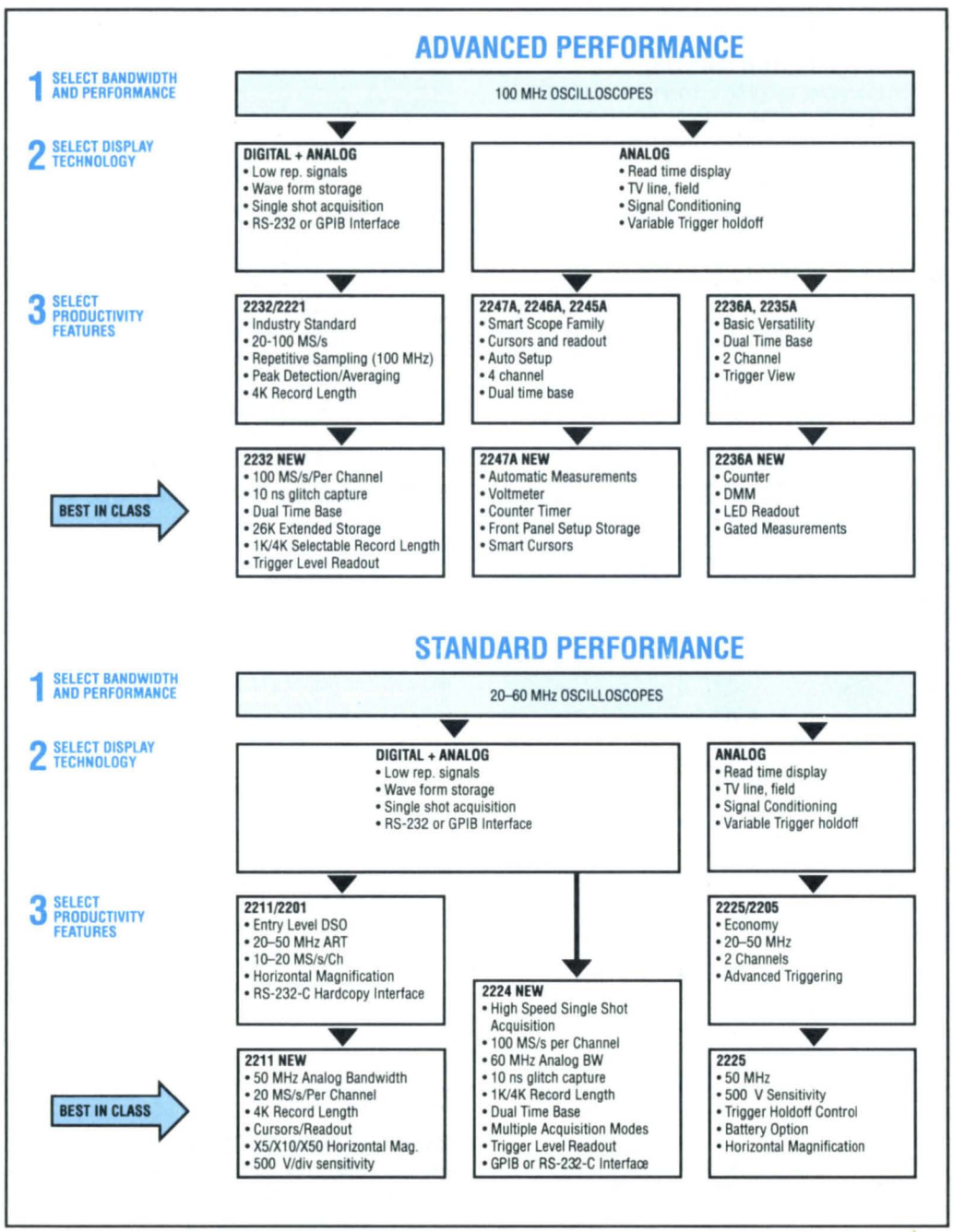
**2 Contact your local sales representative.*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

The Tek 2200 Series digital and 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. The second step is to decide on either digital plus analog display or just analog display. 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 beginning on page 28 provides additional information to assist you in your selection process.



Low-Cost Portable Test Instruments With Both Digital Storage and Analog Real–Time Capabilities.

- *Wide Selection to Meet Any Signal Analysis Need*
- *Economical Operation, Long-Life and Precise Measurements*
- *The Latest in Design and User Interface Features*
- *Lightweight, Compact, and Portable*
- *Rugged, Safe and Reliable*

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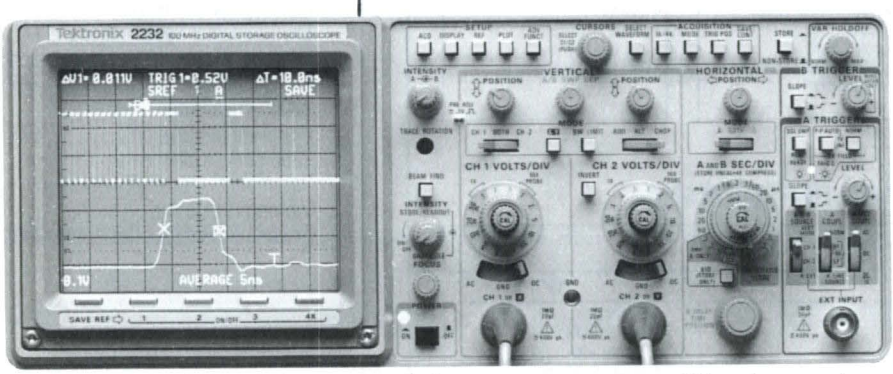
To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

NEW

2232 *100 MHz, 100 MS/s DIGITAL PLUS ANALOG OSCILLOSCOPE*

Waveform Confidence and Versatility Unmatched at the Price.

- *100 MHz Analog Bandwidth; 100 MHz Digital Storage Bandwidth*
- *Dual Time Base*
- *100 MS/s Per Channel Sampling Rate*
- *10 ns Glitch Capture, Any Sweep Speed*
- *Selectable 1K or 4K Record Length*
- *8-bit Vertical Resolution*
- *Time and Voltage Waveform Cursors*
- *Trigger-Level Readout*
- *Point-Selectable Pre/Post Triggering*
- *Extended Battery-Backed Waveform Storage (26K)*
- *Expand/Reposition Any Stored Waveform*
- *GPIB or RS-232-C Communications Options*



The 2232's peak detect mode captures glitches as narrow as 10 ns. Using the second time base and expansion feature, it's then easy to chartacterize the glitch.

GPIB* IEEE-488

**The 2232 oscilloscope complies with IEEE Standard 488.1-1988, RS-232C and Tektronix Standard Codes and Formats*

PREMIUM VERSATILITY

The new 2232 delivers high-end performance at the lowest price in its class. As the new flagship of Tek's 2200 series, the 100 MHz 2232 has advanced capabilities not found in comparable scopes. On the digital storage side, it offers 100 MS/s sampling simultaneously on two channels, 10 ns glitch capture, 4K record length and extended memory. At the push of a button, the 2232 operates as a conventional analog scope with the ease of use and familiarity you expect from Tektronix scopes. And, the 2232 offers all this for a price that makes it the best value in its class.

HIGH SPEED GLITCH CAPTURE

With innovative sampling technologies, the 2232 is capable of catching signal variations that are easy to miss with other scopes. In Peak Detect sampling mode the 2232 is always sampling at 100 MS/s. Because it can capture and display random events as narrow as 10 ns at *any* sweep speed, the 2232 helps you quickly isolate problems that you might otherwise overlook.

EXCELLENT WAVEFORM RESOLUTION

The 2232 acquires either 1K or 4K records with 8-bit vertical resolution, displaying the necessary detail for precise analysis. You can capture four screens of data in a single acquisition with the 2232, and store them in a 4K record. Or, you can compress all points on-screen, look at any 1K portion, or expand to view 100 points in precise detail. For quick update speed, just select 1K acquisition record length from the start. And for even greater resolution, use the 2232's complete dual time base to quickly zoom in on any portion of a waveform and acquire a full record of information – at up to 500 ps sample resolution.

EXTENDED STORAGE CAPABILITY

Once stored, any waveform can be expanded, compressed, and repositioned vertically and horizontally for more precise analysis or comparison with other waveforms.

The 2232 also comes with 26K of extended, battery-backed memory, which lets you store as many as 26 waveform sets for up to three years. Thus, a reference library of known-good waveforms can be recalled at any time for performance verification. Or unknown signals can be captured and recalled for later analysis.

TIME-SAVING FEATURES

Bezel buttons, measurement cursors and on-screen readouts reduce analysis time and measurement error. Conveniently located bezel buttons let you save reference waveforms and select advanced menu functions. These functions include setting acquisition modes, average weighting and sweep limits, point-selectable trigger position, stored waveform formatting and position, and stored waveform recall.

Measurement cursors further simplify scope operation by automatically calculating and displaying time and voltage differentials. The cursors are tied to a selected waveform and can be positioned anywhere in a record for detailed timing analysis. Scale factors automatically track the selected waveform.

SOLID TRIGGERING PERFORMANCE

A full range of triggering capabilities has been built into the 2232 to assure trigger stability. These include features like variable hold-off for triggering on complex waveforms, high frequency and low frequency reject conditioning for noisy environments, and peak-to-peak auto trigger for virtually hands-free trigger level control. A new feature, trigger level readout, allows the user to set a voltage value for the trigger point and read it directly on screen. This capability is especially useful for setting up a single-shot acquisition.

INTEGRATED SOFTWARE PACKAGES

Optional GPIB or RS-232-C interfaces let you tie the 2232 directly to your printer, plotter, or PC for automated data collection and analysis. In addition, a number of software packages designed specifically for the 2232 are available from Tek. For example, Tek's new RS-232-C TeleServicing software is the first commercial package that combines data communication, data management and waveform graphics for remote service applications. See the Test and Measurement Software section of this catalog for more information on this and other software solutions.

WIDE RANGE OF APPLICATIONS

The versatility of the 2232 feature set makes it ideal for a wide range of applications. For example, its ruggedness and portabliity are a perfect match for the field service technician. Its 10 MHz single shot bandwidth, glitch capture and signal analysis capabilities are invaluable for circuit design and troubleshooting. TV triggering and a complete dual time base allow for easy video and image waveform analysis. Waveform averaging and trigger conditioning make it ideal for power supply troubleshooting.

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).

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

100 MHz, 100 MS/s DIGITAL PLUS ANALOG OSCILLOSCOPE

2232 NEW

Resolution – Vertical: 8 bits (25 levels per division), 10 bits useful 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, and 26K of extended memory (store up to 26 waveform sets). Battery-backed memory stores waveforms for up to 3 years.

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 (5ns/div with X10 MAG). B sweep: 50 ms/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 – Nonstore Mode: A, ALT (A intensified by B and B), B. Store Mode: A, A intensified by B, B, 4K COMPRESS.

Delay Jitter – 5000:1

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).

Trigger Operating Modes – A-Mode: Peak-Peak AUTO (also for TV LINE), NORM, TV FIELD, SGL SWP. B-Mode: Runs After Delay, Triggered After Delay.

Trigger Source – A Trigger: VERT MODE, CH 1, CH2, LINE, EXT. 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 (slow mode), dc to 100 kHz (fast mode).

CRT SYSTEM

Display – 8 cm x 10 cm, 14 kV nominal voltage.

Controls – A INTENSITY, B INTENSITY, TRACE ROTATION, BEAM FIND, FOCUS, STORAGE/READOUT INTENSITY, GRATICULE ILLUMINATION.

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 VA).

ENVIRONMENTAL CHARACTERISTICS

(See page 142)

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	360	14.2" with handle
Height	137	5.4"
Depth	440	17.3" w/o front cover
Weight	**kg.**	**lbs.**
Net	8.2	18

Safety – UL 1244 listed, CSA certification.

Warranty – 3 years

INSTRUMENT OPTIONS

ANSI/IEEE-488 GPIB Interface (Option 10) – Function Subsets Implemented: SH1, AH1, T5, L3, SR1, RL2, PP0, DC1, DT0, C0, E2. Plotter Devices: HP-GL, Epson FX-Series, HP ThinkJet. Data Transfer Rate: approx. 1 kByte/s.

EIA Std RS-232-C Interface (Option 12) – Baud Rate: 50 to 2400 for interactive use, up to 4800 for driving plotters. Plotter Devices: HP-GL, Epson FX-Series, HP ThinkJet. Connectors: DCE (female), DTE (male).

QuickStart Training Package (Option 2F) – Includes QuickStart training manual and multiple signal source board with battery.

ORDERING INFORMATION

2232 100 MHz Dual Time Base, Digital + Analog Oscilloscope ☎ **$5,495**
Includes:
Two 10X Voltage Probes (P6109 Opt. 01), Operator's Manual (070-7066-00),
User's Ref. Guide (070-7068-00),
Front Panel Cover (200-2520-00),
Accessory Pouch (016-0677-02),
3 Year Warranty, Power Cord.

INSTRUMENT OPTIONS

Opt. 10 – GPIB Interface **+$300**
Opt. 12 – RS-232-C Interface (w/cable) **+$300**
Opt. 2F – Operator's QuickStart Training Package **+$199**
(See page 361 in education section for information on Quick Start Packages)

ACCESSORY OPTIONS

Opt. 1C – C-5C Opt. 02 Camera **+$500**
Opt. 1K – K212 Instrument Cart **+$380**
Opt. 1P – HC100 Plotter **+$990**
w/GPIB cable (requires Opt. 10)
Opt. 3P – HC100 Plotter **+$895**
w/RS-232-C Cable (req. Opt. 12)
Opt. 1T – Transit Carrying Case **+$280**
Opt. 17 – P6408 Logic Probe **+$350**
Opt. 33 – Travel Line Package **+$295**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1- A5 – Available **NC**
See page 142 for descriptions.

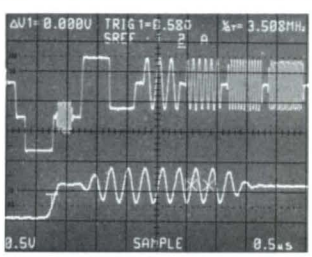
WARRANTY-PLUS SERVICE PLANS

Opt. M2 – +2 yrs service **+$295**
Opt. M3 – +2 yrs srv. & 9 cals **+$800**
Opt. M4 – +5 calibrations **+$615**
Opt. M5 – +2 yrs srv. & 9 cals **+$1,400**
Opt. M7 – +2 calibrations **+$265**
Opt. M8 – +4 calibrations **+$530**

RECOMMENDED ACCESSORIES/ FIELD KITS

Service Manual – (070-7067-00) **$25**
2232 F10 – GPIB Field Upgrade Kit **$350**
2232 F12 – **$350**
RS-232-C Field Upgrade Kit
GPIB Cable, 2m – (012-0991-00) **$160**
Rackmount Kit – (016-1003-00) **$155**
(See page 142 for more accessories.)

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.



The 2232's 100MS/s sampling rate and excellent resolution make it the appropriate choice for a wide range of applications, including video/TV design, troubleshooting and service.

NEW

2224 *60 MHz, 100 MS/s DIGITAL PLUS ANALOG OSCILLOSCOPE*

Bringing the Benefits of High Sample Rates and Narrow Glitch Capture to Low Frequency Applications.

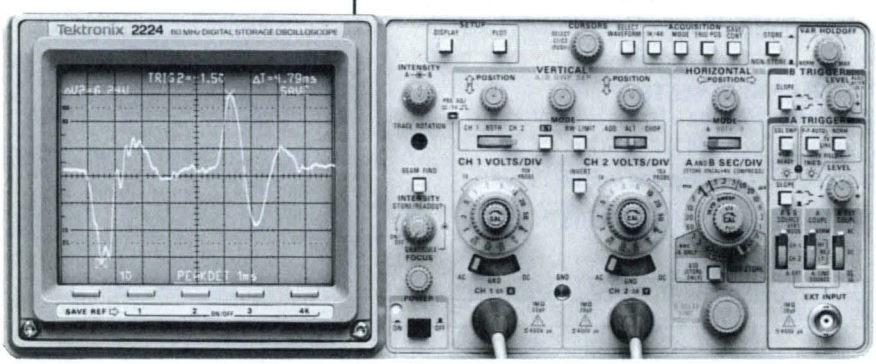
- *60 MHz Analog Bandwidth; 10 MHz Digital Storage Bandwidth*
- *Dual Time Base*
- *100 MS/s Digital Sampling Rate*
- *10 ns Glitch Capture, Any Sweep Speed*
- *Selectable 1K or 4K Record Length*
- *8-bit Vertical Resolution*
- *Time and Voltage Waveform Cursors*
- *Trigger-Level Readout*
- *GPIB or RS-232-C Communication Options*

ACCURATE WAVEFORM CAPTURE AT AFFORDABLE PRICES

Tek's new 2224 digital storage oscilloscope provides high sample rate, narrow glitch capture, and excellent sampling resolution – all at an attractive price. Its 60 MHz analog and 10 MHz digital storage bandwidth make it the right choice for low frequency applications. Because the 2224 utilizes real-time sampling only (no repetitive sampling), the useful storage bandwidth is limited by the sample rate.

MULTIPLE ACQUISITION MODES

The 2224's high sample rate and proprietary peak detection acquisition mode allow you to capture signal variations as narrow as 10 ns at any sweep speed. This capability is especially valuable at slow sweep speeds, often encountered in mechanical or biophysical applications, where important signal detail can occur between typical sampling intervals. By always sampling at 100 MS/s, the 2224 won't miss elusive glitches or peak voltage values. Moreover, accumulated peak detection captures signal drift over time, while signal averaging is useful for removing unwanted noise from a signal.



2224: The 2224's powerful digital storage features make it the perfect scope for monitoring input/output control systems or vibration and shock effects.

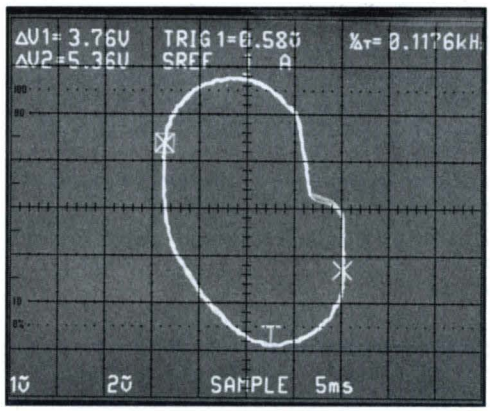
GPIB* IEEE-488

HIGH RESOLUTION AT ALL SWEEP SPEEDS

A selectable 1K/4K record length makes it easy to monitor events occurring over long time periods. You'll maintain high resolution at 100 points/division even while capturing events as slow as 200 seconds per acquisition.

SLOW SPEED VIEWING

One advantage of digital storage is the ability to capture and display slow speed events. The 2224 can acquire at 5 seconds/division, displaying each sample as it is captured. You can select either scan display (left-to-right) or roll display (right-to-left) modes for continuous signal monitoring. The external sample clock input enables you to capture even slower phenomenon, including temperature changes occurring over several hours. It also allows sampling to be synchronized to the event being monitored, such as the rotation of a machine. With dual digitizers, the 2224 also simultaneously samples both channels for precise time-correlated measurements.



2224: Phase relationships can easily be compared using the 2224's X-Y display mode and save reference memories.

FAST WAVEFORM DOCUMENTATION

Use either the optional RS-232-C or GPIB interface to connect your scope to a printer, plotter, or PC. Direct hard copy output, including an auto-plot mode, makes waveform documentation easy. In addition, several off-the-shelf Tek software packages are available which provide capabilities ranging from waveform display to detailed signal analysis on a PC. See the Test and Measurement Section of this catalog for more information.

BUILT-IN EASE OF USE

The 2224 was designed with ease of use in mind. For example CRT bezel buttons provide you quick access to saving and retrieving reference waveforms. They also allow you to select from display and plot setup menus . Easily manipulated measurement cursors automatically calculate and display time and voltage differentials. Advanced trigger features guarantee trigger stability and easy setup. These include trigger voltage read-out, peak-to-peak automatic triggering, and trigger signal conditioning (high frequency and low frequency reject). In addition, trigger position can also be varied among pre-, mid-, and post-trigger choices.

TARGETED APPLICATIONS

The 2224's high sample rate and fast peak detection capabilities provide the ideal solution for electromechanical measurements, biophysical and geophysical research, and process control monitoring. These kinds of applications benefit greatly from the 2224's advanced digital storage capabilities and high single-shot bandwidth.

**The 2224 oscilloscope complies with IEEE Standard 488.1-1987 with Option 10, RS-232C with Option 12, and Tektronix Standard Codes and Formats*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

CHARACTERISTICS

DIGITAL STORAGE SYSTEM

Sample Rate – 100 MS/s per channel.

Resolution – Vertical: 8 bits (25 levels per division), 10 bits useful 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.

Acquisition Modes – Peak Detect (10 ns glitch capture at all available sweep speeds); Accumulated Peak Detect; Average; and Sample.

Save Reference Memory – One 4K or three 1K acquisitions in battery-backed memory.

VERTICAL SYSTEM

(2 Identical Channels)

Bandwidth (–3 dB) and Rise Time – 60 MHz and 5.8 ns (0°C to +35°C);50 MHz and 7.0 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, CH2, 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 1 µs/div in store mode (to 0.5 µs/div in ALT or CHOP). B sweep: 50 ms/div to 0.05 µs/div. 50 ms/div to 1 µs/div in store mode (to 0.5 µs/div in ALT or CHOP).

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 – Nonstore Mode: A, ALT (A intensified by B and B), B. Store Mode: A, A intensified by B, B, 4K COMPRESS.

Delay Jitter – 5000:1.

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, 1.0 div at 60 MHz. External: 40 mV at 10 MHz, 120 mV at 60 MHz (A trigger only).

Trigger Operating Modes – A-Mode: Peak-Peak AUTO (also for TV LINE), NORM, TV FIELD, SGL SWP. B-Mode: Runs After Delay, Triggered After Delay.

Trigger Source – A Trigger: VERT MODE, CH 1, CH 2, LINE, EXT. 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 10 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).

X-Y Plotter Output – Plots all displayed waveforms, crt readout, and graticule (selectable).

External Clock Input – dc to 1 kHz.

CRT SYSTEM

Display – 8 cm X 10 cm, 14 kV nominal voltage.

Controls – A INTENSITY, B INTENSITY, TRACE ROTATION, BEAM FIND, FOCUS, STORAGE/ READOUT INTENSITY, GRATICULE ILLUMINATION.

Z-Axis – 5 V causes noticeable modulation. Usable to 10 MHz.

POWER REQUIREMENTS

Line Voltage Range – 90 Vac to 250 Vac.

Line Frequency – 48 Hz to 440 Hz.

Maximum Power Consumption – 85 W (150 VA).

ENVIRONMENTAL CHARACTERISTICS

(See Page 142)

OTHER CHARACTERISTICS

Safety – UL 1244 listed, CSA certification.

Warranty – 3 years

INSTRUMENT OPTIONS

ANSI/IEEE-488 GPIB Interface (Option 10) – Function Subsets Implemented: SH1, AH1, T5, L3, SR1, RL2, PP0, DC1, DT0, C0, E2. Plotter Devices: HP-GL, Epson FX-Series, HP ThinkJet. Data Transfer Rate: approx. 1 Kbyte/s.

EIA Std RS-232-C Interface (Option 12) – Baud Rate: 50 to 2400 for interactive use, up to 4800 for driving plotters. Plotter Devices: HP-GL, Epson FX-Series, HP ThinkJet. Connectors: DCE (female), DTE (male).

QuickStart Training Package (Option 2F) – Includes QuickStart training manual and multiple signal source board with battery.

ORDERING INFORMATION

2224 60 MHz Dual Time Base Digital + Analog Oscilloscope ☎**$4,495**
Includes:
Two 10X Voltage Probes (P6109
Opt. 01) Operator's Manual
(070-7624-00)
User's Ref. Guide (070-7627 00)
Front Panel Cover (200-2520-00)
Accessory Pouch (016-0677-02)
3 Year Warranty
Power Cord

INSTRUMENT OPTIONS

Opt. 10 – GPIB Interface **+$300**
Opt. 12 – RS-232-C Interface (w/ cable) **+$300**
Opt. 2F – Quickstart Training Pkg. **+$199**
(See page 361 in the Education section for information on the QuickStart packages)

ACCESSORY OPTIONS

Opt. 1C – C-5C Opt. 02 Camera **+$500**
Opt. 1K – K212 Instrument Cart **+$380**
Opt. 1P – HC100 Plotter **+$990**
w/ GPIB Cable (requires Opt. 10)
Opt. 3P – HC100 Plotter **+$895**
w/ RS-232-C Cable (req. Opt. 12)
Opt. 1T – Transit Carrying Case **+$280**
Opt. 17 – P6408 Logic Probe **+$350**
Opt. 33 – Travel Line Package **+$295**

INTERNATIONAL POWER-PLUG OPTIONS

Opt. A1-A5 – Available **NC**
(See page 142 for descriptions.)

***WARRANTY-PLUS* SERVICE PLANS**

Opt. M2 – +2 years service **+$245**
Opt. M3 – +2 years service & 4 cals **+$700**
Opt. M4 – +5 calibrations **+$550**
Opt. M5 – +2 years service & 9 cals **+$1,240**
Opt. M7 – +2 calibrations **+$240**
Opt. M8 – +4 calibrations **+$480**

RECOMMENDED ACCESSORIES/ FIELD KITS

Service Manual – (070-7625-00) **$25**
2224 F10 – GPIB Field Upgrade Kit **$350**
2224 F12 – RS-232-C Field Upgrade Kit **$350**
GPIB Cable, 2 m – (012-0991-00) **$160**
Rackmount Kit – (016-1003-00) **$155**
(See page 142 for more accessories.)

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	360	14.
Height	137	5.4
Depth	440	17.3
Weight	**kg**	**lbs.**
Net	8.2	18.0

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

NEW

2221 *100 MHz – 20 MS/s DIGITAL PLUS ANALOG OSCILLOSCOPE*

Full Analog/Digital Bandwidth Performance with Proprietary Peak Detection Features.

- *100 MHz Bandwidth in Both Digital Storage and Analog Modes*
- *Single Time Base*
- *20 MS/s Sampling Speed*
- *100 ns Glitch Capture at Any Sweep Speed*
- *Cursors for Time and Voltage Measurements*
- *On-Screen Readout*
- *Multiple Acquisition Modes Selectable from the Front Panel*
- *4K Record Length*
- *GPIB or RS-232-C Communications Options*

100 MHZ ANALOG/DIGITAL PERFORMANCE

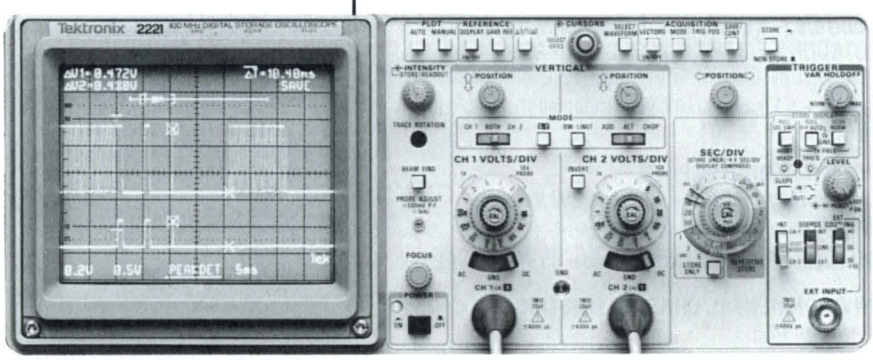
The two channel, 100 MHz Tek 2221 digital storage oscilloscope sets new standards for ease of use and performance for its price. Powerful 20 MS/s digitizing is combined with familiar, full-bandwidth analog operation for a range of general purpose applications.

Now, you can not only capture and view transient events, you can also store waveforms into 4K records and recall them later for analysis or comparison with newly acquired waveforms. The 1K display window allows you to define any portion of the 2221's digital record for review. Stored waveforms can be expanded horizontally (X10) and vertically (up to X10) for detailed analysis.

Cursors and CRT readout deliver simultaneous voltage and timing measurements for faster, more accurate waveform analysis.

100 NS GLITCH CAPTURE

The 2221's peak detect mode lets you catch signal extremes or glitches between sample points as narrow as 100 ns, even at the slowest sweep speeds. In addition, the 2221's accumulated peak detect mode lets you analyze such extremes in signal variations or drift over time.



With high bandwidth digital storage and proprietary peak detect capabilities, the 2221 oscilloscope is ideally suited for general-purpose and troubleshooting applications.

GPIB IEEE-488 *

**The 2221 oscilloscope complies with IEEE Standard 488.1-1987 with Option 10, RS-232C with Option 12, and Tektronix Standard Codes and Formats*

CHARACTERISTICS

DIGITAL STORAGE SYSTEM

Sample Rate – 20 MS/s max; 10 MS/s dual channel. Effective sample rates up to 2 GS/s in repetitive storage mode (2ms/div and faster).

Resolution – Vertical: 8 bits (25 levels per division), 10 bits with average mode. Horizontal: 10 bits (100 points per division). 9 bits per channel in dual channel mode.

Record Length – 4K. 2K per channel in dual channel.

Pre/Post Trigger – 1/8, 1/2, or 7/8 trigger position selectable.

Acquisition Modes – Peak Detect (100ns glitch capture at all available sweep speeds); Accumulated Peak Detect; Average; Sample.

Save Reference Memory – One 4K acquisition.

VERTICAL SYSTEM (2 Identical Channels)

Bandwidth (3 dB) and Rise Time – 100 MHz and 3.5 ns (0°C to 35°C); 80MHz and 4.4 ns (2 mV/div or 35°C to 50°C).

Deflection Factor and Accuracy – 2mV/div to 5 V/div ±2% (15°C to 35°C); 3% (0°C to 50°C).

Vertical Operating Modes – CH 1, CH2, CH 2 INVERT, ADD, ALT, CHOP (500 kHz), and XY.

CMRR – At least 10:1 at 50 MHz.

Input R and C – 1 MΩ, 20pF.

Max Input Voltage – 400 V (dc peak ac). 800 V p-p.

Channel Isolation – 100:1 at 50 MHz.

HORIZONTAL SYSTEM

Sweep Speeds – 0.5 s/div to 0.05 µs/div, extended to 5 ns/div with X10 Mag. 5s/div to 0.05µs/div in store mode (5 ns/div with X10 mag).

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 – X1, X10, 4K COMPRESS.

TRIGGER SYSTEM

Trigger Sensitivity – Internal: 0.35 div at 10 MHz, 1.5 div at 100 MHz. External: 40 mV at 10 MHz, 150 mV at 100 MHz.

Trigger Operating Modes – Peak-Peak AUTO (also for TV LINE), NORM, TV FIELD, SGL SWP.

Trigger Source – VERT MODE, CH 1, CH 2, LINE, EXT.

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).

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. Δ Time: ±1display interval (5 s/div to 5µs/div); ±2 display intervals +500 ps] (2 µs/div to 0.05µs/div).

X-Y Plotter Output – Plots all displayed waveforms, CRT readout, and graticule (selectable).

External Clock Input – dc to 1 kHz.

CRT SYSTEM

Display – 8 cm 10 cm, 14 kV nominal voltage.

Controls – INTENSITY, TRACE ROTATION, BEAM FIND, FOCUS, STORAGE/READOUT INTENSITY.

Z-Axis – 5 V causes noticeable modulation. Usable to 10 MHz.

POWER REQUIREMENTS

Line Voltage Range – 90 Vac to 250Vac.

Line Frequency – 48 Hz to 440 Hz.

Maximum Power Consumption – 85W (150 VA).

ENVIRONMENTAL CHARACTERISTICS

(See Page 142)

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

100 MHz, 20 MS/s DIGITAL PLUS ANALOG OSCILLOSCOPE

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	360	14.2
Height	137	5.4
Depth	440	17.3
Weight	**kg.**	**lbs.**
Net	8.2	18

OTHER CHARACTERISTICS

Safety – UL 1244 listed, CSA certification.

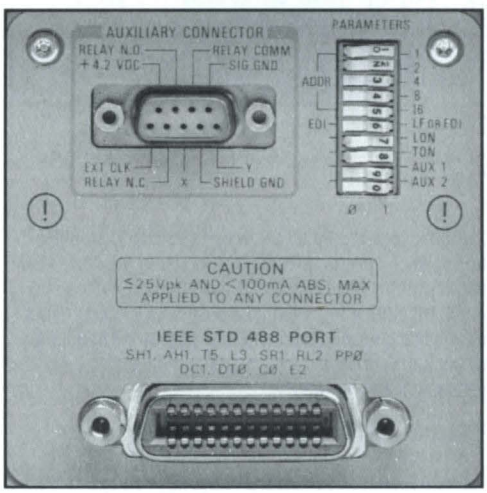
Warranty – 3 years.

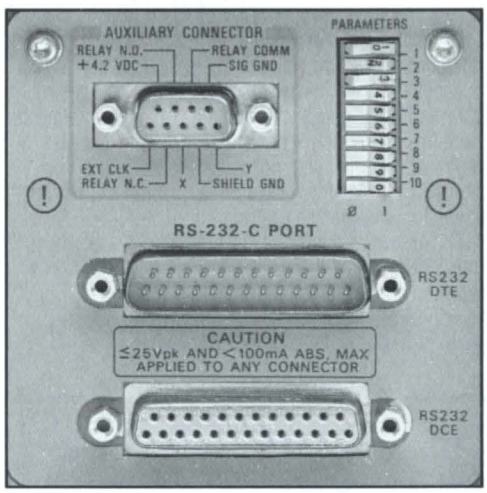
INSTRUMENT OPTIONS

ANSI/IEEE-488 GPIB Interface (Option 10) – Function Subsets Implemented: SH1, AH1, T5, L3, SR1, RL2, PP0, DC1, DT0, C0, E2. Plotter Devices: HP-GL, Epson FX-series, HP ThinkJet. Data Transfer Rate: approx. 1 K bytes/s.

EIA Std RS-232-C Interface (Option 12) – Baud Rate: 50 to 2400 for interactive use, up to 4800 for driving plotters. Plotter Devices: HP-GL, Epson FX-Series, HP ThinkJet. Connectors: DCE (female), DTE (male).

2232/2224/2221 INTERFACE OPTIONS AND SOFTWARE





OPTION 10 – ANSI/IEEE GPIB INTERFACE

Option 10 allows you to transmit and receive waveform data from the 2232, 2224, and 2221 scopes 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, you can send messages or completed results to the scope for display on-screen.

Switches on the oscilloscope side panel allow you to select primary address (0-30), message terminator (EOI or LF/EOI), or talk/listen mode. You can also program maskable interrupts for RQS and OPC.

In addition to complying with the IEEE standard 488.1-1987, Option 10 means that the 2232, 2224, and 2221 oscilloscopes comply with and use Tektronix standard codes and formats.

OPTION 12 – RS-232-C INTERFACE

With Option 12, the scopes provide the standard RS-232-C interface and use an extension of Tektronix standard codes and formats. In addition, Option 12 provides all the functions described above for Option 10

The Option 12 interface has both DCE and DTE connectors. You select baud rate (50-4800), parity (odd, even, mark, space, or none), line termination (CR or CR-LF), and SRQ generation on parity error (on or off) from switches located on the oscilloscope side panel. You can also change the number of bits per character (7 or 8), the number of stop bits (1 or 2), and the CTRL-S/CTRL-Q handshaking, all remotely. The interface automatically senses the presence of Clear To Send (CTS)/Request to Send (RTS) or Data Set Ready (DSR)/Data Terminal Ready (DTR) handshaking lines.

INTEGRATED SOFTWARE PACKAGES

A variety of software packages are available from Tektronix for use with the 2232, 2224, and 2221 scopes. These include waveform acquisition and signal analysis packages. For remote acquisition and waveform transfer, Tek offers the new integrated TeleServicing Software Package. For advanced signal processing, several packages are available, including GURU II, (GPIB Users Resource Utility), SPD (Signal Processing and Display), and ASYST Drivers. For more information on utility and application software, see the Test and Measurement Software Section of this catalog.

PRINTER/PLOTTER CONNECTION

The 2232, 2224, and 2221 all have a standard X-Y analog plotter port available. In addition, when equipped with either Option 10 or 12, the scope can be tied directly to a compatible printer or plotter. Drivers supported include HPGL digital plotters, any Epson FX-Series serial printer, or the HP Thinkjet 2225D. Both interfaces also support the Tektronix HC100 plotter (equipped with appropriate interface option) for single color documentation.

ORDERING INFORMATION

2221 100 MHz Digital + Analog Oscilloscope ☎ **$3,495**
Includes:
Two 10X Voltage Probes (P6109
Opt. 01) Operators Manual
(070-6530-00) Reference Guide
(070-6532-01)
Front Panel Cover (200-2520-00)
Accessory Pouch (016-0677-02)
3 year warranty
Power Cord

INSTRUMENT OPTIONS

Opt. 10 – GPIB Interface **+$300**
Opt. 12 – RS-232-C Interface (w/ cable) **+$300**

ACCESSORY OPTIONS

Opt. 1C – C-5C Opt. 04 Camera **+$530**
Opt. 1K – K212 Instrument Cart **+$380**
Opt. 1P – HC100 Plotter **+$990**
w/GPIB Cable (requires Opt. 10)
Opt. 3P – HC100 Plotter **+$895**
w/RS-232-C Cable (req. Opt. 12)
Opt. 1T – Transit Carrying Case **+$280**
Opt. 17 – P6408 Logic Probe **+$350**
Opt. 33 – Travel Line Package **+$295**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – A5 Available **NC**
(See page 142 for descriptions.)

***WARRANTY-PLUS* SERVICE PLANS**

Opt. M2 – +2 years service **+$318**
Opt. M3 – +2 yrs service & 4 cals **+$776**
Opt. M4 – +5 calibrations **+$537**
Opt. M5 – +2 yrs service & 9 cals **+$1,279**
Opt. M7 – +2 calibrations **+$229**
Opt. M8 – +4 calibrations **+$457**

RECOMMENDED ACCESSORIES/ FIELD KITS

Service Manual – (070-6531-00) **$25**
2221 F10 – GPIB Field UpgradeKit **$350**
2221 F12 – RS-232-C Field UpgradeKit **$350**
GPIB Cable, 2 m – (012-0991-00) **$160**
Rackmount Kit – (016-1003-00) **$155**
(See page 142 for more accessories.)

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.

NEW

2211 *50 MHz, 20 MS/s DIGITAL PLUS ANALOG OSCILLOSCOPE*

Low Cost 50 MHz Oscilloscope with CRT Readout, Cursors and Hardcopy Interface.

- *50 MHz Analog Bandwidth*
- *20 MS/s Per Channel Sampling*
- *8-Bit Vertical Resolution*
- *50s/div to 20 µs/div Time Base Range (Storage)*
- *.5 s/div to 5 ns/div Time Base Range (Non-Storage)*
- *500 µV/div Vertical Sensitivity*
- *4K Per Channel Record Length*
- *CRT Readout, Including Trigger Level Voltage*
- *Cursors Operate in Storage and Non-Storage Modes*
- *Hardcopy Out Interface (RS-232-C)*
- *External Clock Inputs from dc to 10 MHz*

NEW CONVENIENCE

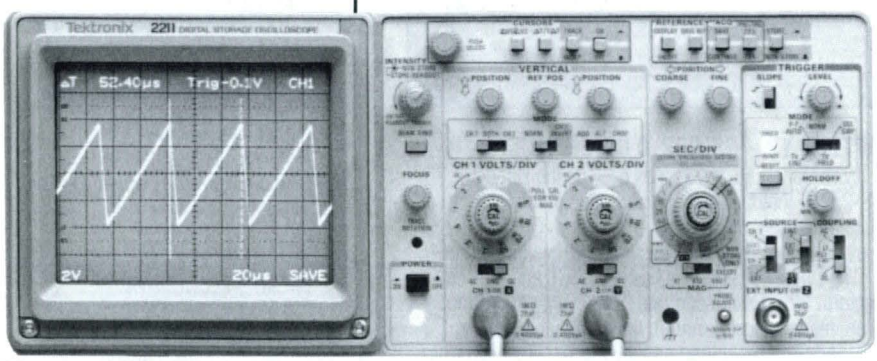
Tek's new 2211 brings you all the features of the popular 2210, plus crt readout, on-screen cursors, and an RS-232-C hardcopy output interface. As a result, you have an oscilloscope that makes digital measurements versatile and easy without giving up the familiarity of analog operation.

IMPRESSIVE DISPLAY FEATURES

The 2211's ctr readout provides scale factors, cursor measurements, and trigger level voltage directly on screen. This is especially useful for precision measurements, documentation or single-shot waveform capture. For example, you can trigger on a pre-determined voltage spike, store the waveform and see pre-trigger events while babysitting a process control application.

By automatically calculating time and voltage differentials, waveform cursors increase accuracy and repeatabiltiy. You'll view calculated values on-screen, along with front-panel scale factors. Time measurements made in store mode are particularly accurate, because they're waveform-based, not screen-based. Plus, you can use horizontal magnification to position a cursor off-screen for ultra-precise analysis.

The 4K per-channel record length provides excellent timing resolution plus analog-like displays. Waveforms appear in crisp detail on the scope's bright, full-size crt. And horizontal magnification of X1, X10 or X50 lets you expand waveforms for detailed examination.

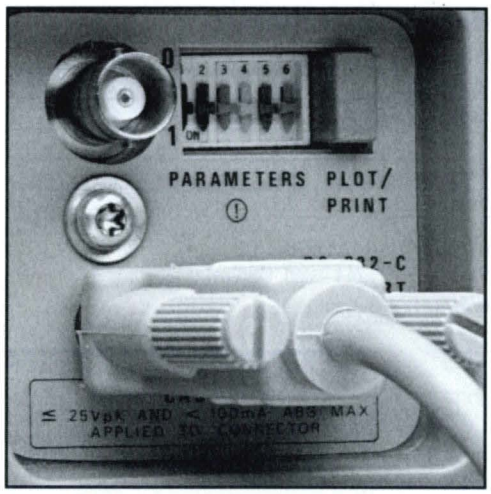


The 2211 is ideally suited for applications such as physical measurements, production testing process control, service, or repair.

PREMIUM SPECIFICATIONS

In addition to quality display features, the 2211 provides 50 MHz analog bandwidth, two-channel sampling at 20 MS/s per channel, 8-bit vertical resolution, excellent vertical sensitivity and 4K record length per channel. Since the 2211 has dual digitizers, you don't sacrifice sampling speed or record length in two channel measurements.

With the 500 µV vertical sensitivity you can evalutate low-level signals which cannot be seen with less sensitive oscilloscopes. For difficult measurements, the enhanced trigger and 8:1 holdoff features make it easy to display almost any signal.



The RS-232-C Printer/Plotter Interface is simple to connect. Output is obtained at the push of a button.

A time base multiplier allows you to extend 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

An RS-232-C hardcopy output serial interface is standard on the 2211. With an EPSON or HPGL compatible printer or plotter, such as the TEK HC100, you can quickly generate 4-color hardcopy documentation – simply by pushing a button.

Plus, Tek's GRABBER software lets you transfer waveform data from the scope 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 or printed for documentation. By using a word processor which accepts HPGL files you can even import stored waveforms to your documents. No complex communication protocols or cabling are required.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

50 MHz, 20 MS/s DIGITAL PLUS ANALOG OSCILLOSCOPE

2211 NEW

CHARACTERISTICS

DIGITAL STORAGE SYSTEM

Sample Rate – 20 MS/s max. per channel.

Resolution – Vertical: 8 bits (25 levels per division). Horizontal: 12 bits (400 points per division).

Record Length – 4K per channel.

Pre/Post Trigger – 25% or 75% trigger position selectable.

Acquisition Mode – Sample

Save Reference Memory – One acquisition (4K/CH).

VERTICAL SYSTEM

(2 Identical Channels)

Bandwidth (-3dB) and Rise Time – 50 MHz and 7.0 ns (+5°C to +35°C); 40 MHz and 8.8 ns (0°C to +40°C).

Deflection Factor and Accuracy – 5 mV/div to 5V/div, ±3%. 500 µV/div, ±5% with X10 vertical mag.

Vertical Operating Modes – CH 1, CH 2, CH 2 INVERT, ADD, ALT, CHOP (500 kHz), X10 vertical mag.

CMRR – At least 10:1 at 20 MHz.

Input R and C – 1 M Ω, 25 pF.

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 – X1, X10, X50, X-Y.

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 – ac, dc, HF REJ, (attenuates above 30 kHz), LF REJ (attenuates below 30 kHz).

Variable Holdoff – At least 8:1.

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 150 kHz.

ADVANCED FUNCTIONS

Cursor Function and Accuracy – ΔVolts: ±3% of reading. ΔTime: ±4% (unmagnified, 15°C to 35°C); ±5% (unmagnified, 0°C to 40°C).

External Clock Input – dc to 10 MHz.

Hardcopy Interface (RS-232-C) – Plots all 4K records (X1 MAG), CRT readout and graticule (selectable). Baud rate: 300 to 9600. Plotter Devices: HP-GL, Epson FX-Series. Connector: 9-pin DTE (male).

Communication Software (Grabber) – Comes with the instrument and transfers waveform data from the 2211 or 2201 to an IBM PC/XT/AT (or compatible). Uses the RS-232-C 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 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 – 85 W (95 VA).

Environmental Characteristics

(See Page 142)

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width (with handle)	380	15
Height	138	5.4
Depth (without front cover)	440	17.3
Weight	**kg**	**lb**
Shipping	7.6	16.8

OTHER CHARACTERISTICS

Safety – UL 1244 listed, CSA certification

Warranty – 3 years

ORDERING INFORMATION

2211 50 MHz Digital Plus Analog Oscilloscope ☎ **$2,495**
Includes:
Two 10X Voltage Probes (P6109 Opt. 01), Operators Manual (070-7233-00),
Users Ref. Manual (070-7235-00),
9-pin to 25-pin RS-232-C Serial, Interface Printer/Plotter Cable,
GRABBER software,
3 Year Warranty,
Power Cord

INSTRUMENT OPTIONS

Opt. 1R – Rackmount Kit **+$160**
Opt. 1V – Operators Videotape **+$30**
Opt. 2F – Quickstart Pkg. (US) **+$199**
Opt. 3F – Quickstart Pkg (Intl.) **+$199**
(See page 361 in education section for information on Quick Start Packages.)

ACCESSORY OPTIONS

Opt. 1C – C-5C Opt. 04 Camera **+$530**
Opt. 1K – K212 Instrument Cart **+$380**
Opt. 1P – HC 100 Plotter (120V) **+$895**
Opt. 1T – Transit Carrying Case **+$280**
Opt. 02 – Pouch and Front Cover **+$55**
Opt. 17 – P6408 Logic Probe **+$350**
Opt. 23 – Add 2 P6062B 1X/10X Probes **+$380**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A-1- A-5 – Available **NC**
See page 142 for description.

WARRANTY-PLUS **SERVICE PLANS**

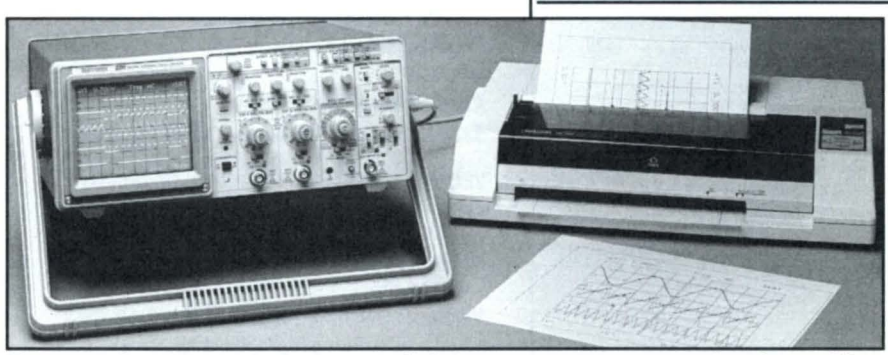
Opt. M2 – +2 years service **+$275**
Opt. M3 – +2 yrs service & 4 cals **+$460**
Opt. M4 – +5 calibrations **+$215**
Opt. M5 – +2 yrs service & 9 cals **+$660**
Opt. M7 – +2 calibrations **+$90**
Opt. M8 – +4 calibrations **+$185**

RECOMMENDED ACCESSORIES/ FIELD KITS

Service Manual –
Order 070-7234-00 **$25**
RS-232-C Interface Cable –
Order 012-1298-00 **$35**
Rackmount Kit –
Order 068-1023-00 *1
(See page 142 for more accessories.)

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

*1 *Contact your local sales representative.*



For convenient documentation you can link the 2211 or 2201 to a 4-color plotter, (like the HC100), to print the waveform record.

2201 *20 MHz, 10MS/s DIGITAL PLUS ANALOG OSCILLOSCOPE*

Here's Digital Storage and Analog Familiarity Plus Documentation at an Affordable Price.

- *20 MHz Analog Bandwidth*
- *10 MS/s Per Channel Sampling*
- *8-bit Vertical Resolution*
- *2K per Channel Record Length*
- *50 s/div to 20 µs/div Time Base Range, (Storage)*
- *0.5 s/div to 10 ns/div, Time Base Range (Non-Storage)*
- *Record/Scan Display Modes*
- *Post/Mid-Trigger*
- *Hardcopy Out Interface Option (RS-232-C)*

ORDERING INFORMATION

2201 20 MHz Digital Plus Analog Oscilloscope ☎ **$1,495**
Includes:
Two 10X Voltage Probes (P6103);
Operators Manual (070-7190-00);
Users Ref. Guide (070-7232-00);
3 Year Warranty; Power Cord.

INSTRUMENT OPTIONS

Opt. 1R – Rackmount Kit **+$160**
Opt. 2V – Training Package **+$60**
Opt. 12 – RS-232-C Output interface (w/GRABBER Software & cable) **+$300**

ACCESSORY OPTIONS

Opt. 1C – C-5C Opt. 04 Camera **+$530**
Opt. 1K – K212 Instrument Cart **+$380**
Opt. 1T – Transit Carrying Case **+$280**
Opt. 02 – Pouch and Front Cover **+$55**
Opt. 23 – Add 2 P6119 1X/10X probes *2

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 - A5 – Available **NC**
(See page 142 for description.)

***WARRANTY-PLUS* SERVICE OPTIONS**

Opt. M2 – +2 years service **+$156**
Opt. M3 – +2 yrs service & 4 cals. **+$340**
Opt. M4 – +5 calibrations **+$215**
Opt. M5 – +2 yrs service & 9 cals. **+$541**
Opt. M7 – +2 calibrations **+$92**
Opt. M8 – +4 calibrations **+$184**

RECOMMENDED ACCESSORIES/ FIELD KITS

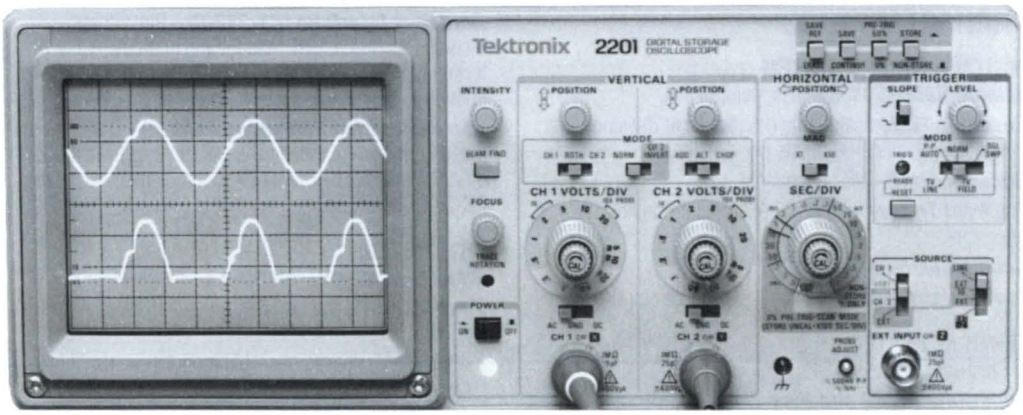
Service Manual – Order (070-7189-00) **$26**
Rackmount Kit – Order (016-0819-00) *2
Self-Study Package Video*1 – Order (068-0290-XX) **$60**
See page 383 for more accessories.

*1 *See the education section page 361 for more information.*
*2 *Contact your local sales representative.*

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width (with handle)	380	15
Height	138	5.4
Depth (without front cover)	440	17.3
Weight	**kg**	**lb**
Shipping	7.6	16.8

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.



The 2201 provides the power of digital storage, the familiarity of analog operation, and the affordability of Tek's lowest priced DSO.

CAPTURE AND VIEW SINGLE-SHOT EVENTS

Select storage or non-storage at the push of a button. In 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 pre-trigger, up to 50% of the display can be reserved for events leading up to a trigger point making it easy to identify trigger conditions.

POWERFUL FEATURES FOR THE NOVICE OR EXPERT

Use the 2201's save reference memory to compare newly acquired signals against a previous acquisition. With the optional hardcopy interface, send your results to a printer for convenient hardcopy documentation. A full-size, bright crt, sensitive 5 mV vertical deflection and fast 10 ns/div sweep capability make the 2201 the right choice for a wide variety of applications. It's ideal for first-time users and seasoned operators alike.

CHARACTERISTICS

DIGITAL STORAGE SYSTEM

Sample Rate – 10 MS/s max. per channel.
Resolution – Vertical: 8 bits (25 levels per division). Horizontal: 11bits (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 4K acquisition.

VERTICAL SYSTEM (2 Identical Channels)

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 M Ω, 25 pF.
Max Input Voltage – 400 V (dc peak ac). 800 V p-p.
Channel Isolation – 100:1 at 10MHz.

HORIZONTAL SYSTEM

Sweep Speeds – 0.5 s/div to 0.1 µs/div, extended to 10 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% (both 15°C to 35°C). X1: ±4%; X10: ±5% (both 0°C to 40°C).
Horizontal Operating Modes – X1, X10, X-Y.

TRIGGER SYSTEM

Trigger Sensitivity – Internal: 0.3div at 5 MHz, 1.0 div at 20MHz. External: 40 mV at 5 MHz, 150 mV at 20 MHz.
Trigger Operating Modes – Peak-Peak AUTO, (also for 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 system.
Phase Difference – ±3° from dc to 50 kHz.

CRT SYSTEM

Display – 8 x 10 cm, 12.6 kV nominal voltage.
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 250Vac.
Line Frequency – 48 Hz to 440 Hz.
Maximum Power Consumption – 70 W (80 VA)

ENVIRONMENTAL CHARACTERISTICS

(See Page 142)

OTHER CHARACTERISTICS

Safety – UL 1244 listed, CSA certification.
Warranty – 3 years.

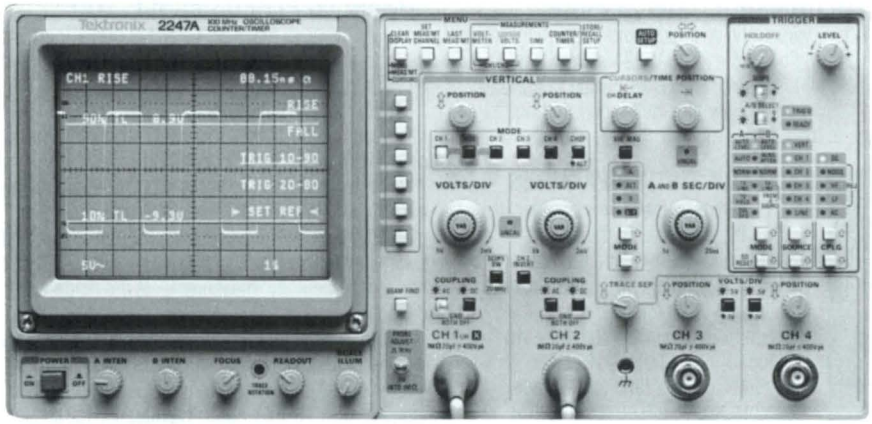
To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.

2247A/2246A 2245A

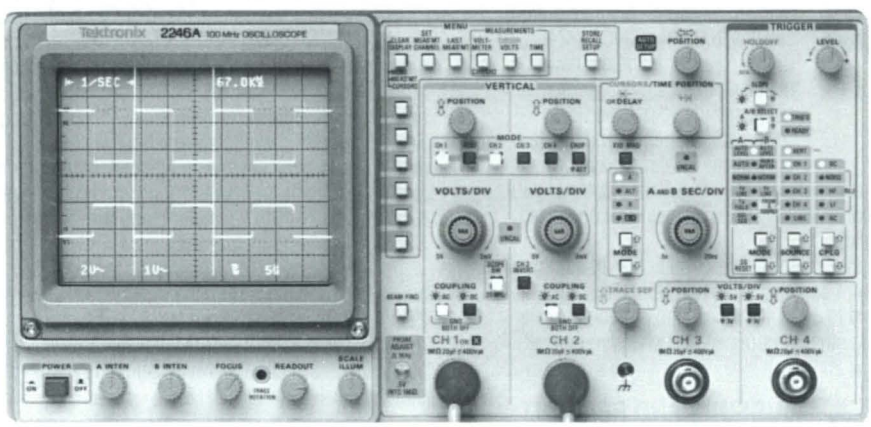
NEW

Smart Scopes with 100 MHz, Four Channels, and Choice of Features like Built-in Voltmeter, Store/Recall of Front Panel Setups and Integrated Counter/Timer.

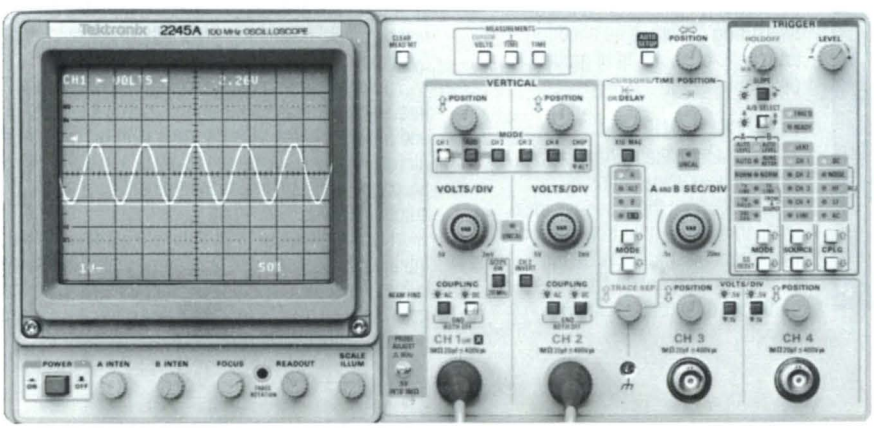
- *Four Independent Channels*
- *Two-Step Auto Setup of Instrument Front Panel*
- *On-Screen Scale Factor Readouts*
- *Dual Time Base with Delayed Sweep*
- *Cursor Time/Voltage Measurements*
- *Pre-Set TV Trigger Slope*
- *Store/Recall of 20 Front Panel Setups (2246A, 2247A Only)*
- *Hands-Off Voltmeter Measurements (2246A, 2247A Only)*
- *SmartCursor™ Track Voltmeter Measurements (2246A, 2247A Only)*
- *Initialized Time Cursors (2246A, 2247A Only)*
- *Delayed Sweep Cursors (2246A, 2247A Only)*
- *Phase Measurements (2247A Only)*
- *Gated Voltmeter Measurements (2246A, 2247A Only)*
- *Integrated Counter/Timer (2247A Only)*
- *Gated Counter Measurements (2247A Only)*
- *Automatic Rise/Fall Time and Propagation Delay Time Measurements (2247A Only)*



NEW 2247A: Packed with time saving automation like full or partial auto setup. Make automatic measurements with the built-in voltmeter and integrated counter/timer. Ideal for service, manufacturing, and design applications where precise time and amplitude measurements are often required



2246A: Highly suitable for work in service, manufacturing, and design where push button measurements and ease of use are important. Make automatic measurements with the built-in voltmeter.



2245A: The best buy for troubleshooting, general repair, and design where cursors with readout are valued. Time and voltage cursors make short work of precise measurements.

Selection Guide

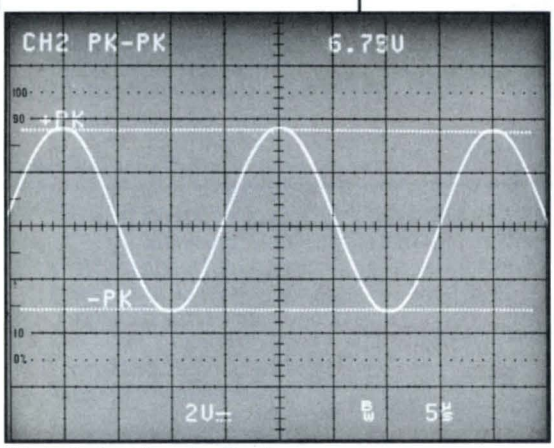
Features	2247A	2246A	2245A
Bandwidth	100 MHz	100 MHz	100 MHz
Channels	4	4	4
Time Base	Dual	Dual	Dual
Scale Factor Readout	Yes	Yes	Yes
Trigger Level Readout	Yes	Yes	No
Auto Setup	Yes	Yes	Yes
Store/Recall	Yes	Yes	No
Time/Volts Cursors	Yes	Yes	Yes
Voltmeter with Smart Cursors™	Yes	Yes	No
Counter/Timer	Yes	No	No
Automatic Measurements	Yes	Yes	No

NEW

2247A/2246A 2245A *100 MHz ANALOG OSCILLOSCOPES*

HIGHER PERFORMANCE, LOWER PRICE

For automation, versatility, accuracy, and performance at a low cost, nothing beats the 2245A, 2246A, and new 2247A portable oscilloscopes. They offer a wide range of features to enhance productivity plus better performance than any scope in their price range.



Make instant hands-off voltage measurements. SmartCursors™ automatically track the signal level you select.

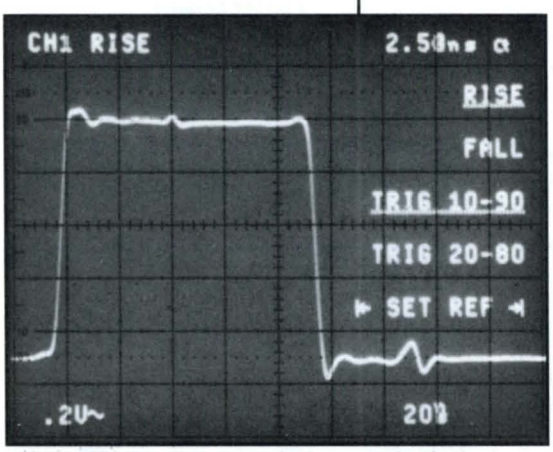
PRODUCTIVITY FEATURES

For starters, these scopes offer 100 MHz bandwidth, the industry standard for today ...and the future. Plus, you get plenty of automation to speed your work on the line, the bench or in the field. You get Auto Setup for perfect displays at the push of a button, time and voltage cursors along with crt readouts for goof-proof measurements and four channels for multiple signals.

AUTO SETUP

Just press a button and you're ready to measure. A single button sets the 100 MHz 2245A, 2246A, or 2247A to acquire and display an unknown input signal. Auto setup automatically adjusts vertical, horizontal, triggering and display controls to display a waveform. In seconds a stable, automatically triggered display of your probed waveform appears on-screen with an optimized front panel setup.

Auto Setup is two step. Press the button to automatically set all front panel controls for optimal display. Press and hold to set only vertical and horizontal scale factors leaving other control settings where you preset them.



Make difficult measurements faster and more accurate. Rise time measurements are made automatically with the integrated counter/timer on the 2247A.

CURSORS AND READOUT

Cursors make time, frequency and voltage measurements pushbutton simple. CRT readout gives you a numerical display of the waveform parameter you are measuring. There is no need for arithmetic or counting of graticule divisions.

FOUR CHANNELS

Four independent channels allow simultaneous observation of signals, making these scopes ideal for high speed digital troubleshooting. Channels 1 and 2 have full sensitivity range while channels 3 and 4 are optimized for logic signals.

ENHANCED PERFORMANCE, TOO.

As if advanced features weren't enough, these scopes incorporate high performance and accuracy that enhance all your design, testing and service tasks.

The 2 ns time base and 100 MHz bandwidth bring out the details on high speed signals, producing measurements with good timing resolution.

Low noise vertical systems produce sharp, bright traces. Low-level signal measurements are easily managed by the 2 mV/div vertical sensitivity and a trigger sensitivity that extends to 150 MHz. With 2% vertical and horizontal accuracy, measurements are made with confidence.

Auto level trigger mode automatically places a stable display of almost any waveform on-screen. Low frequency, high frequency and noise reject modes, together with 10-to-1 holdoff range, deliver stable triggering on complex waveforms. Built-in TV line and field triggering extends measurements to most video related applications.

BUILT-IN VOLTMETER AND STORE/RECALL

Make voltage measurements at the push of a button. The 2246A and 2247A feature a pushbutton activated measurement system which simplifies measurements of +peak, -peak, peak-to-peak, dc and gated volts, all with convenient on-screen readout of values. Tek's unique SmartCursors™ make interpretation even easier. They automatically track changes in voltmeter measurements and visually indicate where ground and trigger levels are located. The built-in voltmeter along with Smart Cursors™ delivers instant answers.

Repetitive testing or servicing is simpler with automated assistance from the impressive 2246A and 2247A. As many as 20 front panel setups can be stored in non-volatile memory for recall when and where they are needed. Switching between setups is easy – just two buttons recall a complete setup.

INTEGRATED COUNTER/TIMER

The new Tek 2247A offers the most complete set of capabilities ever assembled in a low-cost analog scope. Combining an integrated counter/timer and built-in automation, it delivers the crystal controlled accuracy, measurement power and productivity needed for digital systems.

You can measure frequency, period, width, and frequency ratio directly from the 2247A's vertical inputs, and measure gated time intervals with the push of a button. Rise and fall time (10-90% and 20-80%) plus propagation delay time measurements are made automatically.

In fact, with the built-in voltmeter along with the integrated counter/timer, you get at least 11 different automatic voltage and time measurements, plus many gated measurements for closer analysis of a chosen portion of your waveform.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

CHARACTERISTICS

Characteristics are common to the 2245A, 2246A, and 2247A except where noted.*1

VERTICAL SYSTEM (4 channels)

Bandwidth (–3dB) 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 – 1M Ω, 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 Accuracy – ±0.5% + 5% of one div + 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.

2247A 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 and B READOUT INTENSITY, TRACE ROTATION and SCALE ILLUM.

Z-Axis – 3.8 volts causes noticeable modulation. Usable to 10 MHz.

ADVANCED FUNCTIONS

Cursors – Time, 1/Time: ±0.5% +2% of one div; Delta Time, 1/Delta Time, Delta Phase (2247A): ±0.5% +1% of one div; Volts: ±5% +2% of one vertical div.

Voltmeter (2246A and 2247A) – DC Volts: ±(0.5% of reading +2% of one vertical div +250 μV); Plus or Minus Peak Volts: ±(2% of reading + 10% of one div +1.0 mV) and Pk-Pk Volts (25 Hz to 25 MHz): ±(2% of reading +15% of one div +1.5 mV).

Counter/Timer (2247A) – Time Base and Accuracy: 200 MHz and 10 ppm (0.001%). ***Frequency:*** 0.01 Hz to 100 MHz. Max resolution: 0.00000001 MHz. Max accuracy same as time base. ***Period:*** 100 s to 5 ns. Max resolution: 0.1 ps. Max accuracy same as time base. ***Width:*** 100 s to 5 ns. Max resolution: 1 ps. Max accuracy same as time base ±5 ns. ***Totalize:*** 100,000,000 counts. ***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 Timebase 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.

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

(See page 142)

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Height	164	6.4
Width (with handle)	362	14.2
Depth (with front cover)	445	17.5
Weight	**kg**	**lb**
Net	7.9	17.3

OTHER CHARACTERISTICS

Safety – UL 1244 listed, CSA certification.

Warranty – 3 years

INSTRUMENT OPTIONS

Opt. 15 – Ch 2 and A-Gate output

Channel 2 output bandwidth – dc to to 25 MHz; ***deflection factor:*** 10 mV/div into 50Ω, 20 mV/div into 1MΩ; ***dynamic range:*** ±7 divisions;

dc offset: < 0.5 divisions.

A-Gate output level – TTL compatible; ***drive:*** 4 mA (high state), 20 mA (low state).

*1 *Military Versions 22461Y/2R/Mod A available as commercial versions of military products. See page145. Specifications may differ from above, contact your local Tek sales office.*

ORDERING INFORMATION

2247A 100 MHz Oscilloscope with Voltmeter/Counter/Timer ☎ **$2,995**
Includes: Two 1.5 m 10X Voltage probes (P6109 Opt. 01), Oprs. Manual (070-6373-00), Users Ref. Guide (070-6688-00), 3 Year Warranty, Power Cord

2246A 100 MHz Oscilloscope with Voltmeter ☎ **$2,595**
Includes: Two 1.5 m 10X Voltage probes (P6109), Oprs. Manual (070-6556-00), Users Ref. Guide (070-6576-00) 3 year warranty, Power cord

2245A 100 MHz Oscilloscope ☎ **$1,995**
Includes: Two 1.5 m 10X Voltage probes (P6109), Oprs. Manual(070-6558-00), Users Ref. Guide (070-6718-00) 3 Year Warranty, Power Cord

INSTRUMENT OPTIONS

Opt. 1R – Rackmounted Instr. **+$350**
Opt. 15 – CH2 & A Gate Output **+$100**

ACCESSORY OPTIONS

Opt. 02 – Acc. Pouch and Cover **+$50**
Opt. 1C – C-5C Opt. 02 Camera **+$500**
Opt. 1K – K212 Instrument Cart **+$380**
Opt. 1T – Transit Carrying Case **+$280**
Opt. 17 – P6408 Logic Probe **+$350**
Opt. 22 – Add two P6109 Opt. 01 probes **+$126**
Opt. 23 – Add 2 P6062B 1X/10X Probes **+$380**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 - A5 – Available **NC**
(See page 142 for descriptions.)

***WARRANTY-PLUS* SERVICE OPTIONS**

Opt. M2 – 2 years service
2247A **+$194**
2246A **+$187**
2245A **+$176**
Opt. M3 – 2 yrs service & 4 cals
2247A **+$575**
2246A **+$521**
2245A **+$482**
Opt. M4 – 5 calibrations
2247A **+$448**
2246A **+$393**
2245A **+$359**
Opt. M5 – 2 yrs service & 9 cals
2247A **+$995**
2246A **+$889**
2245A **+$817**
Opt. M7 – 2 calibrations
2247A **+$191**
2246A **+$167**
2245A **+$153**
Opt. M8 – 4 calibrations
2247A **+$382**
2246A **+$335**
2245A **+$306**

RECOMMENDED ACCESSORIES/ FIELD KITS

Service Manuals –
2247A (070-6367-00) **$26**
2246A (070-6555-00) **$26**
2245A (070-6557-00) **$30**
Self-Study Package – **$115**
2245A and 2246A *2 (068-0275-XX)
Rackmount Kit – Order 2240F1R **$350**
See page 383 for more accessories.

*2 *See page 361 for additional educational information*

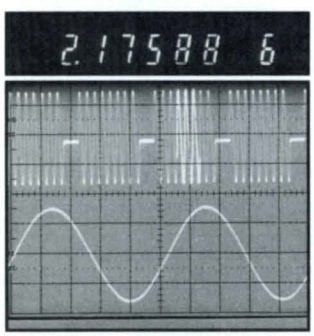
☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200..

The 2235A is the 100 MHz Standard in Advanced Simplicity and Extraordinary Reliability. The 2236A Adds to This Standard the Versatility of a Counter, Timer, and Digital Multimeter.

- *Graticule Illumination*
- *Trigger View*
- *Dual Time Base*
- *HF and LF Reject Trigger Coupling*
- *Delayed Sweep Measurements*
- *Integrated Counter/Timer/ DMM (2236A)*
- *Gated Counter Measurements (2236A)*
- *Delta Time Measurements (2236A)*
- *Full Function DMM–5000 Counts (2236A)*
- *DMM , ac and dc RMS Volts through Channel 1 (2236)*
- *Temperature Measurement Probe (2236 Optional)*

2236A MEASUREMENTS

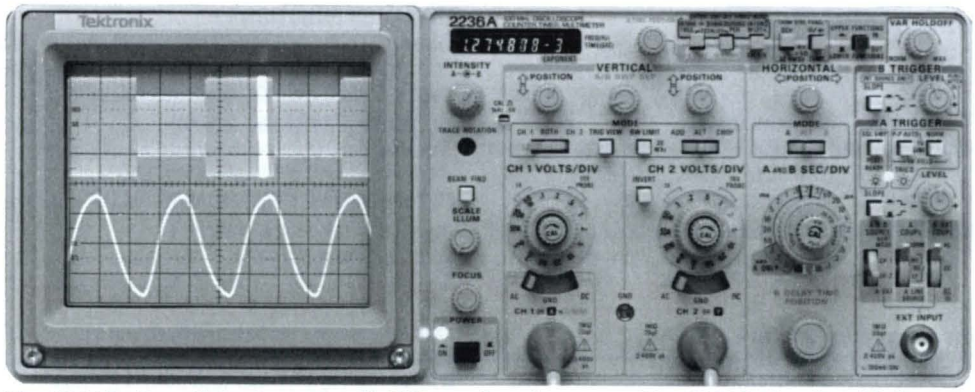
Gated Frequency Measurement



With the B sweep triggered, the frequency within the intensified zone on the A sweep is measured.

Resistance

Extended Range Resistance Measurement using auto-ranged DMM. 0Ω (with 0.01Ω resolution) to 1.99GΩ, to find hard-to-trace problems like leaky capacitors or defective transformers.



The 2236A offers all the features, reliability, and performance of the 2235A plus the added versatility of a counter/timer and digital multimeter.

PROVEN STANDARD IN 100 MHZ TWO-CHANNEL SCOPES

The 2235A and 2236A offer advanced 100 MHz dual time base performance with simple operation. Innovative, reduced component architecture and advanced circuit design and a large bright crt make these scopes accurate, reliable and serviceable.

The 2235A and 2236A scopes are the industry standard in bandwidth for digital and high speed analog circuit troubleshooting. Both offer the needed sensitivity for reliable low-level signal measurements, plus 5 ns/div sweep speed and 2% vertical and horizontal accuracy for high resolution voltage and timing measurements.

COMPLETE TRIGGERING CONTROL

A convenient trigger view and 10:1 variable holdoff make trigger setup easy. The position-independent trigger system includes peak-to-peak auto, normal, a solid TV field and TV line trigger and single sweep for observing transients and single-shot events. Trigger sources include CH 1, CH 2, external, line and alternate channels.

SCOPE, COUNTER/TIMER, DMM – ONE INTEGRATED SYSTEM

The 2236A adds the power of a total measurement system, featuring a fully integrated counter/timer, and digital multimeter.

You get a digital readout of frequency, period, width, totalized events, delay time and delta time – all with push button ease. Make auto-ranged and auto-averaged counter/timer measurements on the signal triggering the A sweep or, in gated modes, on the signal triggering the B sweep.

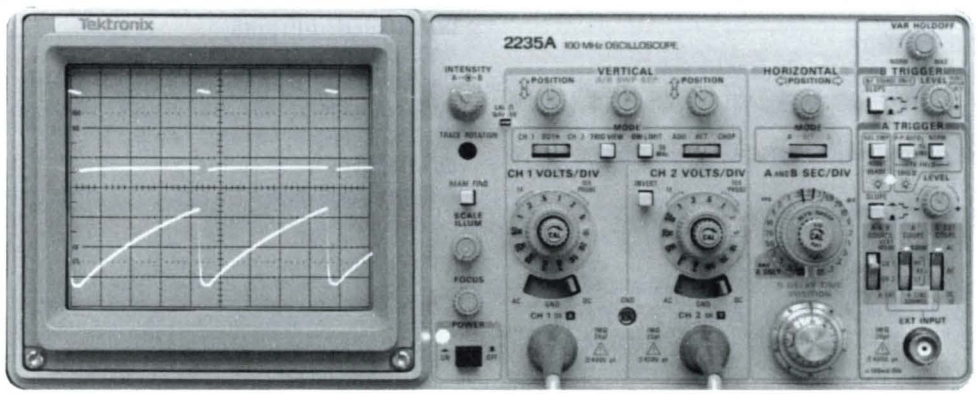
Auto-ranged DMM measurements are made through floating DMM side inputs and up-range at 5000 counts. Plus, you can make dc and ac RMS voltage measurements directly through channel one.

COMPLEX MEASUREMENTS ARE PUSHBUTTON SIMPLE

The 2236A doesn't stop with simple tasks. You'll accomplish gated, delay time, and delta time calculations with impressive speed. Even complex procedures such as automatic diode detection, acquisition time of a disk drive, or tracking shorts between circuit board runs are easily accomplished.

PORTABLE AND EASY TO USE

Both the 2235A and 2236A give you rugged construction, light weight portability, and a front panel designed for easy operation. Finally, two 10X voltage probes and a 3-year warranty (including crt) come standard with both scopes.



The 2235A analog oscilloscope offers superior reliability plus new enhancements such as graticule illumination, trigger conditioning and a probe calibration signal.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.

CHARACTERISITCS

Specifications are common to the 2235A and 2236A except where noted.

VERTICAL SYSTEM

(2 Identical Channels)

Bandwidth (-3 dB) and Rise Time – 100 MHz and 3.5 ns (0°C to 15°C). 90 MHz and 4.4 ns (2 μV/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.

CMRR – At least 10:1 at 50 MHz.

Input R and C – 2235A: 1 MΩ, 20 pF. 2236A: 1 MΩ, 22 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: 0.5 s/div to 0.05 μs/div. B: 50 ms/div to 0.05 μs/div. Both extended to 5 ns/div with X10 magnifier.

Accuracy – ±2%, Magnified ±3% (degrade by 1% outside +15°C to +35°C).

Horizontal Operating Modes – A, ALT and B.

Delay Jitter – 2235A: 20,000:1. 2236A: 10,000:1.

Delay Accuracy – 2235A: ±1%. 2236A: Same as counter/timer time base ±20 ps.

TRIGGER SYSTEM

Trigger Sensitivity (A and B) – Internal: 0.35 div at 10 MHz, 1.5 div at 100 MHz. External: 35 mV (2235A) or 40 mV (2236A) at 10 MHz, 200 mV (2235A) or 250 mV (2236A) at 100 MHz (A trigger only).

2236A Counter Sensitivity (A and B Trigger) – Internal: 0.5 div at 10 MHz, 2.0 div at 100 MHz. External: 50mV at 10 MHz, 300 mV at 100 MHz (A trigger only).

Trigger Operating Modes – Peak-Peak AUTO (also for TV LINE), NORM, TV FIELD, SGL SWP.

Trigger Source – A Trigger: VERT MODE, CH 1, CH 2, LINE, EXT. 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; HF and LF Rej. with external source: ac, dc, or dc/10.

Variable Holdoff – At least 10:1.

X-Y OPERATION

Deflection Factors – Same as vertical system.

Bandwidth – X-Axis: 3 MHz. Y-Axis: same as vertical system.

Phase Difference – ±3° from dc to 150 kHz.

CRT SYSTEM

Display – 8 cm x 10 cm, 14 kV nominal voltage.

Controls – A INTENSITY, B INTENSITY, TRACE ROTATION, BEAM FIND, SCALE ILLUMINATION, FOCUS.

Z-Axis – 5 V causes noticeable modulation, useable to 20 MHz.

POWER REQUIREMENTS

Line Voltage Range – 90 Vac to 250 Vac.

Line Frequency – 48 Hz to 440Hz.

Maximum Power Consumption – 2235A: 40 W (70 VA). 2236A: 60 W (110 VA).

2236A ADVANCED FUNCTIONS

Counter/Timer/DMM – C/T Time Base: 200 MHz, 10 ppm (0.001%); with optional temp. compensated crystal oscillator (TCXO): 0.5 ppm (0.00005%).

Frequency – 0.2 Hz to 100 MHz. Max resolution: 0.00000001 Hz. Max accuracy same as time base.

Period – 5 s to 10 ns. Max resolution: 10 ps.Max accuracy same as time base.

Width – 5 s to 5 ns. Max resolution: 10 ps. Max accuracy same as time base ±10 ns.

Totalize – 8,000,000 cts.

Delay Time – 2.5 s to 500 ns. Max resolution: 10 ps. Max accuracy same as time base ±20 ps.

Delta Time – 1 ns to 2.5 s. Max resolution: 10 ps. Max accuracy same as time base ±50 ps.

Dc Volts – 0 to 500 V. Max resolution: 100 mV. Accuracy ±1%. Input: side DMM leads.

RMS AC Volts – 0 to 350 V (20 Hz to 20 kHz). Max resolution: 100 mV. Accuracy ±1%. Input: side DMM leads.

CH 1 V dc – 0 to 500 V. Max resolution: 1 mV. Accuracy ±5%.

CH 1 V RMS ac – 0 to 350 V (50 Hz to 20 kHz). Max resolution: 1 mV. Accuracy ±2%.

Resistance – 0 to 20 GΩ. Max resolution: 0.01 Ω. Max accuracy 0.15% ±2 LSD's.

Diode Detect – 0.15 V to 2.0 V. Max resolution: 1 mV. Max accuracy 1% ±1 LSD.

Continuity – 0 to 5 Ω. Accuracy ±1 Ω.

Temperature – 62°C to 230°C. Accuracy ±2% ±1.5°C.

ENVIRONMENTAL CHARACTERISTICS

(See page 142)

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width (with handle)	360	14.2
Height	137	5.4
Depth (without front cover)	440	17.3
Weight	**kg**	**lb**
2235A	6.1	13.5
2236A	7.3	16.2

OTHER CHARACTERISTICS

Safety – UL 1244 listed, CSA certification.

Warranty – 3 years

ORDERING INFORMATION

2236A 100 MHz Dual Time Base Oscilloscope with Counter/Timer/Multimeter **$3,195**
Includes:
Two 10X Voltage probes (P6109 Opt. 01), DMM Test Leads (070-4205-00),3 Year Warranty, Power Cord.

2235A 100 MHz Dual Time Base Oscilloscope **$1,795**
Includes:
Two 10X Voltage probes (P6109 Opt. 01), Operators Manual (070-4207-00), 3 Year Warranty, Power Cord.

INSTRUMENT OPTIONS

Opt. 1A – (2236A only) – P6602 Temperature Probe *2
Opt. 14 – (2236A only) – Temperature Compensated Crystal Oscillator 0.5 ppm accuracy **+$315**

ACCESSORY OPTIONS

Opt. 1C – C-5C Opt. 04 Camera **+$530**
Opt. 1K – K212 Instrument Cart **+$380**
Opt. 1T – Transit Carrying Case **+$280**
Opt. 02 – Pouch and Cover **+$55**
Opt. 17 – P6408 Logic Probe **+$350**
Opt. 23 – Add 2 P6119 1X/10X Probes **+$120**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro **NC**
220V, 50 Hz Order 020-0859-00
Opt. A2 – United Kingdom **NC**
240V, 50 Hz Order 020-0861-00
Opt. A3 – Australian **NC**
240V, 50 Hz Order 020-0861-00
Opt. A4 – North American **NC**
240V, 60 Hz Order 020-0862-00
Opt. A5 – Switzerland **NC**
220V, 50 Hz Order 020-0863-00

WARRANTY-PLUS SERVICE OPTIONS

Opt. M2 – 2 years service
2235A *2
2236A *2
Opt. M3 – 2 years service & 4 cals
2235A *2
2236A *2
Opt. M4 – 5 calibrations
2235A *2
2236A *2
Opt. M5 – 2 years service & 9 cals
2235A *2
2236A *2
Opt. M7 – 2 calibrations
2235A *2
2236A *2
Opt. M8 – 4 calibrations
2235A *2
2236A *2

RECOMMENDED ACCESSORIES/ FIELD KITS

Service Manuals –
2235A Order 070-4206-00 **$26**
2236A Order 070-4202-00 *2
Rackmount Kits –
2235A Order 016-1062-00 *2
2236A Order 016-0015-02 *2
Self-Study Packages*1 –
2235 Order 068-0277-xx **$115**
2236 Order 068-0276-xx **$115**
Temperature Compensated Crystal Oscillator (TCXO) Retrofit Kit –
(2236A only) Order 040-1136-00 **$370**
See page 383 for more accessories.

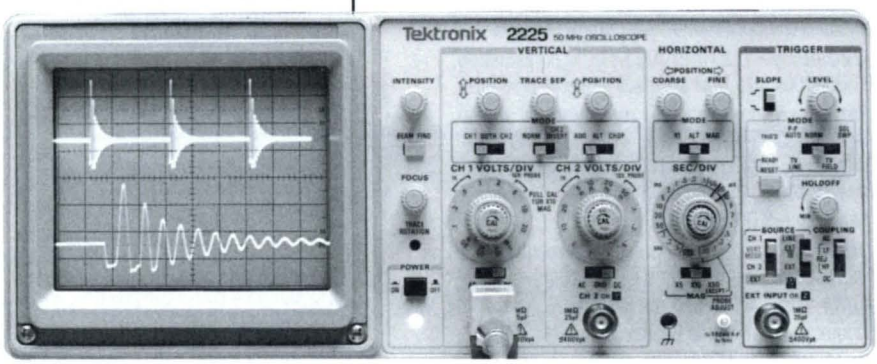
*1 *See the educational section, page 361 for more information.*
*2 *Contact your local sales representative.*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

2225 *50 MHz ANALOG OSCILLOSCOPE*

Real Economy Coupled with Unique Real-Time Performance

- *500 μV/div Vertical Sensitivity*
- *HF/LF Reject Trigger Filters*
- *X5, X10, X50 Magnification*
- *Peak-to-Peak Auto Triggering*
- *Opt. Battery Power Operation*
- *Opt. External ac Operation*



The 2225 offers simplified but precise operation for such applications as field service, design, education, and production test.

HIGH-END FEATURES AND ECONOMICAL

The two-channel, single time base 2225 contains features usually found in more expensive instruments. For example, the new low-noise vertical system operates at 500 mV/div. You also get horizontal alternate sweep magnifications of X5, X10 and X50. These allow you to perform most measurements typically associated with dual time base scopes.

HANDS-FREE TRIGGERING

The 2225 provides the convenience of Tek's "hands-free" triggering, including HF and LF reject trigger filtering, TV line and field triggering. You also get a single-sweep function useful for babysitting signals and waveform photography.

DC OPERATION

Two new 2225 options offer you the choice of battery power, or external dc operation. Option 07, is an internally mounted inverter which permits the 2225 to be powered by external dc sources ranging from 11.8 Vdc to 30 Vdc. The second, Option 30, includes the inverter and the new external, rear mounted 1104 battery pack. This provides up to two hours of operation under battery power. The integrated charger allows operation during the charging cycle. See page 443 for details.

CHARACTERISTICS

VERTICAL SYSTEM (2 Identical Channels)

Bandwidth (-3 dB) and Rise Time – 50 MHz and 7.0 ns (5°C to 35°C); 40 MHz and 8.8 ns (0°C to 40°C).

Deflection Factor and Accuracy – 5 mV/div to 5 V/div, ±3%. 500 μV/div, ±5% with X10 vertical mag.

Vertical Operating Modes – CH 1, CH 2, CH 2 INVERT, ADD, ALT, CHOP, X10 vertical mag.

CMRR – At least 10:1 at 20 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 10MHz.

HORIZONTAL SYSTEM

Sweep Speeds – 0.5 s/div to 0.05μs/div. X5, X10, X50 MAG to a maximum of 5 ns/div.

Accuracy – X1: 3%; X5 & X10: 4%; X50: 5% (all 15°C to 35°C).

Horizontal Operating Modes – X1 (main only), ALT (main sweep and mag sweep), MAG, X-Y.

TRIGGER SYSTEM

Trigger Sensitivity – Internal: 0.3div at 5 MHz, 1.0 div at 50MHz. External: 40 mV at 5 MHz, 150 mV at 50 MHz.

Trigger Operating Modes – Peak-Peak Auto (for TV LINE), NORM, TV FIELD, SGL SWP.

Trigger Source – VERT MODE, CH 1, CH 2, LINE, EXT, EXT/10.

Trigger Coupling – ac, dc, HF REJ (attenuates above 30 kHz), LF REJ (attenuates below 30 kHz).

Variable Holdoff – At least 8:1.

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 150 kHz.

CRT SYSTEM

Display – 8 cm x 10 cm, 12.6 kV nominal voltage.

Controls – INTENSITY, TRACE ROTATION, BEAM FIND, FOCUS.

Z-Axis – 5 V (to 5 MHz) causes noticeable modulation.

POWER REQUIREMENTS

Line Voltage Range – Low: 95 Vac to 128 Vac. High: 185 Vac to 250 Vac.

Opt. 07 – Input Voltage Range 11.8 Vdc to 30 Vdc.

Line Frequency – 48 Hz to 440 Hz.

Maximum Power Consumption – 70 W (80 VA)

ENVIRONMENTAL CHARACTERISTICS

(See page 142)

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width (with handle)	380	15
Height	138	5.4
Depth (without front cover)	440	17.3
Weight	**kg**	**lb**
Net	6.9	15.2

OTHER CHARACTERISTICS

Safety – UL 1244 listed, CSA certification

Warranty – 3 years

EXTERNAL BATTERY OPERATION (OPT. 30) –

Option 07 is not retrofitable.

Operating Time – 2 hours.

Charge Time – Approx. 16 hours.

Protection – Under voltage, reverse polarity and overload. Inverter automatically shuts down when line voltage is connected to the 2225 Opt. 07.

System Weight – 13.5 kg (30 lbs)

Warranty – 3 years (*Opt. 07*); 1 year *(1104)*

2815 OPTOSCOPE

The 2225 is the foundation for a new unique optical oscilloscope used for fiber optic measurements. See pages 374-375 for details.

ORDERING INFORMATION

2225 50 MHz Oscilloscope ☎ **$1,095**
Includes:
2 10X Voltage probes (P6103),
Opr. Manual (070-6298-00),
3 Year Warranty, Power Cord.

INSTRUMENT OPTIONS

Opt. 1R – Rackmount Kit **+$160**
Opt. 1V – Operators Tape **+$60**
Opt. 07 – Internal DC Inverter **+$445**
Opt. 30 – External Battery Power **+$745**
(1104 battery plus Option 07)

ACCESSORY OPTIONS

Opt. 1C – C-5C Opt. 04 Camera **+$530**
Opt. 1K – K212Instrument Cart **+$380**
Opt. 1T – Transit Carrying Case **+$280**
Opt. 02 – Pouch and Panel Cover **+$55**
Opt. 17 – P6408 Logic Probe **+$350**
Opt. 18 – Sub P6122 for P6103 **+$85**
Opt. 23 – Add 2 P6119 1X/10X Probes **+$120**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1- A5 – Available **NC**
See page 142 for description.

***WARRANTY-PLUS* SERVICE PLANS**

Opt. M2 – 2 yrs service **+$126**
Opt. M3 – 2 yrs service & 4 cals **+$338**
Opt. M4 – 5 calibrations **+$249**
Opt. M5 – 2 yrs service & 9 cals **+$571**
Opt. M7 – 2 calibrations **+$106**
Opt. M8 – 4 calibrations **+$212**

RECOMMENDED ACCESSORIES
FIELD KITS

Service Manual – (070-6299-00) **$26**
Self-Study Package *1 – (068-0279-XX) **$115**
Rackmount Kit – (016-0819-00) *2
See page 383 for more accessories.

*1 *See the educational section, page 361 for more information.*
*2 *Contact your local sales representative.*

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

SOLID PERFORMANCE AND TEK QUALITY

The 20 MHz, two channel 2205 is the most basic of the 2200 Series analog scopes, yet it offers Tek 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.

Unlike other scopes in this range you don't have to give up signal quality, trigger stability, or accuracy when using the full bandwidth of the instrument. This is a true 20MHz oscilloscope.

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.

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 300-301 for TestMate TM250 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 (5C to 35C). 15 MHz and 23.3 ns (0°C 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 INVERT, 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 20MHz.

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.

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.

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.

Everything You Need for Basic Scope Measurements to 20 MHz.

- *20 MHz Bandwidth*
- *Peak-to-Peak Auto Triggering*
- *0.3 div Trigger Sensitivity at 5 MHz*
- *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 Tek bench equipment, and you have the perfect combination for field applications, classroom labs, or production test.

CRT SYSTEM

Display – 8 cm 10 cm, 1.8 kV nominal voltage.

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 250Vac.

Line Frequency – 48 Hz to 440 Hz.

Maximum Power Consumption – 40 W (60 VA).

ENVIRONMENTAL CHARACTERISTICS

(See page 142)

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

OTHER CHARACTERISTICS

Safety – UL 1244 listed, CSA certification

Warranty – 1 year; 3 years optional

ORDERING INFORMATION

2205 20 MHz Oscilloscope ☎ **$695**
Includes:
Two 1X test leads (103-0275-00),
Operators Manual (070-6717-00),
1 Year Warranty, Power Cord

INSTRUMENT OPTIONS

Opt. 1R – Rackmount Kit **+$160**
Opt. 2V – Operators Tape *2

ACCESSORY OPTIONS

Opt. 1C – C-5C Opt. 04 Camera **+$530**
Opt. 1K – K212 Instrument Cart **+$380**
Opt. 1T – Transit Carrying Case **+$280**
Opt. 02 – Pouch and Front Cover **+$55**
Opt. 17 – P6408 Logic Probe **+$350**
Opt. 22 – Add 24 1X Lleads **+$60**
Opt. 23 – Add 2 P6119 1X/10X Probes **+$120**
Opt. 24 – Add 2 P6103 X10 Probes **+$80**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 - A5 Available **NC**
See page 142 for descriptions.

WARRANTY-PLUS **SERVICE OPTIONS**

Opt. M1– 2 yrs service & 2 cals **+$207**
Opt. M9 – 2 yrs service **+$124**

RECOMMENDED ACCESSORIES/ FIELD KITS

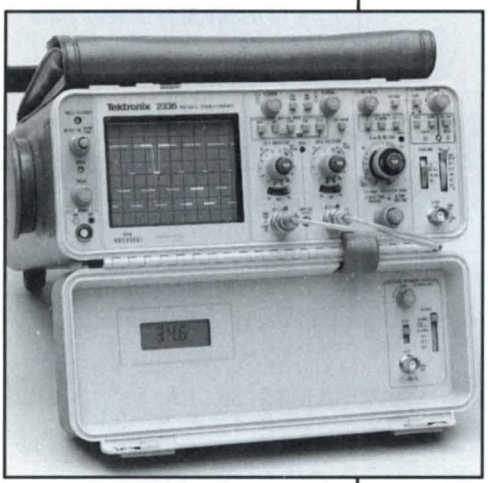
Service Manual – (070-6716-00) **$28**
Rackmount Kit – (016-0819-00) *2
Self Study Package Video *1 – (068-0289-xx) **$115**
See page 383 for more accessories.

*1 *See the educational section, page 361 for more information.*
*2 *Contact your local sales representative.*

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

100 MHz RUGGEDIZED OSCILLOSCOPES

TYPICAL APPLICATIONS
- *Rugged Field Service*
- *Computer Peripheral Service*
- *Communication Equipment Service*



FEATURES
- *DC to 100-MHz Bandwidth*
- *5 mV/Div to 5 V/Div*
- *5 ns/Div Sweep Rate*
- *DMM 2337*
- *Delta Time 2336/2336YA 2337*
- *Elapsed Time Indicator 2336YA*
- *Rackmountable 2335*
- *Three Year Warranty–Five Year Option*
- *UL/ CSA Listed*
- *National Stock Numbers*
- *Single Piece Case*

DESIGNED FOR FIELD SERVICE

The 100 MHz 2300 Series oscilloscopes are the most rugged and durable instruments in their bandwidth. Offering a one-piece case, fliptopcover, scratch resistant front panels, the ability to withstand shocks of 50 g's, and meet the environmental specifications for Class 3 instrumentation as prescribed in MIL-T28800, in an industry standard size make these the ultimate field-service oscilloscopes. The following characteristics are common to the 2335, 2336, 2336YA, and 2337 oscilloscopes except where indicated.

CHARACTERISTICS

VERTICAL SYSTEM (Two Identical Channels)

Bandwidth and Rise Time

-15 to +40C	40 to 55C
dc to 100 MHz, 3.5 ns	dc to 85 MHz, 4.15 ns

Bandwidth Limit – 20 MHz by BW limit switch.

Lower -3 dB Point AC Coupling – 1X Probe: 10 Hz or less. 10X Probe: 1 Hz or less.

Deflection Factor – 5 mV/div. 1-2-5 sequence. Accuracy ±3%. Uncalibrated: Continuously variable between steps and to at least 2 mV/div.

Display Modes – CH 1, CH 2, Add CH 2, Alternate, Chopped (275 kHz rate).

Common-Mode Rejection Ratio: 25:1 at 10 MHz; 10:1 at 100 MHz.

Channel Isolation – 100:1 at 25 MHz.

Input R and C – 2MW paralleled by 20 pF 10.

Maximum Input Voltage – ac or dc coupled, 400 V (dc + peak ac) or 500 V p-p ac at 1 kHz or less.

HORIZONTAL SYSTEM

Time Base A – 0.05 ms/div to 0.5 s/div (1-2-5 sequence). X10 magnifier extends maximum sweep rate to 5 ns/div.

Time Base B – 0.05 ms/div to 50 ms/div (1-2-5 sequence). X10 magnifier extends maximum sweep rate to 5 ns/div.

Variable Time Control – Time base A is continuously variable between steps and to at least 1.25 s/div.

Time Base A and B Accuracy*[1]

	20°C to +30°C	-15°C to +55°C
Unmagnified	+2%	± 3%
Magnified	± 3%	± 4%

[1] Full ten divisions.

Display Modes – A, A intensified by B, B delayed.

CALIBRATED SWEEP DELAY

Delay Time Range – Continuous from 50 ns to at least 5 s after start of delaying sweep.

Jitter – One part or less in 20,000 (0.005%) of 10 times the A Sweep Time/Div setting.

TRIGGERING

Mode – Normal, Automatic, Single Sweep

A and B Trigger Sensitivity

	Internal	External*[2]	External*[2]/10
20 MHz	0.3 div	50 mV	500 mV
100 MHz	1.1 div	150 mV	1.5 V
2336YA @ 150 MHz	1.1 div	300 mV	3 V

[2] External B Trigger sensitivity is not applicable to the 2335.

Trigger Coupling – ac (-3db 20Hz), dc, LF REJ attenuates signals above 50 kHz. B Trigger coupling is ac only.

A Trigger Holdoff – Adjustable control permits stable presentation of repetitive waveforms.

Δ ***Time B Trigger Modes*** – (2336, 2336YA, 2337): Provides two intensified zones on crt trace for differential time measurements. Time difference between two intensified zones determined by B Delay Time Position and Time Position controls, and is displayed on LCD readout.

Runs After Delay – B Sweep starts immediately after the delay time selected by the Delay Time Position control and is independent of B trigger signal.

Triggerable After Adjustable Delay Time – B Sweep Trigger sourced from a composite of CH 1 and CH 2; CH 1 only, CH 2 only or from the Ext Trigger input connector.

Jitter – 2335, 2336, 2337: 1.0 ns or less at 100 MHz. 2336YA: 0.5 ns at 100 MHz.

A Sources – Vertical Mode, CH 1, CH 2, Line, Ext, Ext/10.

B Sources – (2336, 2336YA and 2337 only) DTime runs after delay, Vertical Mode, CH 1, CH 2, Ext (all modes ac coupled).

External Inputs – R and C: 1 MΩ ±10%, 20 pF ±30%. 400 V (dc+peak ac) or 500 V ac p-p at 1 kHz or less.

X-Y OPERATION

Full Sensitivity X-Y (CH 1 Horizontal, CH 2 Vertical) – 5 mV/div to 5 V/div (1-2-5 sequence), accurate ±5% from 0°C to 40°C, accurate ±8 % from 15°C to 55°C.

X-axis band width: dc to 2 MHz.

Y-axis bandwidth: dc to 100 MHz

Phase difference between amplifiers: dc to 200 kHz.

CRT AND DISPLAY FEATURES

CRT – 10 div (8 mm/div) display. Horizontal and vertical center lines further marked in 0.2 div increments. Accelerating potential: 18 kV. GH (P31) phosphor.

Internal, nonparallax, nonilluminated; markings for measurement of rise time.

Beam Finder – Compresses trace to within graticule area to locate an offscreen signal.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

Z-Axis Input – Positive-going, dc coupled signal decreases intensity; 5 V p-p signal causes noticeable modulation at normal intensity; dc to 20 MHz.

OTHER CHARACTERISTICS

Amplitude Calibrator – 0.2 V accurate 1% from 0°C to 40°C.

POWER REQUIREMENTS

Line Voltage Ranges – 100-132 V ac and 200-250 V ac. Option 03: 90-115 V ac or 180-230 V ac.

Line Frequency – 48 to 440 Hz.

Maximum Power Consumption – 35 W at 115 V, 60 Hz.

PHYSICAL CHARACTERISTICS

	2335, 2336, 2336YA, 2337		2335 Option 1R Cabinet	Rackmount
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	274	10.8	483	19.0
Height	210	8.3	133	5.2
Depth	430	17.0	378	14.9
Weight	**kg**	**lb**	**kg**	**lb**
Net (w/acc. & pouch)	12.6	27.8	8.6*1	19.0*1

*1 *No pouch for 2335 Option 1R.*

ENVIRONMENTAL

The 2335 meets environmental capabilities for Class 3, type 3, style D instruments as prescribed in MIL-T-28800C. The 2336, 2336YA and 2337 meet the capabilities for Class 3, Type 3, Style D instruments as prescribed by MIL-T-28800 except as indicated herein to avoid potential damage to the LCD readout.

Temperature (Forced-air ventilation during *normal operation)* – Operating: -15°C to +55°C. Nonoperating: -40°C to+55°C.

Altitude – Operating: 0 to 4,600 m (15,000 ft) Nonoperating: Sea level to 15,000 m (50,000 ft).

Vibration – Test samples subjected to sinusoidal vibration in X, Y, and Z-axes; frequency varied from 10 to 55 to 10 Hz in one minute cycles for 15 minutes. Total displacement: 0.025 in. p-p(4 g's at 55 Hz).

Humidity – Operating and Nonoperating 2335: 95%, five cycles (120 hours), referenced to MIL-T-28800B Paragraph 3.9.2.2.

2336, 2336YA and 2337 – Operating: 90% (72 hours) at +55°C.

2336, 2336YA, 2337 and DMM –Operating: 90% (24 hours) at +35°C and 70% (24 hours) at +50°C.

2336, 2336YA, 2337 and DMM –Nonoperating: 90 (72 hours) at +60°C.

Shock – Operating: 50 g's, 1/2 sine, 11-ms duration, 3 shocks per axis along each major axis. Total of 18 shocks.

Electromagnetic Compatibility (EMC) – Test samples in compliance with the Class 3 requirements of MIL-STD-461B using procedural steps outlined in MIL-STD-462. Increase RS03 requirements from 1 V/m to 10 V/m. For RE01, use 500 Hz to 30 kHz in place of 30 Hz to 30 kHz.

2337 WITH DIGITAL MULTIMETER

The following are unique to the 2337's DMM.

DC VOLTAGE

Ranges – 2, 200, and 500 V (autoranging).

Resolution – 100mV at 200 mV full scale.

Accuracy – Within 0.15% of reading ±1 count.

Response Time – Within 3 s (no autorange); within 9 s (up range); within 7 s (down range).

Input Resistance – 10MΩ ±0.25%.

Rejection Ratio – Normal-Mode: 60 dB min. at 50 and 60 Hz. Common-Mode: 100 dB min. at dc, 60 dB minimum at 50 and 60 Hz.

Maximum Input Voltage – 500 V (dc+peak ac).

AC VOLTAGE

Ranges – 2, 200, and 350 V (autoranging).

Accuracy – Within ±03%, ±6 counts.

Input Impedance – 10 MW paralled by 150pF.

Common-Mode Rejection Ratio – 60 dB min. at 50 and 60 Hz, 2 V range; 53 dB min. at 50 and 60 Hz, 200 V and 350 V ranges.

Response Time – Same as dc.

Maximum Input Voltage – Same as DC.

RESISTANCE

Ranges – 2k Ω, 200k Ω, 2M Ω .

Resolution – 0.1 Ω.

Accuracy – Within ±5%, ±2 counts + 4 Ω.

Response Time – <4 s.

Maximum Input Voltage – Same as dc.

ORDERING INFORMATION

2335 100 MHz Oscilloscopes **$4,450**
Includes: Two P6108A 10X Probes; Accessory Pouch (016-0674-00); Clear CRT Implosion Shield (337-2781-00); Installed, Blue CRT Implosion Shield (337-2760-00); Two 1 A Fuses (159-0022-00); 1/2 A Fuse (159-0025-00) Power Cord (161-0104-00); Operator Manual (070-4115-00).

2336 100 MHz Oscilloscope with Δ Time **$4,850**
Includes: same as 2335 plus operator manual (070-4117-00).

2336YA 100 MHz Oscilloscope with Δ Time & ETI **$5,100**
Includes: same as 2335 plus P6101A Probe; Three Probe Tip Adaptors (103-0051-01); Three Spring Tip Adaptors (206-0060-00); Operator Manual (070-5010-00); Service Manual (070-5011-00).

2337 100 MHz Oscilloscope with Δ Time & DMM **$5,350**
Includes: same as 2335 plus Operator Manual (070-4119-00).

INSTRUMENT OPTIONS

Opt. 03 – 100 V/200 V, ac nominal, 48 to 440 Hz. **NC**

Opt. 1R – (2335 only) Rack Conversion. **+$375**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – A5 – Available **NC**
See page 142 for descriptions.

WARRANTY-PLUS SERVICE PLAN

Opt. M2 – 2 Years Service
(2335) **+$172**
(2336/2336YA) **+$201**
(2337) **+$246**

Opt. M3 – 2 Yrs Service and 4 Cals
(2335) **+$475**
(2336/2336YA) **+$569**
(2337) **+$657**

Opt. M4 – 5 Calibrations
(2335) **+$354**
(2336/2336YA) **+$430**
(2337) **+$482**

Opt. M5 – 9 Calibrations
(2335) **+$806**
(2336/2336YA) **+$970**
(2337) **+$1,109**

OPTIONAL ACCESSORY

Conversion Kit – Rackmount Conversion – 2335 only. Order 016-0468-00. **$485**

RECOMMENDED PROBES

P6022 – Current probe. **$530**
P6062B – 1X/10X probe. **$190**
P6108A – 10X probe. **$90**
P6202A – 10X FET probe. **$780**
A6902B Voltage Isolator – For floating measurements **$2,070**

RECOMMENDED CAMERA

C-5C Option 04 – Includes: 016-0359-01 adaptor and flash. **$530**

RECOMMENDED CART

K212 – For on-site, mobility. **$380**

INTERNATIONAL POWER PLUG OPTIONS

Option	Type	Description	Part Number	Cost	Option	Type	Description	Part Number	Cost
Opt. A1	Universal Europe	220V, 50 Hz	(020-0859-00)	NC	Opt. A4	North American	240V, 60 Hz	(020-0862-00)	NC
Opt. A2	United Kingdom	240V, 50 Hz	(020-0861-00)	NC	Opt. A5	Switzerland	220V, 50 Hz	(020-0863-00)	NC
Opt. A3	Australian	240V, 50 Hz	(020-0861-00)	NC					

2200 SERIES 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.

Oscilloscope Model	2232 2224	2221	2211 2201	2247A 2246A 2245A	2235A	2236A	2225	2205
Ambient Temp								
Operating	0°C to +50°C	0°C to +50°C	0°C to +40°C	-10°C to +55°C	0°C to +50°C	0°C to +50°C	0°C to +40°C	0°C to +40°C
Nonoperating	-40°C to +71°C	-55°C to +75°C	-55°C to +75°C	-51°C to +71°C	-50°C to +75°C	-55°C to +75°C	-55°C to +75°C	-55°C to +75°C
Humidity								
Percent	95% 5 cycles,(120 hours)							90% +40C 4 hours
Reference	MIL-T-28800D, paragraph 4.5.5.1.2.2.					MIL-T-28800C		TEK 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	0.015	0.015	0.025	0.015	0.015	0.015	0.015
Shock								
Operating	30g, 1/2sine, 11ms duration, 3 shocks per axis along each major axis. Total of 18 shocks.							

2200/2300 SERIES RECOMMENDED ACCESSORIES*1

DESCRIPTION	PAGE	ITEM	PRICE (EA)
PROBES			
PASSIVE			
100 MHz, 1X/10X, switchable, w/readout	411	P6062B	$190
100 MHz, 1X/10X, switchable, w/o readout	411	P6119	$60
150 MHz, 10X, ruggedized, w/readout	412	P6109 Opt. 01	$68
100 MHz, 10X, miniature, w/readout	412	P6121	$120
100 MHz, 10X, miniature, w/o readout	412	P6122	$63
50 MHz, 10X, ruggedized, w/o readout	412	P6103	$40
34 MHz, 1X, modular	410	P6101A	$60
CURRENT			
20 Amp max, dc to 50 MHz, w/A6302	425	AM503S	$2,200
100 Amp max, dc to 15 MHz, w/A6303	425	AM503S Opt 03	$2,750
HIGH VOLTAGE			
1.5 kV 100X, 120 MHz	420	P6009	$230
40 kV 1000X, 75 MHz	420	P6015	$780
SPECIALTY			
100 MHz 1X differential probe	418	P6046	$2,000
Temperature probe, 230 degrees C max (2236A only)	430	P6602	$275
Logic probe, 16 channel word recognizer	423	P6408	$350
INTERFACE CABLES			
2221/2224/2232 for GPIB option 10	436	012-0991-00	$160
RS-232 2221/2224/2232 to PC (25 pin)	436	012-0911-00	$100
RS-232 2221/2224/2232 to plotter (25 pin)	436	012-1285-00	$40
RS-232 2201/2211 to plotter (25 pin)	436	012-1298-00	$35
CARTS	399	K212	$380
CAMERAS			
General purpose (2224, 2232, 2245A, 2246A, 2247A)	392	C5C Opt 02	$500
(2201, 2205, 2211, 2221, 2225, 2235A, 2236A, 2815)	392	C5C Opt 04	$530
PRINTERS/PLOTTERS			
2221 Opt 10, 2224 Opt 10, 2232 Opt 10	384	HC100 Opt 01	$990
2221 Opt 12, 2224 Opt 12, 2232 Opt 12, 2201 Opt 12, 2211	384	HC100 Opt 03	$895
2221 Opt 12, 2224 Opt 12, 2232 Opt 12, 2201 Opt 12, 2211	385	HC200 Opt 03	*2

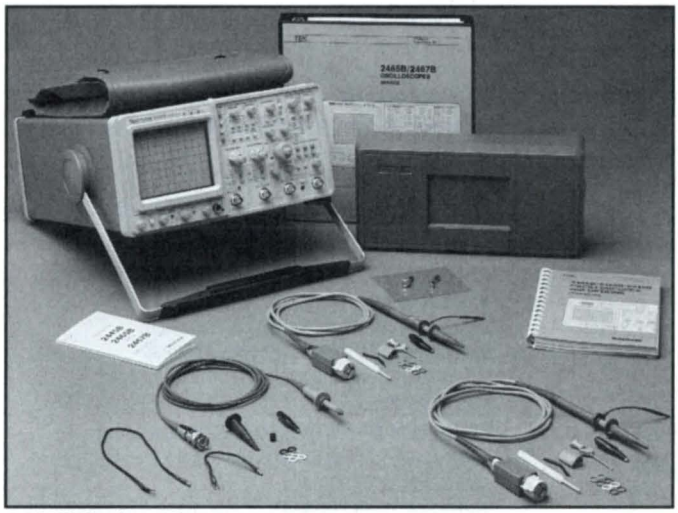
DESCRIPTION	PAGE	ITEM	PRICE
DC POWER			
Battery pack (for 2225 only)	443	1104	$350
Battery pack	443	1106	$2,030
12Vdc to 110 Vac inverter	443	1107	$1,530
Mounting bracket for 1107 to 2221, 2224, 2232, 2235A, 2236A	443	016-0785-00	$60
TRAVEL ACCESSORIES			
Carrying strap	441	346-0199-00	$19.25
Carrying case	441	016-0792-01	$280
Front panel cover 2235A, 2236A	441	200-2520-00	$6
2245A, 2246A, 2247A	441	200-3232-00	$7
2201, 2205, 2211, 2225	441	200-3397-00	$5
Accessory pouch	441	016-0677-02	$45
Rain cover	441	016-0848-00	$18
VIEWING HOODS			
Collapsible	442	016-0592-00	$15
Binocular	442	016-0566-00	$21
Polarized	442	016-0180-00	$60
CRT SHIELDS			
Blue	442	337-2775-00	$4.20
Clear	442	337-2775-01	$1.95
Gray w/tv graticule	442	035-0175-00	*2
RACKMOUNT KITS			
2221, 2224, 2232	440	016-1003-00	$155
2211	440	016-1023-00	*2
2225, 2201, 2205, 2815	440	016-0819-00	*2
2236A only	440	016-0015-00	$285
2335 only	440	016-0468-00	$485
2245A, 2246A, 2247A	440	2240F1R	$350
2235A only	440	016-1062-00	*2

*1 *See the Accessories section pages 389-443 for detailed information.*

*2 *Contact your local sales representative.*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

MILITARY AND SPECIAL SERVICE ANALOG AND DIGITAL OSCILLOSCOPES



2465B Option 46

2465B OPTION 46

MIL-T-28800D, Type III, Class 3, Style D

- 400 MHz Analog Oscilloscope
- Four Channels, 500 ps/div Time Base
- Auto Setup
- Automatic Parametric Measurements
- Fully Programmable
- Volts and Time Cursors
- Save/Recall Setups

For additional information see page 112.

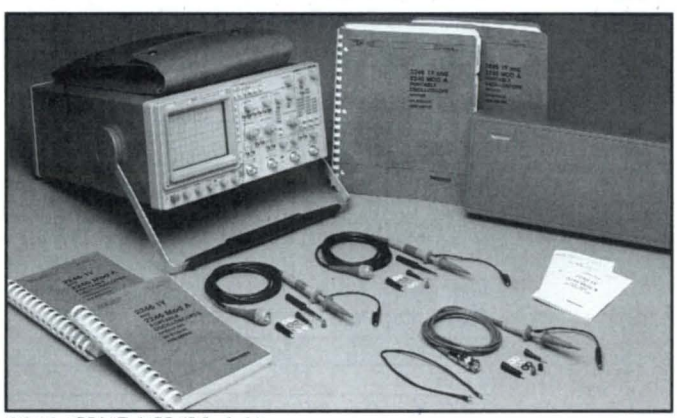
2430A Option 46

2430A OPTION 46

MIL-T-28800D, Type III, Class 3, Style D

- 150 MHz Digital Storage Oscilloscope
- 100 MS/s, 2 Channel Simultaneous
- 8 Bit Resolution
- Help Text Mode
- Auto Setup, Auto Measurement
- Fully Programmable
- Hard Copy Out
- Cursors

For additional information see page 117.



2246 1Y/2R/2Y (Mod A)

2246 1Y/2R/2Y (MOD A)

MIL-T-28800D Type III Class 3 Style D

- Meets MIL std. 461C for EMI
- 100 MHz Bandwidth
- 4 Channels
- Cursors and crt readout
- Time/volts measurements
- Voltmeter measurements

These instruments are based on the popular 2246 and are ideal for bench or field service use. Typical applications include use near high EMI fields or military contract applications.

For additional information see page 137.

Tek Offers a Broad Range of Scopes to Meet Military Requirements.

- *Meet or Exceed MIL Specs. for Shake, Shock and EMI*
- *Three Year Warranty*
- *UL Listed, CSA Certified*

ORDERING INFORMATION

OVER 100 MHz ANALOG

2465B Opt. 46 — **$7,380**
US Air Force preferred
400 MHz, 4 CH analog scope
NSN 6625-01-272-8054

2465B Opt. 11, Mod WB — **$6,280**
US Navy preferred
400 MHz, 4CH analog scope
NSN 6625-01-273-8156

F3801A2 Mod YE — **$9,600**
US Navy preferred
400 MHz battery powered scope
NSN 6625-01-271-9845

2445B — **$3,995**
DOD preferred
150 MHz, 4CH analog scope
NSN 6625-01-178-9491

OVER 100 MHz DIGITAL

2430A Opt. 46 — **$8,315**
US Army preferred
150 MHz, 2CH DSO
NSN 6625-01-258-0022

2430A — **$8,235**
US Marine Corp preferred
150 MHz, 2CH DSO
NSN 6625-01-257-2868

2430A Opt. 1R — **$8,555**
US Marine Corp preferred
150 MHz rackmounted DSO
NSN 6625-01-252-0344

2430M — **$18,080**
Air Force MATE/C11L compatible
150 MHz, rackmounted DSO
NSN 6625-01-266-8763

100 MHz ANALOG

2246 Mod A — **$2,995**
US Air Force preferred
100 MHz, 4 CH analog scope
NSN 6625-01-275-4766
Order # 2246 Opt 2Y

2246 1Y — **$2,995**
US Navy preferred
100 MHz, 4 CH analog scope
NSN 7Z 6625-01-260-6908
Order # 2246 Opt. 1Y

2246 2R — **$3,345**
Rackmount version of 2246 1Y
NSN 7Z 6625-01-263-5932
Order # 2246 opt 2R

2235L — **$2,395**
US Army preferred
100 MHz, 2 CH analog scope
NSN 6625-01-187-7847
Order # 2235L

336A *50 MHz DIGITAL PLUS ANALOG OSCILLOSCOPE*

TYPICAL APPLICATIONS
- *Medical Systems*
- *Communication-Equipment Service*
- *Electronic Design*
- *X-Ray Equipment Maintenance*

FEATURES
- *AutoSetup of Time & Voltage*
- *Save Setup/Recall*
- *50 MHz Digital/Analog Bandwidth*
- *20 MS/s, 2 MHz Single Shot BW*
- *100 ns Glitch Capture*
- *Parametric Measurements*
- *Time and Voltage Cursors*
- *Signal Averaging*
- *Envelope Mode*
- *GPIB and Eight-Screen Memory*
- *CRT Readout*

336A 50 MHZ OSCILLISCOPE

The SONY/TEKTRONIX 336A is a combination analog/digital-storage portable oscilloscope, capable of displaying analog and digitized waveforms simultaneously, and can store up to 16 digitized waveforms for recall and display. Features like AutoSetup, Save Setup/Recall, and Parametric measurements make the 336A a real productivity enhancing tool.

CHARACTERISTICS

DIGITIZER AND MEMORY

Digitizing rates up to 20 ms/s.

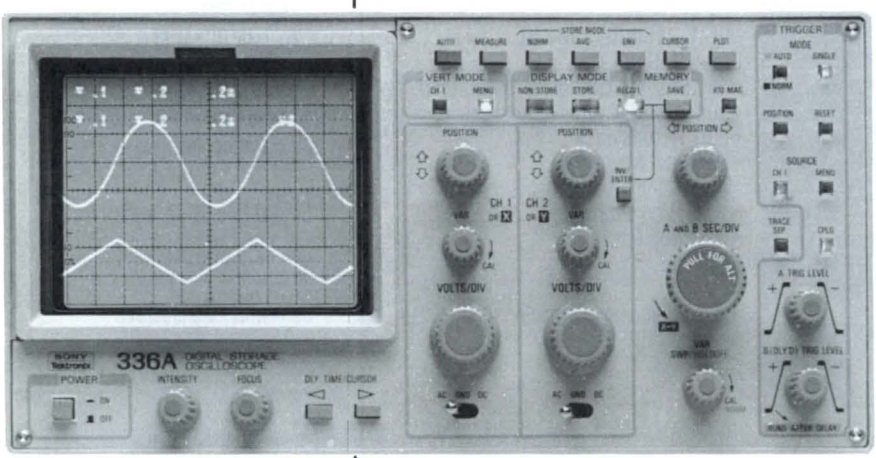
Useful Storage Bandwidth –
Real-Time: DC to 2.8 MHz (-3 dB).
Equivalent-Time: DC to 50 MHz (-3 dB).

Resolution – Vertical: 8-bit. Horizontal: 10-bit.

Acquisition Modes – Normal, Avg., Envelope, Continuous Envelope.

Normal Mode – Displays acquired waveform

Average Mode – 16, 64, or 256 sweep averages.



Envelope Mode – 1,16, 64, 256 sweeps, or continuous at s/div settings of 2 ms to 0.2 s/div.

Pre/Post Trigger – 1/8, 1/2, 7/8 of waveform.

Record Length – 1K.

Save Reference Memory – 8 screens of 2 waveforms, for a total of 16 waveforms (16K).

Plotter Output/GPIB – Output to HC-100 and 4041.

Parametric Measurements –
RMS: Within 3% + 6% of Volts/Div Setting
P-P: Within 3% + 4% of Volts/Div Setting
Mean: Within 3% + 4% of Volts/Div Setting
Max: Within 3% + 4% of Volts/Div Setting
Min: Within 3% + 4% of Volts/Div Setting

VERTICAL SYSTEM (2 Identical Channels)

Bandwidth and Rise Time –
(0°C to +40°C) DC to at least 50 MHz
(+40°C to +50°C) DC to at least 40 MHz
At all deflection factors terminated from a 50 Ω source.

Deflection Factor – Range: 5 mV to 10 V/div. Accuracy is ±3%. Uncalibrated, continuously variable between steps, and up to at least 25 V/div.

Vertical Modes – CH 1, CH 2, Dual.

Common-Mode Rejection Ratio – At least 10:1 at 10 MHz (5-MHz storage).

Input R and C – 1MΩ paralleled by 33 pF.

Maximum Input Voltage – 200 V (dc + peak ac) or 200 V p-p ac to 1 kHz or less.

HORIZONTAL SYSTEM (Nonstore Mode Only)

Time Base A – 0.2 s to 0.1 ms/div in a 1-2-5 sequence. X10 Mag extends the maximum sweep rate to 10 ns/div. (At sweep speeds slower than 0.2 s, the scope automatically goes to Roll mode).

Time Base B – 50 ms to 0.1ms/div in a 1-2-5 sequence. X10 Mag extends the maximum sweep rate to 10 ns/div.

Variable Time Control – Continuously variable between calibrated settings of the A s/div switch. Extends the slowest sweep rate to at least 0.5 s/div.

Time Base Accuracy –

	Unmagnified	Magnified
+20°C to +30°C	2%	3%
0°C to +50°C	3%	4%

DIGITAL STORAGE

Horizontal Acquisition

Resolution – Ten bit. 1024 data points.

Range

Equivalent-Time Sampling – 2 µs to 0.1 µs/div.

Real Time Sampling – 0.2 s to 5 µs/div.

Roll Mode – 20 s/div to 0.5 s/div.

Envelope Mode – 0.2 s/div to 0.1ms/div (peak detector 0.2 s/div to 2 ms/div).

Accuracy (Sample Period)

Real Time Sampling – 0.1%

Equivalent-Time Sampling –

+ 20°C to + 30°C	3%
0°C to + 20°C	4%
+ 30°C to + 50°C	4%

CURSORS/READOUT

Accuracy –

$\frac{\Delta V}{\Delta T}$

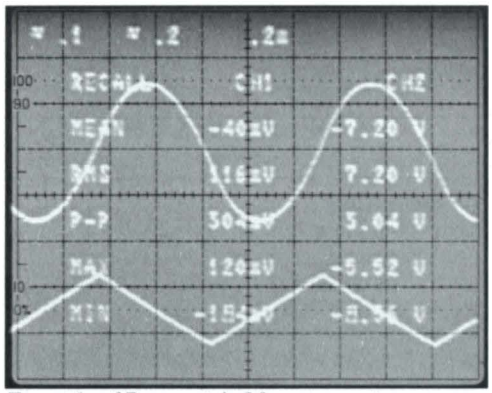
Within ±3%of reading + 4% of Volts/div switch setting

Real Time – Within ±0.1% of full scale.

Equivalent Time –

+ 20°C to + 30°C	3%
0°C to + 20°C	4%
+ 30°C to + 50°C	4%

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.



Example of Parametric Measurements

CALIBRATED SWEEP DELAY

Differential Time Measurement Accuracy – (Nonstore Mode) +25°C to +35°C: Within 1% of indicated value. 0°C to 25°C: Within 2.5 of indicated value.

Delay Time Jitter – (Nonstore Mode) 1 part in 10,000.

TRIGGERING

A AND B Trigger Modes –

Normal: Sweep generator requires a trigger to generate a sweep.

Automatic: Sweep generator free runs in the absence of a trigger.

Single Sweep: One sweep is initiated by the first trigger after reset.

Trigger Sources – Internal, CH 1, CH 2, or external.

Sensitivity and Coupling –

Coupling	To 10 MHz	To 50 MHz
AC	0.3 div above 30 Hz 70 mV external	1.5 div 350mV ext.
LF Rej	0.5 div above 50 kHz 140 mV external	1.5 div 350mV ext.
HF Rej	0.5 div, 30 Hz to 50 kHz 140 mv ext	
DC	0.3 div 70 mV external	1.5 div 350mV ext.

External Trigger

Input – 1 MΩ paralleled by 33 pF.

Maximum Input Voltage – 200 V (dc + peak ac): 200V p-p ac at 1 kHz or less.

TV Triggering – Stable video rejection and sync separation from sync-negative NTSC or PAL composite video. Provides either field or line sync to A; line sync only to B.

External Z-Axis

Maximum Input Voltage – + 25 V.

Usable Frequency Range – Dc to 1-MHz.

Input Resistance – At least 10 kΩ.

X-Y OPERATION

Deflection Factor – Full Sensitivity X-Y. (CH 1 Horizontal, CH 2 Vertical) – 5 mV to 5 V/div.

Bandwidth (Nonstore) – dc to 1 MHz. Phase difference is 3 from dc to 50 kHz.

Bandwidth (Storage) – dc to 50 MHz.

CRT AND DISPLAY

CRT – 10 div (0.6 cm/div) display, GH (P31) phosphor. 12 kV operating potential.

Graticule – Internal. Vertical and horizontal center lines marked in 5 minor div/major 0.6 cm/div.

Phosphor – P31.

ENVIRONMENTAL

Ambient Temperature – Operating: -15°C to + 55°C (Oscilloscope). Nonoperating: –25°C to + 75°C.

Altitude – Operating: To 9000 m (30,000 ft) maximum, decrease maximum temperature by 1C/1000 ft from 5,000 to 30,000 ft. Nonoperating: To 15,000 m (50,000 ft) maximum.

Vibration – 15 minutes along each of the 3 major axes, 0.025 in. (0.06 cm) p-p displacement (4 g's at 55 Hz), 10 to 55 to 10 Hz in 1 min. cycles.

Humidity – Nonoperating: 5 cycles (120 hours) of MIL-E-16400G. Omit freezing and vibration and allow a post-test drying period at + 25°C, + 5°C and 20°C to 80% relative humidity.

Shock – Operating and Nonoperating: 30 g's, 1/2 sine, 11-ms duration. Total of 12 shocks.

AC POWER REQUIREMENTS

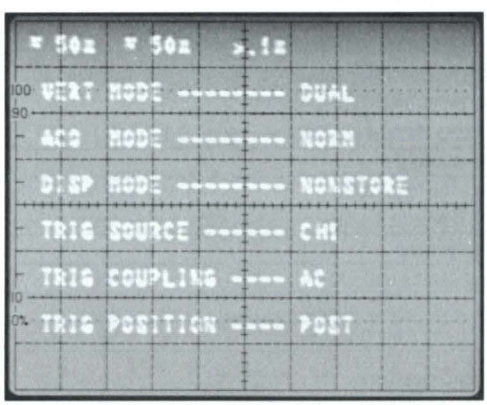
Line-Voltage Ranges – 90-132 V,180-250 V.

Line Frequency – 48 Hz to 440 Hz.

Power Consumption – 50 W maximum.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	237	9.3
Height	112	4.4
Depth		
Handle Not Extended	370	14.5
Handle Extended	482	19.0
Weight	**kg**	**lb**
Net	5	11.1
Shipping	10.5	23.1



Example of Scope Parameters Accessed Through the Front Panel

ORDERING INFORMATION

336A Digital Oscilloscope ☎ **$5,745**
Include: 2 10X P6148A Probes; Pouch (016-0718-00); Front Panel Cover(016-0719-00); crt filter (378-0225-00); Operators Manual (070-7360-00).

OPTION

Opt. 1P – HC 100 Plotter *1

INTERNATIONAL POWER PLUG OPTION

Opt. A1- A5 – Available **NC**
See page 142 for descriptions.

OPTIONAL ACCESSORIES

HC100 – Plotter **$895**
GPIB Cable – (012-0630-03) **$110**
Mesh Filter – (378-0223-00) **$23**
Viewing Hood – (016-0297-00) **$2.10**

RECOMMENDED PROBES

P6148A – 10X Probe **$140**
A6303 – Current Probe **$1,240**
AM 503 – Current Probe Amplifier **$1,330**

RECOMMENDED CART

K212 – Portable Instrument Cart **$380**

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

*1 *Contact your local sales representative.*

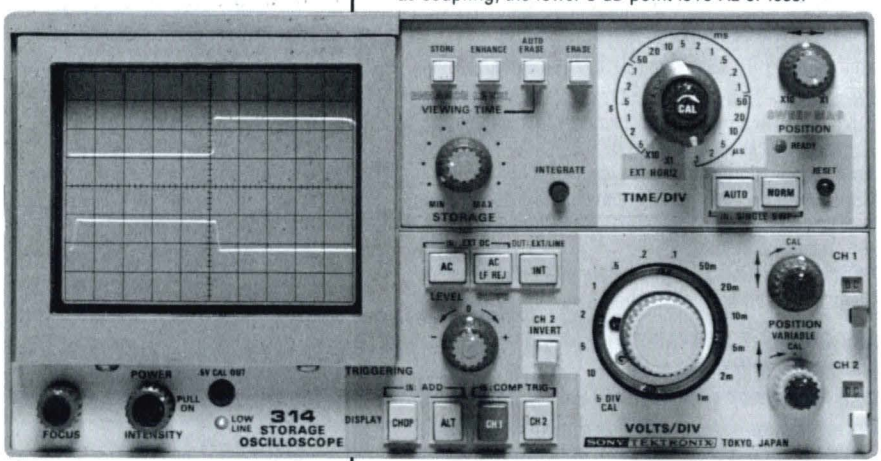
314 10 MHz CRT STORAGE OSCILLOSCOPE

TYPICAL APPLICATIONS
- *Industrial Control Systems*
- *Biophysical Instrumentation*
- *Communication Equipment Service*

FEATURES
- *10 MHz at 1 mV/Div*
- *100-ns/Div Sweep Rate With X10*
- *Stored Viewing Time to Four Hours*
- *Integrate Mode for Intensifying Fast Rise-Time, Low-Rep-Rate Signals*
- *Operates From ac Line, 12, 24 Vdc*

SONY®/TEKTRONIX ®314

The SonyTektronix 314 weighs only 10.5 pounds and provides four-hour stored viewing time. This long-term storage is useful for monitoring signal lines for suspected undesired transients. The compact size and ac or external dc operation allows the 314 to easily go when and where you need a storage scope.



CHARACTERISTICS

VERTICAL SYSTEM

Bandwidth and Rise Time –
DC to at least 10 MHz. Rise time: 35 ns or less. For ac coupling, the lower 3 dB point is10 Hz or less.

Deflection Factor – 1 mV/div to 10 V/div (1-2-5 sequence), accurate ±3%. Uncalibrated: Continuously variable between steps to at least 25 V/div.

Display Modes – CH 1, CH2, CH2 Invert, chop, alternate,add, and X-Y.

Input R and C – 1 MΩ paralleled by 47 pF.

Maximum Input Voltage – AC or DC coupled, 300 V (dc + peak ac).

Amplitude Calibrator – 0.5 V accurate ±1% from + 20° to 30°C, ±2% from –15 to + 55C.

HORIZONTAL SYSTEM

Time Base – 1 s/div to 5 s/div. X10 magnifier extends sweep rate to 100 ns/div.

Variable Time Control – Uncalibrated, variable between steps and to at least 12.5 s/div.

Time Base Accuracy – (Center 8 divisions)

Unmagnified	
1 s/div to 0.2 s/div	+ 3%
0.5 s/div to 5 s/div	+ 4%
Magnified	
50 ms/div to 0.5 s/div	+ 5%
0.5 s/div to 20 ms/div	+ 4%
0.1 s/div and 0.2 s/div	+ 5%

TRIGGERING

Modes – Normal, Auto, Single sweep

Trigger Sources – Internal: CH 1, CH 2, or composite; external.

Sensitivity and Coupling –

Coupling	1 MHz	10 MHz
DC Internal	0.3 div	1 div
DC External	150 mV	500 mV
AC	Requirements increase below 30 Hz	
AC LF Reject	Requirements increase below 50 kHz	

X-Y OPERATION

Input – X-axis input is via the external horizontal input connection. Both CH 1 and CH 2 provide vertical inputs. Using chopped mode, two simultaneous X-Y displays can be obtained.

X-Axis Deflection Factors – Continuously variable from 20 mV/div to 2 V/div. Bandwidth, dc to at least 200 kHz.

Input Impedance – 2 MΩ paralleled by 62 pF.

CRT AND DISPLAY FEATURES

CRT – 8x10-div (0.6 cm/div) display. Accelerating potential is 2 kV. GX (P44) phosphor.

Graticule – Internal, nonilluminated.

Z-Axis Input Range – 5 to 20 V (dc coupled) with a 100 kHz or greater usable frequency range.

Maximum Input Voltage – 50 V (dc + peak ac).

STORAGE FEATURES

Display Modes – Direct view, bistable storage, and nonstore modes. Enhanced writing rate in single-sweep mode. Autoerase mode to erase stored display after each sweep.

Stored Writing Speed – Normal, at least 80 div/ms. Enhanced, increases to at least 400 div/ms (250 cm/ms) in enhanced mode.

Erase Time – 300 ms.

POWER REQUIREMENTS

Line-Voltage Range- – 90 to 130V ac or 180 to 264 V ac.

Line Frequency – 48 to 440 Hz.

Power Consumption – 29 W max. at 115 V ac.

External DC Source – 11-14 V dc or 22-28 V dc.

DC Current Drain – +12 V or 0.8 A at 24 V.

ENVIRONMENTAL

Ambient Temperature – Operating: –15°C to + 55°C. Nonoperating: – 40°C to + 75°C

Altitude – See page 145.

Shock – See page 145.

Humidity – Nonoperating: 5 cycles (120 hours) of MIL-Std-202D, Method 106°C. Omit freezing and vibration and allow a post-test drying period at 25°C ± 5°C and 20% to 80% relative humidity.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width, w/handle	23	9.3
Height, w/o pouch	112	4.4
Depth, handle not extended	347	13.6
Net Weight	**kg**	**lb**
W/O accessories	4.7	10.5
Shipping	7.6	17.0

ORDERING INFORMATION

314 CRT Storage Oscilloscope **$5,340**
Includes: 2 ea P6149A X10 Probes; Carrying Case and Pouch (016-0612-00); Strap (346-0131-02), External DC Current Assembly (012-0406-00); 2 1.6A fuses (159-0098-00); 20.8A fuses (159-0132-00); 2 0.15A fuses (159-0130-01); 3 0.16A fuses, (159-0131-00); Service Manual (070-1824-00); Operators Manual (070-1823-00).

OPTIONAL ACCESSORY

Viewing Hood –
Order 016-0297-00. **$2.10**

RECOMMENDED CAMERAS

C30BP Opt. 1 **$1,760**
Camera Adapter.
Order 016-0327-01. **$190**

RECOMMENDED CART

K212 – Port. Instrument Cart **$380**

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

SONY®/TEKTRONIX®305

The 305 Oscilloscope/DMM is the ideal oscilloscope for those who demand portability and multifunction versatility in their test instrumentation.

CHARACTERISTICS

VERTICAL SYSTEM

DC to 5 MHz (-3 dB). Bandwidth in Add mode is dc to at least 4.5 MHz.

Deflection Factor – 5 mV/div to 10 V/div (1-2-5 sequence) accurate ±3% from 0°C to + 40°C. Uncalibrated, variable up to 25 V/div.

Display Modes – CH 1, CH 2, Chopped, Alternate, Add, Invert CH 2, and X-Y.

Input R & C – 1 MΩ, paralleled by 47 pF.

Maximum Input Voltage – AC or dc coupled, 250 V (dc + peak ac), or 250 V p-p at 1 kHz.

HORIZONTAL SYSTEM

Time Base – 500 ms/div to 1 s/div (1-2-5 se quence). X10 magnifier to 0.1 s/div.

Variable Time Control –Uncalibrated, variable between steps and up to at least 1.25 s/div.

Time Base Accuracy –

	0°C to 40°C	–15°C to +55°C
Unmagnified	±3%	±4%
Magnified	±5%	±6%

TRIGGERING

Modes –Normal and Auto (p-p).

TTL Triggering – TTL trigger level control presets for optimum triggering from TTL levels, in 50 mV, 0.1,0.2 V/div or external trigger signals.

Trigger Sources – CH 1, CH 2, external.

Trigger Sensitivity in Normal Mode

Coupling To	0.5 MHz	At 5 MHz
DC Internal	0.3 div	0.75 div
DC External	15 mV	50 mV
AC	Requirements increase below 60 Hz	

External Trigger – Max. Input Voltage: Same as Vertical.

X-Y OPERATION

Input – X-axis via CH1, Y-axis via CH 2.

X-Y Characteristics – Same as vertical, except deflection factor accuracy is ±4 % from 0°C to 40°C over the center 8 div.

X-Axis Bandwidth – DC to 150 kHz.

CRT AND DISPLAY FEATURES

CRT – 10 div (0.632 cm/div) display. GH (P31)phosphor std. Accelerating potential is 2 kV.

Graticule – Internal, nonilluminated.

Common-Mode Rejection – 100 dB at dc, 80 dB at 60 Hz with 1k imbalance.

Normal-Mode Rejection – 30 dB at 60 Hz.

Input R – 10 MΩ, ± 2%

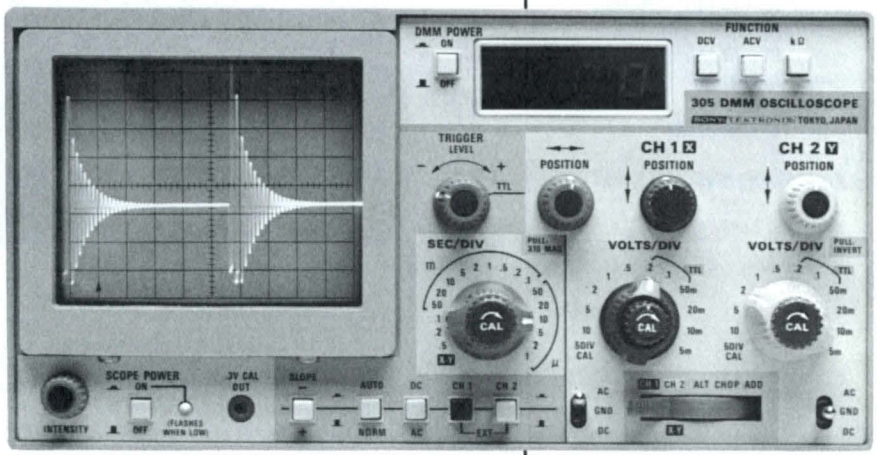
Maximum Input Voltage – 1000 V (dc + peak ac).

AC VOLTAGE

Ranges – 2, 20, 200, and 700 V (autoranging).

Accuracy – Within 0.5% of reading, +10 counts, 40 to 500 Hz.

Response Time – < 5 s plus range step time (< 1 s/step).



Input Impedance – 10 MΩ paralled by 70 pF.

Maximum Input Voltage – 700V RMS if sinusoidal.

RESISTANCE

Ranges – 2, 20, 200, and 2000 k.

Accuracy – Within 0.6 of reading 3 counts.

Response Time – Same as AC Voltage

Maximum Input Voltage –100 V between HI and LO inputs. 500 V (dc+peak ac) between LO and chassis (LO Floating Voltage).

POWER REQUIREMENTS

Line-Voltage Range – 90-132V or180-250V ac.

Line Frequency – 48 Hz to 440 Hz.

Maximum Power Consumption –17W.

External DC Source – 9 to 32 V.

Charge Time – At least 16 hours for full charge.

Operating Time – Internal NiCad batteries provide 1.6 hours of combined operation, 10 hrs of DMM operation, or 2 hrs of scope operation.

ENVIRONMENTAL

Ambient Temperature – Operating: –15°C to + 55°C (Oscilloscope), 0°C to + 55°C (DMM). Nonoperating: –25°C to + 75°C.

Altitude – Operating: To 9000 m (30,000 ft) maximum, decrease maximum temperature by 1C/1000 ft from 5,000 to 30,000 ft Nonoperating: To 15,000 m (50,000 ft) maximum.

Vibration – 15 minutes along each of the 3 major axes, 0.025 in. (0.06 cm) p-p displacement (4 g's at 55 Hz), 10 to 55 to 10 Hz in 1 min. cycles.

Humidity – Nonoperating: 5 cycles (120 hours) of MIL-E-16400G. Omit freezing and vibration and allow a post-test drying period at + 25°C, + 5°C and 20% to 80% relative humidity.

Shock – Operating and Nonoperating: 30 g's, 1/2 sine, 11-ms duration. Total of 12 shocks.

TYPICAL APPLICATIONS

- *Electromechanical Measurements*
- *Medical Electronics Maintenance*
- *Automotive/Motor Vehicle*
- *Plant Maintenance*
- *Field Service*

ORDERING INFORMATION

305 Oscilloscope /DMM **$3,310**
Includes: Two P6149A 10X Probes; Carrying Case (016-0401-00); Carrying Case Cover (200-2260-00); Carrying Strap (346-0131-02); DMM Probe Package; Clear crt Filter (331-0394 01); (378-0206-01); External dc Cable Assembly (012-0406-00); Service Manual (070-2423-01); Ooperators Manual (070-2424-00).

OPTIONAL ACCESSORIES

Viewing Hood –
Order 016-0297-00 **$2.10**

Adapter Connector BNC to Binding Post –
Order 103-0033-00 **$7.00**

RECOMMENDED CAMERAS

C30BP Opt. 01 **$1,760**

Camera Adapter –
Order 016-0327-01 **$190**

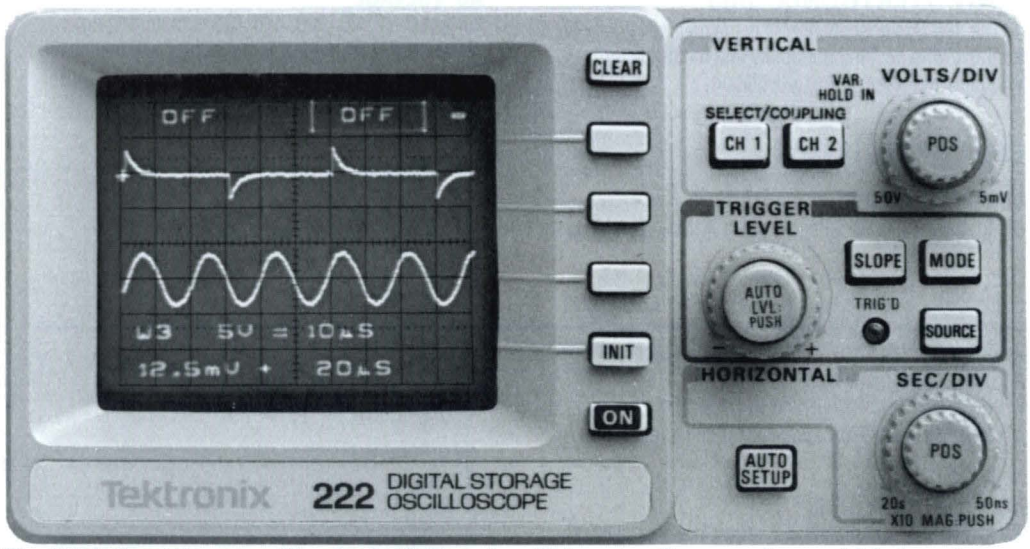
RECOMMENDED CART

K212 – Portable Instrument Cart **$380**

NEW

222 *10 MHz HANDHELD DIGITAL STORAGE OSCILLOSCOPE*

- *Digital Storage*
- *Fully Programmable via RS-232*
- *10 MHz Bandwidth*
- *10 MS/s Dual Digitizers*
- *100 ns Glitch Capture*
- *AutoSetup/Save Setup/Recall*
- *Auto Trigger*
- *Save Reference Memory*
- *Floatable to ±400V/Channel*
- *Ultra-Portable*
- *Rugged Construction*
- *Battery Operation*
- *DC Operation*
- *4.4 lbs Total Weight*
- *UL Listed*
- *3 Year Warranty*



The 222 is the optimum oscilloscope for field service. This scope offers several powerful features in a compact size including AutoSetup, RS232, full programmability and floating measurements. Actual size shown.

222 10 MHZ HANDHELD OSCILLOSCOPE

Tek's 222 introduces unprecedented power in the world of HandHeld Oscilloscopes. The new 222 comes standard with a 10 MHz bandwidth, 10 MS/s digitizing rate, floating measurements to ±400V per channel, RS-232 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 - 28Vdc or 16 - 20Vac makes the 222 truly a portable scope on the go.

AUTOSETUP/SAVE/RECALL

The 222's AutoSetup/Save/Recall features eliminate the need for unneccessary manipulation of the front panel. Just push the AutoSet button and the 222 selects all the parameters for you. Save and recall those setups for repetitive situations at multiple sites and see the savings in time.

WAVEFORM STORAGE

After you've acquired your waveform using AutoSetup, save it in one of four 512pt. 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 222

After saving your waveforms and setups, make a permanent record. Simply connect the 222 to your PC and transfer them. Send them back to the 222 when that same job is due again. In fact, you can control the entire front panel from a remote location utilizing the RS-232 port.

FLOATING MEASUREMENTS

The 222 is a fully isolated, double insulated instrument capable of safely measuring ±400V per channel or 800V p-p. Operators can feel safer and operate in a safer mode from now on.

SOPHISTICATED PROCESSING IN A SMALL PACKAGE

The 222 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-232 programmability combine to make the 222 the ultimate service tool. It comes complete with a ballistic nylon carrying case that doubles as a neck strap for hands free operation.

RUGGED DESIGN

The 222 is packaged in impact resistant plastic, capable of withstanding 150g's of force. It can operate in temperatures as low as -10°C and still be accurate. The batteries allow for a minimum of two hours of remote operation.

INDUSTRY STANDARD WARRANTY

The 222 comes standard with a full three year warranty. Optional service warranties are also available to make the 222 the worry-free instrument for the technician on the move, anywhere in the world.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

10 MHz HANDHELD DIGITAL STORAGE OSCILLOSCOPE

CHARACTERISTICS

VERTICAL SYSTEM
Bandwidth *DC to 10 MHz (-3 dB)*

Single Shot Bandwidth – DC to 1 MHz.

Rise Time – 15 ns.

Deflection Factor – 5 mV/div. to 50 V/div (1-2-5 sequence) Variable increases by factor of 2.5 to 1.

Resolution – 8 bits, 25 levels div, 10.24 div of dynamic range.

DC Accuracy – 10°C to +55°C = ±3%.

Input R & C – 1MΩ ±10% paralleled by 27pF ±3 pF.

Maximum Safe Input Voltage – 400V (dc + peak ac) or 800Vac p-p at 1 kHz or less.

Channel Isolation – Greater than 1000:1 at 10 MHz.

Operating Modes – Channel 1, Channel 2, Dual.

HORIZONTAL SYSTEM
TimeBase – 50 ns/div to 20 s/div (X10 mode increases max sweep speed to 5 ns/div).

Accuracy – X1 = ±2%, X10 = ±5%

Sample Rate – 10 MS/s.

Sample Rate Accuracy – 0.01%

Record Length – 512 points, calibrated to 50 pts/div.

Displayed Trace Length – 10.24 divisions.

TRIGGER SYSTEM
Internal Sensitivity – 0.5 div @ 10 MHz.

Level – ±20 divisions.

External Sensitivity – 200 mV to 10 MHz.

Level – ±2.3%.

Input R & C – 1MΩ ±10% paralleled by 18 pF ±5 pF.

Trigger Jitter – 2ms to 50 ns/div.

Trigger Sources – Internal and External.

DIGITIZER AND MEMORY
Maximum Sampling Rate – 10 MHz @ 10 ms.

Useful Storage Bandwidth – Single Shot: 1 MHz; Repetitive: dc to 10 MHz.

Resolution – Vertical: 8 bits, 25 levels.

Acquisition/Process Modes – Normal, Peak Detect, Accumulated Peak, Averaging.

Pre/Mid/Post-Trigger – 1/8, 1/2, 7/8 of waveform.

Record Length – 512 bytes

Save Reference Memory – Four 512 byte acquistions.

Front Panel Save/Recall – Save and recall up to four setups.

X-Y OPERATION
Accuracy – Same as Vertical System.

Useful Bandwidth – Same as Vertical System.

Skew between CH1 & CH2 – 5 ns.

CRT AND DISPLAY FEATURES
CRT – 6 x 10 divisions (0.5 cm).

Phosphor – P31.

Graticule – Internal, non-illuminated.

Trigger Jitter – 2ms to 50 ns/div.

Trigger Sources – Internal and External.

RS-232 INTERFACE
Maximum applied Voltage – 25V (dc + peak ac).

Baud Rates – 300, 1200, 2400 (selectable).

Levels – Compatible with RS-232C.

POWER REQUIREMENTS
Line Voltage Range – 12 to 28V dc, 16 to 20 V ac.

Line Frequency – 47 Hz to 400 Hz.

Maximum Power Consumption – 16 VA

Minimum OperatingTime (batteries) – Two hours at maximum sample rate , no trigger, and auto-shutdown defeated.

Typical Operating Time (batteries) – Four to six hours.

Charging Time – 6 hours.

Type – Sealed lead acid.

Discharge Protection –Scope automatically shuts down when charge drops to 7.42 V.

ENVIRONMENTAL
Ambient Temperature – Operating: -10°C to +55°C Nonoperating: -51°C to +75° 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,1 ms duration each direction along each major axis. Total of 18 shocks.

ORDERING INFORMATION

222 HandHeld DSO ☎ **$2,450**
Includes:
Operator Manual (070-7100-00),
Quick Ref. Guide (070-7099-00),
RS-232 Guide (070-7533-00),
AC adapter (120-1807-00),
Pouch (016-1024-00),
Feet (020-1752-00),
Probe Acc. Kit (020-1711-00).

INSTRUMENTS OPTIONS

Opt. 02 – (delete adapter) **NC**

***WARRANTY PLUS* SERVICE OPTIONS**

Opt. M2 – 2 yrs. service **+$171**
Opt. M3 – 2 yrs. service + 4 cals **+$301**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 & A2 – Available **NC**
See page 142 for descriptions.

OPTIONAL ACCESSORIES

External Battery Charger –
Order 013-0256-00 **$270**
Battery/AC Adapter Pouch –
Order 016-0993-00 **$10**
Viewing Hood –
Order 016-1021-00 **$10**
RS-232 Software –
Order 063-0070-00 **$25**
Trigger Adapter –
Order 103-0090-00 **$11**
European Power Adapter –
Order 120-1826-00 **$25**
UK Power Adapter –
Order 120-1827-00 **$25**
Spare Battery –
Order 146-0075-00 **$55**
RS-232 Cable –
Order 174-1453-00 **$20**
Cigarette Lighter Adapter –
Order 174-1734-00 **$6.25**
External Trigger Probe –
P6122 **$63**

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

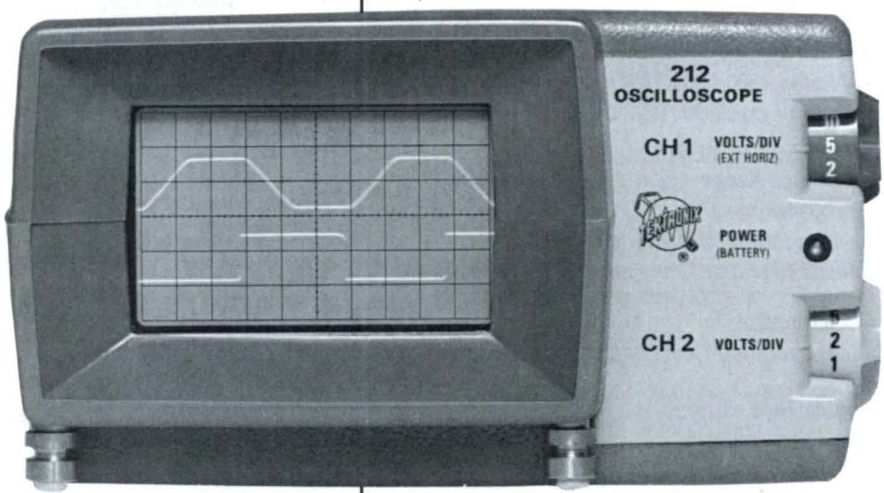
☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

221/214/212 HANDHELD 500 kHz TO 5 MHz MINISCOPES

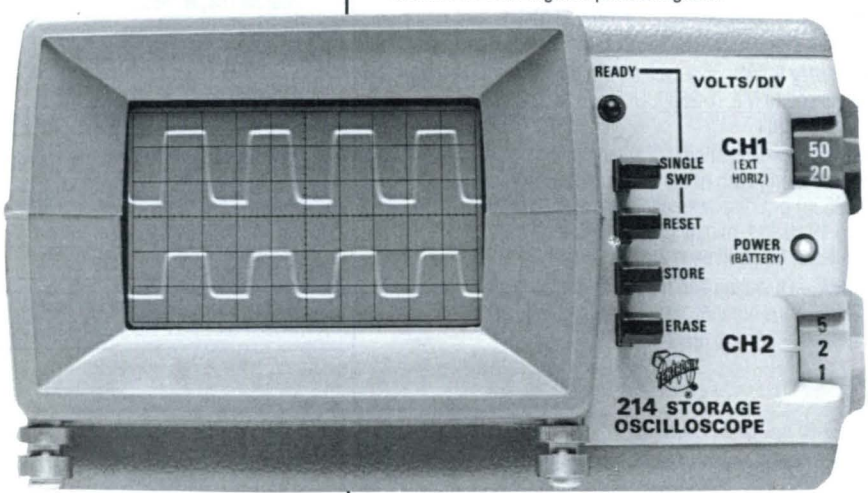
- *Electromechanical Measurements*
- *Biomedical*
- *Dual Channel*
- *DC to 500 kHz, 1 mV/Div to 50 V/Div.*
- *CRT Storage (214 only), Internal Battery Pack*
- *Integral 1 M WProbe*
- *Floatable to 600V*

Offering bandwidths from 500 kHz (212/214) to 5 MHz (221), neckstraps for convenient viewing and single side mounted control knobs make the 200 Series ideal for industrial maintenance applications where portability is a must.

The 212/214/221 are lightweight (3.5 pounds), compact(3.5x2.5x9.5 inches), and built of impact-resistant, double insulated plastic and are fully self-contained. They allow the user to make "floating" measurements since it is double insulated, and can be elevated to 600 V (dc + peak ac) above ground when operated from batteries.



All of the 200 Series products feature integral probes; they are always there when you need them. Available with the 212/214 are X10 attenuator packages allowing the user to view high amplitude signals.



The 214 CRT Storage scope allow for waveform comparison when accuracy is a must when viewing hard to find signals. The 221 at 5 MHz offers the ability to view the higher voltages and higher speeds found in motor controllers.

Internal rechargeable batteries allow at least two hours operation away from external power sources. The 221 will operate and charge from practically all the world's principal line voltages without making any change to the instrument.

CHARACTERISTICS

VERTICAL SYSTEM

Bandwidth – 212/214 DC to at least 500 kHz from10 mV/div to 50 V/div, reducing to at least 100 kHz at 1 mV/div.

Bandwidth – *221* DC to 5 MHz at all calibrated deflection factors. Lower 3 dB point ac coupled is 2 Hz for all.

Deflection Factors – *212/214* 1 mV/div to 50 V/div (1-2-5 sequence). Accuracy: ±5%. Uncalibrated: Continuously variable between steps to at least 125 V/div.

Deflection Factors – *212:* 5 mV/div to 100 V/div (1-2-5 sequence). Accuracy: ±3%. Uncalibrated: Continuously variable between steps to at least 300 V/div.

Display Modes – *212/214* CH 1 only, CH 2 only, or CH 1 and CH 2, Chopped (chop rate = 50 kHz) from 500 ms/div to 2 ms/div of time base, alternate from 1ms/div to 5 ms/div of time base.

Display Mode – *221* Channel 1 only, XY.

Input R and C – *212/214* 1MΩ paralleled by ≈160 pF from 1 mV/div to 50 mV/div; and 140 pF from 100 mV/div to 50 V/div.

Input R and C – *221* 1M Ω paralleled by ≈ 29 pF via attached signal-acquisition probe.

Maximum Input Voltage – (1X probe only) 1 to 50 mV/div 600 V (dc + peak ac) ac not over 2 kHz 0.1 to 50V/div 600 V (dc + peak ac) 600 V p-p ac 5 MHz or less.

HORIZONTAL SYSTEM

Time Base – 212/214 5 ms/div to 500 ms/div ±5%.

Time Base – 221 1 ms/div to 200 ms/div, accurate ±3%.

Variable Magnifier – Increases each sweep rate X5 with a maximum sweep speed of 1 ms/div.

External Horizontal Input – (CH 1) 1 mV/div to 50 V/div ±10%; dc to 100 kHz: X-Y phasing to 5 kHz <3 . Input characteristics same as CH 1.

Maximum External Horizontal Input Voltage and Impedance – Same as for vertical inputs.

TRIGGERING

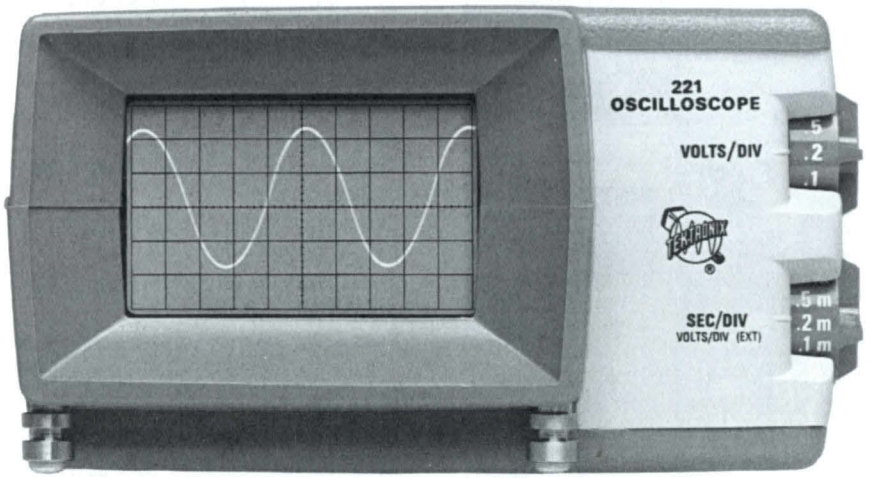
Automatic or normal. Level and slope selected with a single control. Automatic operation minimizes trigger adjustment and provides a bright baseline with no input. In dual-channel operation (212/214 only) at a setting of 1 mV/div, a bright baseline may not appear in the Auto Trigger Mode.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

HANDHELD 500 kHz TO 5 MHz ANALOG MINISCOPES

221/214/212

- *Single Channel, XY Mode*
- *DC to 5 MHz,*
- *5 mV/Div to 100 V div*
- *Internal Battery, Integral Probe*
- *Floatable to 600 V*



TRIGGER SENSITIVITY AND COUPLING (212/214)

DC Coupling	To 500 Hz
Internal w/composite trigger source	0.2 div
Internal w/CH 2 trigger source	0.2 div
External	1V

Maximum Ext Trigger Input Voltage – 212/214 8 V (dc+peak ac), 16 V (p-p ac) at 500 kHz or less.

Input Impedance – R and C, 1 MΩ paralleled by = 30 pF.

221 only

Source	To 1 MHz	To 5 MHz
Internal	0.5 div	1div
External	0.5 V	1V

X-Y OPERATION (221 ONLY)

Input – X-axis input is via the external trigger or the external horizontal input.

X-Axis Deflection Factor – 1V/div ±10%, dc to 500 kHz. Sensitivity is increased by a factor of 10 (0.1 V/div) using horizontal magnifier.

Maximum External Horizontal Input Voltage – 200 V (dc+peak ac), 200 V (p-p ac) to 500 kHz, decreasing to 20 V p-p ac at 5 MHz.

Input Impedance – 0.5 MΩ paralleled by 30 pF.

CRT AND DISPLAY FEATURES

CRT – 6 X 10 div (0.52 cm/div) display.
212/221: Standard phosphor GH (P31).
214: Bistable Storage phosphor GX (p44)

Graticule – Internal, black line, nonilluminated

STORAGE FEATURES 214 Only

Stored Writing Speed – Normal, at least 80 div/ms. Enhanced, increases single-sweep storage writing speed to at least 500 div/ms. Enhance is automatic from 0.1 ms to 5 s/div in single sweep.

Stored Luminance – At least 8 fL at 25C.

Storage Viewing Time – One hour.

OTHER CHARACTERISTICS

Insulation Voltage – 500 V RMS or 700 V (dc + peak ac) when operated from internal batteries, with the line cord and plug stored. When operated from ac, line voltage plus floating voltage not to exceed 250 V RMS; or 1.4X line (dc peak ac) not to exceed 350 V.

Power Sources – Internal NiCad batteries provide three to five hours operation for a charging and operating temperature between +20°C and +30°C. Internal charger charges the batteries when connected to an ac line with instrument turned off. Battery operation is automatically interrupted when battery voltage drops to 10 V . Full recharge requires 16 hours.

POWER REQUIREMENTS

Line-Voltage Range – *(212/214)* 110 to 126 V ac. Can be operated at 104 to 110 V ac with resulting slow discharge of internal batteries. Option 01 is 220 to 250 V. Option 02 is 90 to 110 V. *(221)* 90 TO 250 VAC or 80 to 250 V dc.

Line Frequency – *(212/214)* 58 to 62 Hz. Options 01 and 02 are 48 to 52 Hz. *(221)* 48 to 62 Hz

Maximum Power Consumption –
(212/214): 3W. (221): 5W

ENVIRONMENTAL

Ambient Temperature – Operating (Batt. only): -15°C to +55°C. Charging or operating from AC line: 0°C to +40°C. Nonoperating: -40°C to +60°C.

Altitude – Operating: 7600 m (25,000 ft), Nonoperating: 15,000 m (50,000 ft).

Humidity – 95%, five cycles (120 hours). Referenced to MIL-T-28800C, par 4.5.5.1.2.2.

Vibration – Operating and Nonoperating: 15 minutes along each of the 3 major axes, 0.06 cm (0.025 in) p-p displacement (4 g's at 55 Hz) 10 to 55 to 10 Hz in 1-minute cycles. Held for 3 minutes at 55 Hz.

Shock – Operating and nonoperating: 100 g's 1/2 sine, 2 ms duration each direction along each major axis. Total of 12 shocks.

ORDERING INFORMATION

212 500 kHz, Dual-Channel ☎ **$2,450**
Includes: Integral probes, Viewing Hood (016-0099-01); Carry Case (016-0512-00); 2 4-A fuses (159-0121-00); ID Tags (000-7983-00); ID Tag (334-2614-00); Carry Strap (346-0104-00); Oprs. Manual (070-5052-00); Service Manual (070-5053-00)

214 500 kHz, Dual Channel ☎ **$3,100**
CRT Storage Oscilloscope
Includes: Same as 212, except Oprs. Manual (070-5054-00) Service Manual(070-5055-00)

221 5 MHz, Single Channel ☎ **$2,950**
Includes: Integral probe, Viewing Hood (016-0199-01); Carrying Case (016-0512- 00); Neck Strap (346-0104-00); Two Spare Fuses (159-0080-00); Service Manual (070-1573-01); Operator Manual (070-1572-00), Battery

OPTIONS (212/214 only)

Opt. 01 – 220 to 250 V (48 Hz-52 Hz) **NC**

Opt. 02 – 90 to110 V (48 Hz-52 Hz) **NC**

OPTIONAL ACCESSORIES

10X Attenuator Package – (212/214 ONLY) A slip-on tip to provide lower circuit loading (4.4MΩ, =20 pF) and higher maximum input voltage 1000 V (dc + peak ac). Includes: Flex Tip(206-0060-00); 10X attenuator (010-0378-00); Pincher Tip (013-0071-00); Banana Tip (134-0013-00); IC Adapter (206-0203- 00)
Order 010-0378-01 **$85**

Alligator Clip Kit – Pair of alligator clips that connect probe and ground lead to large (up to 3/8 inch) conductors. Includes: Red Clip (015-0229-00); Yellow Clip (015-0230-01); 6-32 to Probe Adapter (103-0051-01)
Order 015-0231-00 **$36**

Probe Tips – To BNC Adapters
(Panel Connector) 013-0084-01 **$10**
(Cable Adapter)103-0096-00. **$15**

PHYSICAL CHARACTERISTICS

Dimension	mm	in.
Width	133	5.2
Height	76	3.0
Depth	241	9.5
Weight	**kg**	**lb**
Net, w/o accessories	1.6	3.5
Shipping	3.2	7.0

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.

T201/T202 *HANDHELD 5 MHz LCD OSCILLOSCOPES*

FEATURES
- *AutoSetup*
- *Save Setup/Recall*
- *9 Save Reference Memories*
- *Cursors*
- *On Screen Readout*
- *Built in DVM/Counter*
- *20 MS/s Sample Rate*
- *Dual channel/IDualTime Base*
- *Signal ZOOM*
- *LCD Display*
- *Signal Processing Capabilities*

BENEFITS
- *Ultra Portable*
- *Light Weight*
- *Sophisticated Measurements*
- *Battery Operation*
- *Productivity Enhancer*

ORDERING INFORMATION

T201 5 MHz LCD Oscilloscope. (Calculator Interface) Includes: 2 P6115 X1 Probes, Battery Pack/Carrying Case, AC Pack, Manual. **$1,295**

T202 5 MHz LCD Oscilloscope (Oscilloscope Interface) Includes: 2 P6115 X1 Probes, BatteryPack/Carrying Case, AC Pack, Manual. **$1,995**

Opt. 44 – Delete Battery Pack **–$250**

INTERNATIONAL POWER PLUG OPTION

Opt. A1-A2 – Available **NC**

See page 142 for descriptions.

OPTIONAL ACCESSORIES

Extra Battery Pack & Probes – Order 1111 **$410**

Extra Battery Pack Only – Order 1110 **$325**

P6115 – X1 probe **$32**

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width	111	4.4
Heigth	257	10.1
Depth	48	1.9
Weight	**kg**	**lb**
Net	0.85	1.9
Shipping	3.2	6.9

SOPHISTICATED CAPABILITIES IN A LIGHT-WEIGHT ULTRAPORTABLE PACKAGE

The Tek T201/T202 are light, compact, and fit easily into a glove box, tool box, or brief case. Only Tek offers these two choices in HandHeld LCD scopes. The T201/T202 are combination 5 MHz digital storage scopes, voltmeters and frequency counters in one compact package. Features like Autosetup, Save Setup/Recall, Cursors and On Screen Readout combine to make this product a real productivity enhancer.

A CHOICE OF TWO HUMAN INTERFACES

If you are a pro at scope operation, choose the T202, with its traditional layout. If logical left to right manipulations are more appealing, choose the T201 and it's calculator type keyboard

BATTERY OPERATION

The T201/T202 come complete with a sturdy Battery Pack/Carrying Case. Combined with the high impact case of the instrument, these are two products ready for any environment.

CHARACTERISTICS

VERTICAL SYSTEM

Range – 0.01 to 20 V/div (1-2-5 sequence).

Linearity – ±5 LSB.

Step response – 70ns.

Maximum Sample Rate – 20 MS/s for single channel acquisitions/ 10 MS/s dual channel.

Vertical System Bandwidth – (-3dB) DC to at least 5 MHz).

Useful Bandwidth – - Up to 5 MHz for repetitive acquisitions; Up to 2 MHz for single shot events.

Resolution – 7 bits, 20 levels per division.

Input R & C – 1MΩ paralleled by 25 pf.

Ch1/Ch 2 Isolation – 100:1 at 5 MHz

Max. Safe Input Voltage –42 V (dc + peak ac)

HORIZONTAL SYSTEM

Time Base – 1 hour/div to 50 ns/div ±1%.

Accuracy – ±0.1 division.

Time between Sec/div and Delta Time – ±0.1 division.

Resolution – 7 bits, 128 display points.

Record Length – 256 points.

Save Reference Memory – 9 each 256 pt. acquisitions

Save Setup Memory – 9 each stored setups. (vertical sensitivity and coupling are not stored)

CURSORS

Delta Time Accuracy – ±0.1 division.

Delta Volt s Accuracy – Same as vertical.

TRIGGERING SYSTEM

Sensitivity – Internal: 0.5 div External:1.5 V.

Jitter – ±2 display points.

LevelRange – at least ±2.5 div from 0.1V.

Modes – Normal, Single, Automatic, Chop, Alt.

Ext.Trig Max. Input Voltage –42V (dc + peak ac).

Input R & C – 2.2 MΩ paralleled by 25 pf.

DISPLAY

Dimensions – 57.6 x 57.6 mm or 6.4 div by 6.4 div.

Usable Signal Area –100 pts vert. x 128 horiz.

DVM/COUNTER

Frequency and Period – 1 to 100 Hz at ±0.5% 101 Hz to 500 kHz at ±0.08% 501 kHz to 5 MHz at ±0.04%

Voltage Measusrements of RMS, Avg. PK-PK and Zero to PK – ±0.5%

BATTERY PACK

(4 amp hour Nicads supplied)

Charging Current – 100 mA or 400 mA (selectable)

Charge Time – 1 amp hour batteries: 12-14 hrs, 4 amp hour batteries: 24-30 hrs.

Typical Operating Time – 3 to 5 hours.

ENVIRONMENTAL

Temperature – Operating: 0°C to + 40°C Nonoperating: -30°C to +75°C

Altitude – Operating to 4500 meters (15,000 ft) Nonoperating to15,000 meters (50,000ft)

Humidity – (Operating and nonoperating) 5 cycles (120 hrs) referenced to MIL-T28800C, para. 4.5.5. 1.2.2 for Type III, Class 5 instruments.

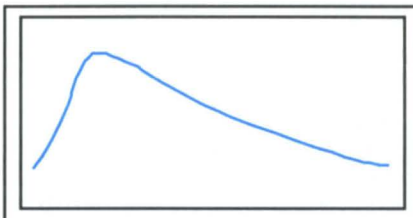
EMI – Does not meet VDE-0871, Class B

Vibration – 15 minutes along 3 major axes, 0.06cm (0.025 in) p-p displacement (4 g's at 55Hz, for a total of 15 minutes.

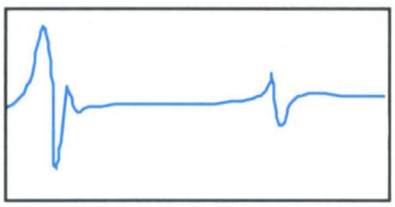
Shock – (Operating and nonoperating) 150g, half sine, 2 ms duration, 2 shocks per axes, for a total of 12 shocks.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

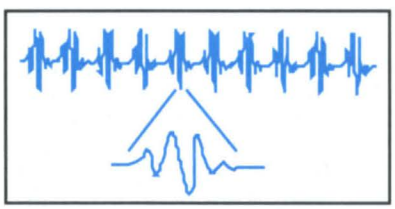
DIGITIZER APPLICATION STRENGTHS



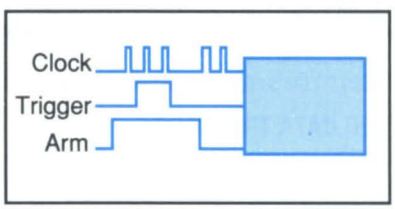
Impulse Events
- ***Laser Measurements (e.g., Fluorescence Decay)***
- ***EMP Simulation and Measurements***
- ***Materials Research***
- ***ESD Testing***
- ***High Voltage Impulse***



Pulse-Echo Applications
- ***Ultrasonics***
- ***Radar***
- ***Lidar***
- ***Sonar***



Long Record Length Requirements
- ***Disk Drive Testing***
- ***Video Development and Testing***
- ***Intelligence***
- ***Electronic Warfare***



Synchronization to the Outside World
- ***Charge Coupled Device Testing***
- ***Multiplexed Systems***
- ***Radar***

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7250 High Bandwidth Transient Digitizer 164
NEW SCD5000/SCD1000 High Bandwidth Transient Digitizers 166
NEW Analytek Series 2000 Digitizer 169
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NEW

RTD 720 *FAST TRANSIENT DIGITIZER*

Fast Transient Digitizer

- *2 GS/s Single Channel Mode*
- *1 GS/s Dual Channel Mode*
- *500 MS/s Four Channel Mode*
- *500 MHz Analog Bandwidth*
- *8 bit Vertical Resolution with ± 1.0% ΔV DC Accuracy*
- *Long Waveform Memory - 128K Standard with Expansion Available*
- *Fast Multiple Record Capability*
- *Optional Removable Display with Remote Capability*

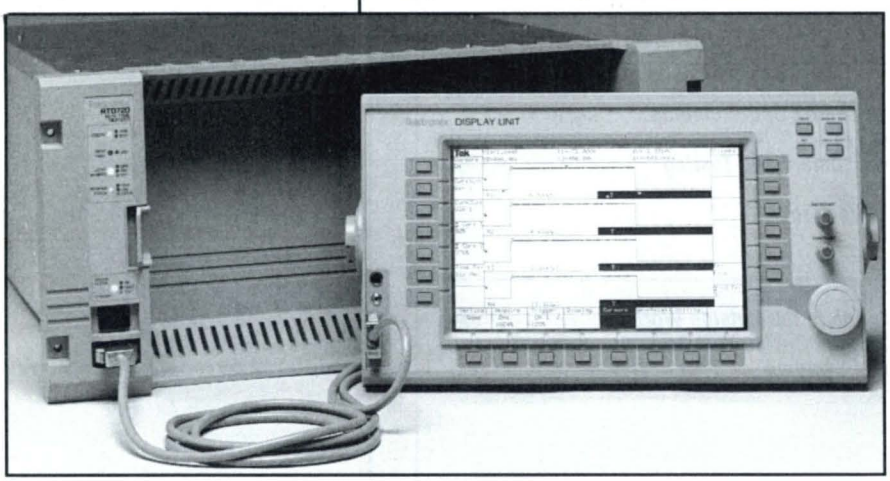
RTD 720 WAVEFORM DIGITIZER

- Multiple Channel Acquisition
- Long Record Length
- High Bandwidth and Sample Rate
- Transient Event Acquisition

SIGNAL FIDELITY AND SAMPLE RATE

The Tektronix RTD 720 Transient Waveform Digitizer provides 8-bit vertical resolution at sample rates up to 2 Gigasamples per second (GS/s).

The high performance input amplifiers provide excellent transient response with over 500 MHz of bandwidth. A selection of ranges and offset capability allows matching signal levels to the full range of the ADC system. The RTD 720 provides two channels of acquisition with the option to add two additional channels for a total of four (4) acquisition channels. The user controls the number of active channels (1, 2, or 4). For multiple channel acquisitions, all active channels acquire data simultaneously.



RTD 720 Transient Digitizer with Optional Front Panel

GPIB IEEE-488 *

LONG ACQUISITION MEMORY WITH FLEXIBLE ALLOCATION AND TRIGGERING

The RTD 720 standard acquisition memory is 128K (131,072 or > 65 µsec time window at 2 GS/s) waveform data points. Options are available for even larger acquisition memories and to support internally powered battery backed-up memory. Memory can be assigned entirely to one channel or shared equally among all active channels (1, 2, or 4) for simultaneous acquisition on all channels.

The trigger and time base system provides a high level of timing accuracy and resolution of the trigger event. Basic timing is provided by an internal precision SAW oscillator exhibiting a high degree of short term stability and low phase noise. Trigger time resolution is a function of the sample rate and number of active channels. The triggering and arming capabilities (external or internal) of the RTD 720 provides flexibility to allow capture of the signals of interest.

Pretrigger and post trigger acquisition of waveform data is supported by the RTD 720. For examining conditions prior to the trigger event, the RTD 720 supports pretrigger capture up to approximately the full record length. In order to examine in detail an event that occurs after the trigger event, the RTD 720 provides post trigger capabilities of up to 99,999,999 sample intervals after the trigger event before data capture begins. This equates to acquisition beginning 100 milliseconds after the trigger event at a sample rate of 1 nanosecond/point.

Record lengths can be selected from 512 data points to the full length of memory available, based on number of active channels. When using shorter record lengths, a corresponding larger number of records are available for each active channel. Depending on the number of active channels, the record length selected and the amount of memory installed in the digitizer, up to 1024 records per channel can be acquired.

In support of these multiple records, the RTD 720 features an Auto-Advance mode with time-stamping of each trigger event on each active channel. This allows the capture of multiple events with each record requiring a separate trigger. The re-arm time between acquisitions is ≤ 5 µsec, plus pretrigger fill time. This allows the capture of every event with event repetition rates in excess of 200,000 per second. Time stamp recording keeps track of the time of trigger for each successive event with timing resolution based on the sample rate of the acquisition.

HIGH SPEED DATA TRANSFER

Complementing the high capture rate of the RTD 720 is a fast and efficient data transfer capability. The RTD 720 supports this requirement with both hardware and instrument firmware to speed data transfer to a computer.

The primary computer interface for the RTD 720 is the IEEE-488.1 (GPIB) providing instrument control and data transfer. In burst mode (such as when transferring waveform data) the maximum rate is ≥ 500K bytes per second. This rate is dependent on the instrument controller used. For even faster waveform data output capability a 16-bit parallel port, capable of 5M byte per second (2.5M word per second) transfer rates, is provided. This parallel port operates with TTL levels and is designed to work with a number of typical computer parallel data input ports.

To further increase data transfer rates for the RTD 720 the instruments firmware supports predefinition of the information to be transferred so that time is not lost sending instructions and turning the interface around. These commands allow specifying from which channels to transfer data, which records to transfer (if in Auto-Advance mode), what part of the records to transfer, and the number of times these are to be repeated. This applies to both the IEEE-488.1 and parallel interface. The end result is that the RTD 720 is designed to transfer data to a computer very rapidly.

**The RTD 720 Digitizer complies with the IEEE Standard 488.1 and Tektronix Codes and Formats.*

SYSTEM DIGITIZER OR STANDALONE

The RTD 720 is fully programmable via the IEEE-488.1 and conforms to Tektronix Standard Codes & Formats, with long waveform data support. This allows for easy integration in to existing systems and a strong basis for building new systems. The standard product is designed for system applications; with no display, limited human interface (only the power switch and functional indicator lights), signal connections in the rear, and ships ready to mount in a standard 19" instrument rack.

The optional instrument front panel provides control of the instrument, waveform display and cursor measurements. The detachable display unit provides better support for bench-top and ATE applications and is a powerful tool when developing system software. This unit can be snapped on to the front of the RTD 720 or used remotely from the instrument. For multiple unit applications, the front panel can be moved from instrument to instrument by simply moving the plug-in connector.

For faster response, the RTD 720 also provides 10 non-volatile instrument settings and powers up with the same settings as when it was powered down.

The **RTD 720** provides signal fidelity and digitizing performance necessary to capture waveforms with confidence.

CHARACTERISTICS

VERTICAL

Input Channels – Two, optional four (4), single ended. Simultaneous digitizing on all channels, in dual and quad modes of operation.

Input Range and Offset – Input range 100 mV to 20 V full scale input covered by 24 settings. Each range provides a signal offset capability and fast overdrive recovery.

Bandwidth (-3dB) – DC coupling; DC to 500 MHz. AC coupling; 1000 Hz to 500 MHz. All ranges ≥ 200 mV full scale.

Input Protection – Thermal cut-off on attenuator at 5 VRMS for ≥ 30 msec (can be overridden in firmware). Diode bridge protection to amplifier for pulses ≥ 15 V at the amplifier, response time ≤ 30 nsec.

Auto Calibration – (Accuracy after Auto Calibration - Mean value)

- ΔV DC Accuracy : ±(1.0% of signal + 0.5% of full scale).
- Offset Accuracy : ±(0.5% of input range + 0.5% offset range + 1.0% of offset).
- DC Zero-volt shift: < 1.0%.

TIME BASE

Internal Clock Frequency – 500 MHz ±50 ppm (20°C to 30°C). 500 MHz +50 ppm - 150 ppm (0°C to 50°C). Short-term stability 0.1 ppm/sec (50 Hz/sec). Long-term stability 50 ppm/10 years.

External Clock Input – 500 MHz ±200 ppm, 2 V peak to peak sine wave minimum amplitude with a 0 volt average. Input impedance 50 Ω ±3%.

DIGITIZING

Vertical Resolution – 8 bits providing 256 discrete levels (≥ 48 dB dynamic range). This provides a resolution of < 800 μV on the 200 mV full scale input range.

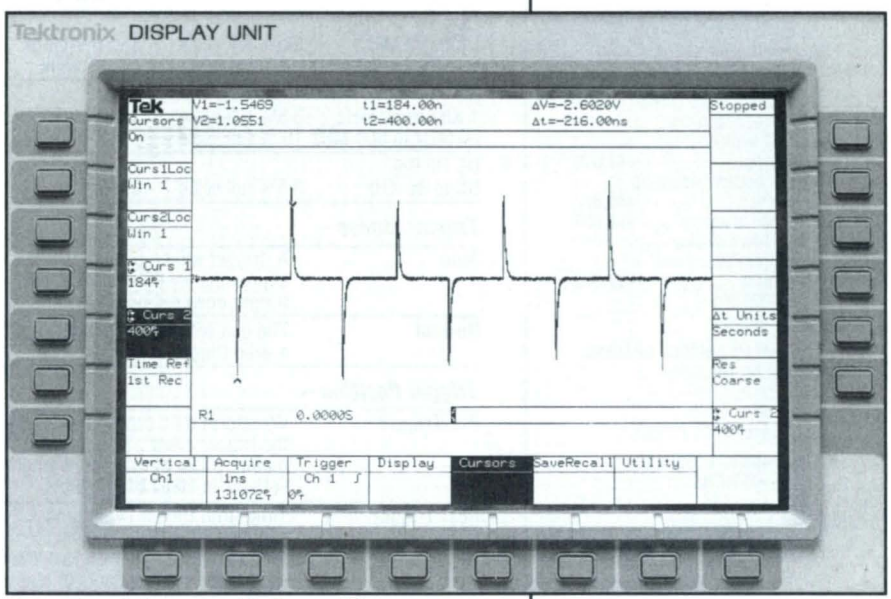
Maximum Sample Rates –

Single Channel	2 GS/s (500 psec/pt)
Dual Channel	1 GS/s (1 nsec/pt)
Four Channel	500 MS/s (2 nsec/pt)

Auto Calibration – Sets interleave timing between ADC's for single channel and dual channel operating modes for highest signal fidelity.

TYPICAL APPLICATIONS

- ***Impulse Phenomena***
  - *EMP and Radiation Simulators*
  - *Analysis of Fast Pulsed Events*
  - *Laser Induced Phenomena*
  - *High Energy Physics*
  - *Nuclear Effects*
- ***Pulse Echo Events***
  - *RADAR & LIDAR*
  - *High Frequency Ultrasonics*
- ***Long Record Length***
  - *Computer Mass Storage Devices*
  - *Media Characterization*
  - *Digital System Debug*
  - *Intelligence*



Front Panel close-up with Cursor Measurements

Acquisition Memory –

128K waveform points standard.
512K waveform points battery backed-up (optional).
1M waveform points (optional).

Acquisition memory is shared equally among all active channels (1, 2, or 4).

Multiple Records – Memory can be further segmented in up to 1024 records per channel.

Re-arm time between records - ≤ 5 μsec + pretrigger fill time. This allows capture of multiple triggered waveform events at an event rate of over 200,000 events per second and on all active channels. All records are time-stamped, for comparing time between events.

NEW

RTD 720 *FAST TRANSIENT DIGITIZER*

ORDERING INFORMATION

RTD 720 Waveform Digitizer **$23,200**
Includes: 2 input channels 128K acquisition memory; power cord (161-0066-12); Fuses; Instruction Manual (070-7294-00); Instrument Interfacing Guide (070-7295-00); User Reference Guide (070-7296-00); Rack Mount Kit.

INSTRUMENT OPTIONS

Opt. 06 – Four (4) acquisition channels (add 2 additional full function channels) **+$2,500**
Opt. 10 – 512K battery backed-up acquisition memory **+$5,500**
Opt. 11 – 1M acq. memory **+$6,900**
Opt. 19 – Attachable display unit for waveform viewing and instrument control **+$2,900**
Opt. 25 – Add PEP 301 Instrument Controller *1

***WARRANTY-PLUS* SERVICE OPTIONS**

M1 – 2 years + 2 calibrations *1
M9 – 2 years *1
Note: Options M1 and M9 available only at time of purchase.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 - A5 – Available **N/C**
See page 488 for description.

*1 *Contact your local sales representative*

TRIGGERING

Sources – Internal from any channel (either active or inactive channels may be used) or External.

Trigger Coupling & Impedance – DC, AC, or DC High Frequency Reject.

Impedance – Internal same as input channel coupling (50 Ω); External 50 Ω

Trigger Slope – Positive or Negative Slope.

Trigger Level Range & Accuracy – Internal ±62.5% of full scale input range in 0.5% steps with an accuracy of ±(1.0% of setting + 1.0% of input range). External ±6.2 V programmable in 50 mV steps with an accuracy of ±(3% of setting + 120 mV).

Trigger Sensitivity –

Coupling	Internal	External
DC		
DC to 50 MHz	3.5% full scale	350 mV pk-pk
50 MHz to 500 MHz	10% full scale	1 V pk-pk
AC		
1 KHz to 50 MHz	3.5% full scale	350 mV pk-pk
50 MHz to 500 MHz	10 % full scale	1 V pk-pk
DC HF Rej		
DC to 30 KHz	3.5% full scale	350 mV pk-pk

Trigger Modes –

Auto	A trigger will be generated after approximately 60 msec if a valid trigger does not occur.
Normal	The unit will wait indefinitely until a valid trigger occurs.

Trigger Position –

Pre-Trigger	Waveform data captured prior to the trigger event. To approximately 100% of the record length settable in steps of 64 points.
Post Trigger	Time from trigger event until acquisition begins. To over 30,000,000 sample intervals after the trigger event settable in steps of 64 points. Waveform acquisition begins after the Post Trigger Position and captures the full defined record length.

Arming – Internal or External Arming. Triggers are not recognized until the unit is armed.

Auto Calibration – Sets level accuracy of trigger input and aligns trigger to record timing.

COMPUTER INTERFACES

GPIB IEEE-488.1 – Interface is standard for instrument control and waveform data transfer. Maximum transfer rate ≥ 500K bytes/second. All instrument functions, settings and operating modes are programmable, with the exception of the power switch.

Parallel Port – A waveform data output only 16 bit parallel port is provided capable of 5M byte/sec (2.5M words/sec). This provides TTL level outputs and has operating modes to allow use with a wide range of computers.

Data Throughput – The interface hardware and instrument command set are structured to provide a high output capability for logging information to a computer or other outboard memory device.

DISPLAY & INSTRUMENT CONTROL

Attachable Display Unit – There is an optional display available that provides for waveform viewing and instrument control. This display can be remotely mounted and moved from instrument to instrument by simply moving the connecting cable. This offers the instrument operator full control of the instrument plus the ability to view captured waveform data. The waveform data display provides viewing of up to 4 waveforms at a time with cursor measurement capabilities and waveform display expansion in both time and amplitude. The waveform expansion capability allows viewing, as an example, a full 1M long waveform or zooming in for closer examination of details of interest. The display also supports a video hardcopy capability of all information and waveform data on the display.

ENVIRONMENTAL (STANDARD INSTRUMENT)

Temperature Range – Operating: –10 to 55°C; Nonoperating: – 51 to 71°C.

Humidity – 0% to 95% relative humidity (Noncondensing) to 55°C.

Altitude – Operating: 4,750 m (15,000 ft.) ; Nonoperating: 15,240 m (50,000 ft.).

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 W fully optioned

Electromagnetic Compatibility – The RTD 720 qualifies under test limits specified in FCC Part 15, subpart J Class A and VDE 0871 Class B.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width	482.6	19
Height	225.25	8.75
Depth	635	25
Weight ≈	**kg**	**lb**
Net	19	49

Warranty – The RTD 720 carries a standard Tektronix one-year warranty covering labor and replacement parts. Options are available for extended warranty coverage.

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 one 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.

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 timebase 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 5 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.

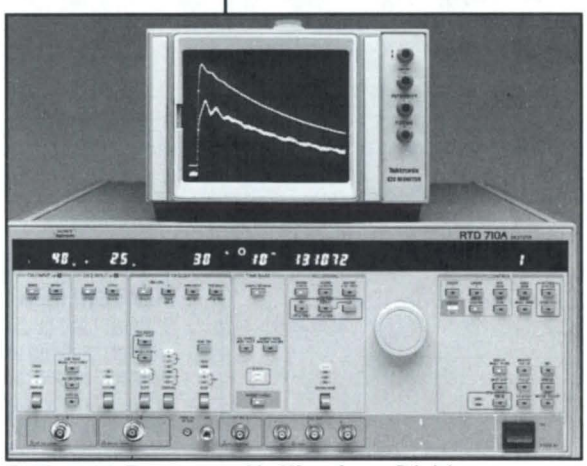
In Comparison triggering mode, the RTD 710A continuously acquires events and compares them to reference-waveform values. If an event deviates from the range of values (Compare Out mode) or lies entirely within them (Compare In mode), the waveform is held for further analysis.

FEATURES/BENEFITS

- *200 MS/s Single Channel*
- *100 MS/s Dual Channel*
- *100 MHz Analog Bandwidth*
- *10 Bit Vertical Resolution*
- *256K Word Waveform Memory*
- *Hardware Signal Averaging*
- *Internal/External A/D Clocking*
- *Cursor Measurements of Time, Voltage and Frequency*

TYPICAL APPLICATIONS

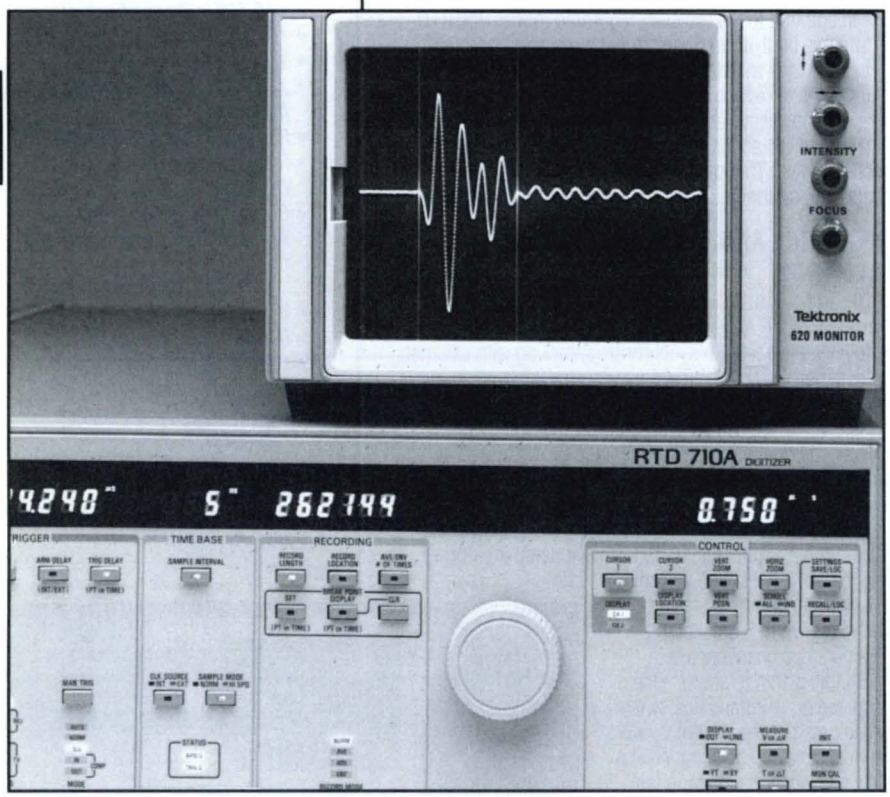
- *Video and HDTV*
- *Ultrasonics, Radar, Lidar*
- *High Voltage Impulse Testing*
- *Power Supply & Power Conversion*
- *Communications and EW*
- *CCD Development*
- *Semiconductor & Hybrid Test*
- *ATE Systems*



RTD 710A Programmable Waveform Digitizer

GPIB IEEE-488 *

**The RTD 710A Digitizer complies with the IEEE Standard 488.1 and Tektronix Codes and Formats.*



RTD 710A Cursor Display on Tektronix 620 Monitor

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.

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.

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.

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 –3dB 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.

Sample Rate Switching – Up to 5 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 nonsystem-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.

COMPUTER INTERFACE

GPIB – IEEE-488.1 interface is standard for instrument control and waveform data transfer. Maximum transfer rate ≥ 250K bytes/second. 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 M Ω.

Feed-Through Connectors – Three 50 Ω coaxial cables for front-to-rear signal connections.

Direct A/D Output – 50 pin AMPMODU MT connector. Channel 1 and Channel 2 digitized signals available. ECL-compatible signal levels. Maximum data rate is 100 Mega-words per second (20 bit word). Contact 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).

Electromagnetic Compatibility – The RTD 710A qualifies under test limits specified in FCC Part 15, subpart J Class A and VDE 0871 Class B.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width	429	16.9
Height	177	7.0
Depth	643	25.3
Weight ≈	**kg**	**lb**
Net	23.5	51.8

ORDERING INFORMATION

RTD 710A Waveform Digitizer **$21,900**
(161-0123-00); Fuses (8A & 4A); Instruction Manual (070-7204-00); RTD 710A Instrument Interfacing Guide (070-7207-00).

INSTRUMENT OPTIONS

Opt. 05 – Video Trigger **+$1,495**
Opt. 19 – Blank Front Panel (Includes Rack Mount Assembly) **–$500**
Opt. 1R – Rack Mount Package **+$395**

OPTIONS

Opt. A1- A5 – Available **NC**
See page 488 for description.

WARRANTY-PLUS SERVICE OPTIONS

Opt. M1 – 2 years + 2 cals. **+$1,800**
Opt. M9 – 2 years **+$800**
Note: Options M1 and M9 available only at time of purchase.

OPTIONAL ACCESSORIES

Rack Mount Kit –
Order 016-0886-02 **$435**
Service Manual –
(Vol. 1.) Order 070-6398-00 **$60**
(Vol. 2.) Order 070-6399-00 **$60**
GPIB Cable – 2 meters
Order 012-0991-00 **$160**
A/D Out Cable – 2 meters
Order 012-1117-00 *1
HC100 – Color Plotter
Opt. 01 - GPIB Cable **$895**

*1 *Contact your local sales representative*

9503/9504 FAST DATA CACHE

NEW Fast Data Cache

FEATURES/BENEFITS

- ***Long Record Length***
  - *4 Mwords Total in 9503*
  - *Up to 32 Mwords in 9504*
- ***Data Rates to 100 Mwords/s, Dual Channel or Interleaved for 200 Mwords/s, Single Channel***
- ***16 bit or 8 bit Word Width Selectable***
- ***GPIB Controlled***
- ***ECL or TTL Data Inputs (25 Mwords/sec.TTL)***

TYPICAL APPLICATIONS

- ***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***

9503/9504 FAST DATA CACHE

- Extremely Long Record Length
- Data rates to 100 Mwords/sec
- 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 nonexpandable memory buffer configured for 2 Mwords per channel or 4 Mwords single channel. The *9504* is an expandable memory buffer that starts with 4 Mwords total memory and can be increased to a total of 32 Mwords.

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 its class. The 9503 and 9504 support the high speed single channel mode of the RTD 710A to capture data up to 200 Mwords/second.

The 9503 or 9504 provides storage of long data records obtained from high speed analog-to-digital converters. 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 it fully compatible with the A/D outputs of the RTD 710 and RTD 710A waveform digitizers. It also accepts data from the RTD 710/A operating in the high speed mode to provide data storage at an effective sampling rate of 200 megawords per second. The standard configuration for either product provides 2 megawords of memory per channel. The 9503 memory length is fixed at 2 megawords per channel.

The 9504 can be configured with additional 2 megaword memory cards to provide a maximum of 16 megawords of memory per channel.

ECL DIFFERENTIAL OR TTL LEVEL INPUTS

The 16 data bit inputs are selectable in groups of 4 under program control to 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.

THE 9503 AND 9504 FAST DATA CACHE

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 710 and RTD 710A. These system units are GPIB-controlled, and stored data is output via GPIB or over the high speed parallel port.

OPERATIONAL MODES

NORMAL (Independent) Mode

Both channels accept independent data streams and triggers.

INTERLEAVE Mode

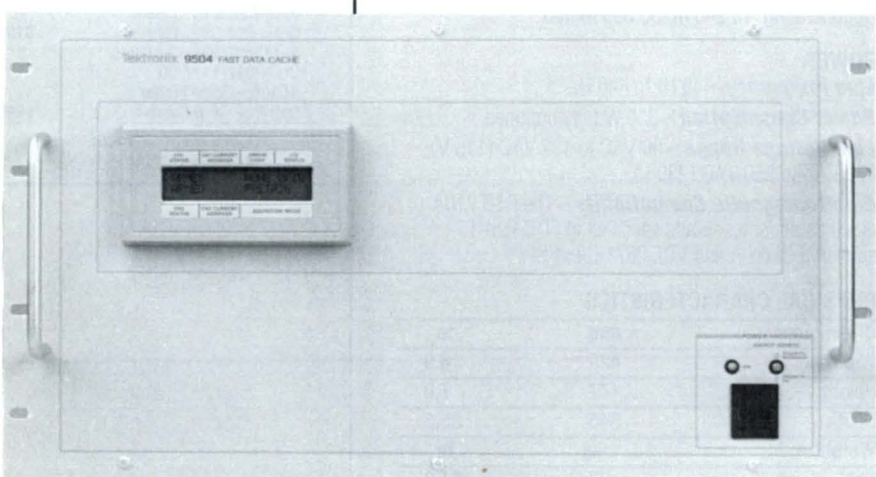
Allows storage of data from channel one memory to be interleaved with data from channel two memory. Supports the RTD 710A high speed mode at 200 Mword/sec single channel. Assumes RTD 710A channel one data point zero to be first in combined record.

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.



9504 Fast Data Cache Memory Buffer

GPIB IEEE-488 *

**The 9500 Series of Fast Data Caches complies with the IEEE Standard 488.2 and Tektronix Codes and Formats*

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 100MHz: 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.

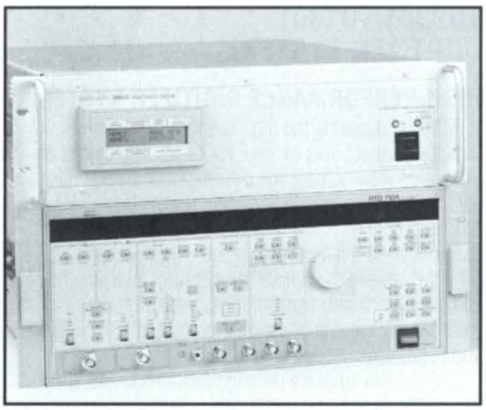
MEMORY SIZE

9503: 2 MWords/channel: or 4 MWords total.
9504: 2 MWords/channel; Expandable to 16 MWords/channel or 32 MWords total.

COMPUTER INTERFACES

GPIB – IEEE-488.2 and Tektronix Codes and Formats.

Parallel Port – A waveform data (output only) 16 bit parallel port is provided capable of 5M byte/sec (2.5M words/sec). This provides TTL level outputs and has operating modes to allow use with a wide range of computers.



RTD 710A with 9503 Fast Data Cache

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 (15000 ft) max. Nonoperating: 15,240 m (50000 ft) max.

POWER

Line Frequency – 48 to 63 Hz.

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 Volts DC, 100 mA maximum (fused).
9504: 4.75 to 15 Volts DC, 450,mA maximum (fused).

PHYSICAL CHARACTERISTICS

	9503		9504	
Dimensions	**in**	**mm**	**in**	**mm**
Height	5.25	133	10.5	267
Rack Depth	22.6	574	22.6	574
Overall Depth	24.5	622	24.5	622
Width	19.0	483	19.0	483
Weight ≈	**lb**	**kg**	**lb**	**kg**
Net	27	12.3	38	17.3

9504F01 FAST DATA CACHE MEMORY MODULE

Two megawords (4 MBytes). Adds 2 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	**$18,000**
9504 Fast Data Cache Unit	**$23,000**
9504F01 Fast Data Cache 2 Megaword memory Module	**$7,000**

INSTRUMENT OPTIONS

Opt. 1 – (8 MW total) Adds 2 ea 9504F01	**+$13,200**
Opt. 12 – (12 MW total) Adds 4 ea 9504F01	**+$26,400**
Opt. 13 – (16 MW total) Adds 6 ea 9504F01	**+$39,600**
Opt. 14 – (20 MW total) Adds 8 ea 9504F01	**+$52,800**
Opt. 15 – (24 MW total) Adds 10 ea 9504F01	**+$66,000**
Opt. 16 – (28 MW total) Adds 12 ea 9504F01	**+$79,200**
Opt. 17 – (32 MW total Adds 14 ea 9504F01)	**+$92,400**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 - A5 – Available	**NC**

See page 488 for complete description.

FEATURES/BENEFITS

- *Interactive Measurement Software*
- *MS-DOS Compatible*
- *Flexible Waveform Graphics*
- *Broad Hardcopy Support*
- *Automated Setup of Instrumentation*
- *Multi-channel Waveform Acquisition*
- *Time and Frequency Domain Analysis*
- *Flexible Graphing Formats*
- *Interactive Operation from Menu with User Defined Macros for Efficiency*
- *MS-DOS Platform Provides Broad Software Compatibility*

TYPICAL APPLICATIONS

- *High Energy Physics*
- *Ultrasonics, Radar, Lidar*
- *High Voltage Impulse Testing*
- *Power Supply and Power Conversion*
- *Communications and EW*
- *Video and CCD Development*
- *Semiconductor and Hybrid Test*

TD2301/TD1301 DIGITIZER SYSTEMS

HIGH-PERFORMANCE DIGITIZER SYSTEMS

TD1301 supports the high-resolution transient digitizing capabilities of the RTD 710A. It provides an integrated viewing package with digitizer and monitor enclosed in a standard instrument rack.

The TD2301 system includes a Tektronix PEP 301 controller and interactive software. This package provides waveform capture, processing, analysis, display and storage. Instrument settings, measurement environments and application macros can also be stored and recalled as needed.

The system software package contains broad support for waveform analysis and graphic display of results. An interactive mode is provided through a direct menu scheme. Keystroke macros can be used to reduce many operations to a single menu selection. Collections of macros can be stored and recalled as needed to suit the measurement problems at hand. Each macro is assigned a user-provided description to facilitate selection.

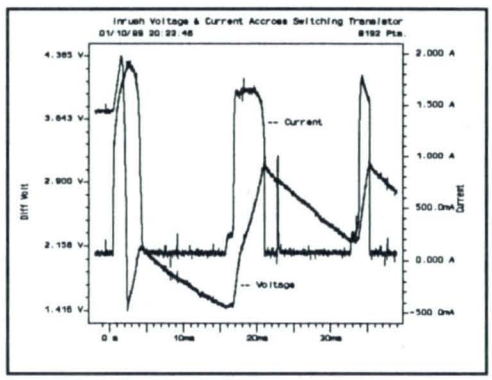
The Tektronix PEP 301 controller provides excellent processing power for waveform analysis and high quality graphics. This high-performance MS-DOS compatible platform provides support for data collection and analysis, report generation, database management, and communications with other computing resources.

ACQUISITION

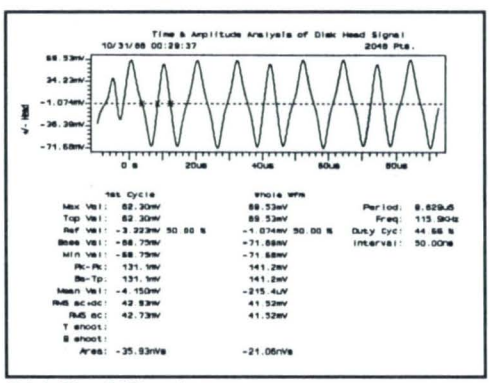
Waveform data can be acquired from one or several RTD 710A digitizers. Probes and transducers are directly supported with scaling and unit correction for proper data representation.

PROCESSING

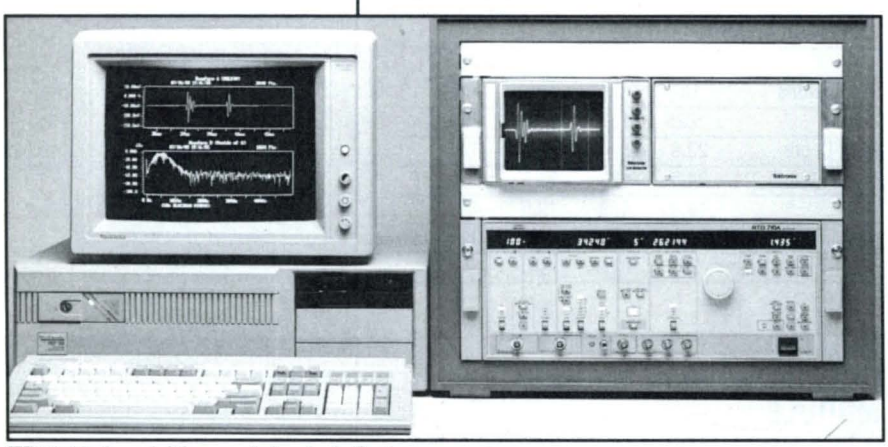
Waveform processing operations such as multiplication and integration for power and energy measurements are provided. Other functions such as subtraction, differentiation and cross-correlation are also available.



V and I on Dual-Axis Plot



Disk Head Waveform



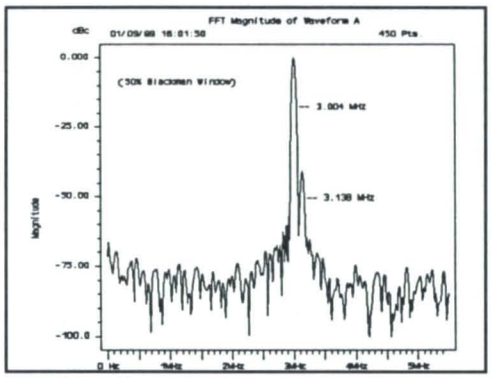
TD2301 Acquisition and Analysis System

GPIB IEEE-488 *

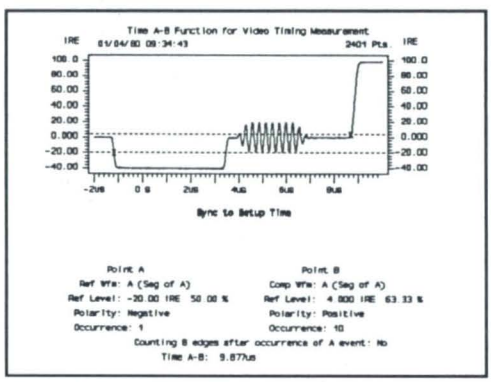
**The TD2301/TD1301 Series of Digitizers complies with the IEEE Standard 488.1-1987 and Tektronix Codes and Formats*

ANALYSIS

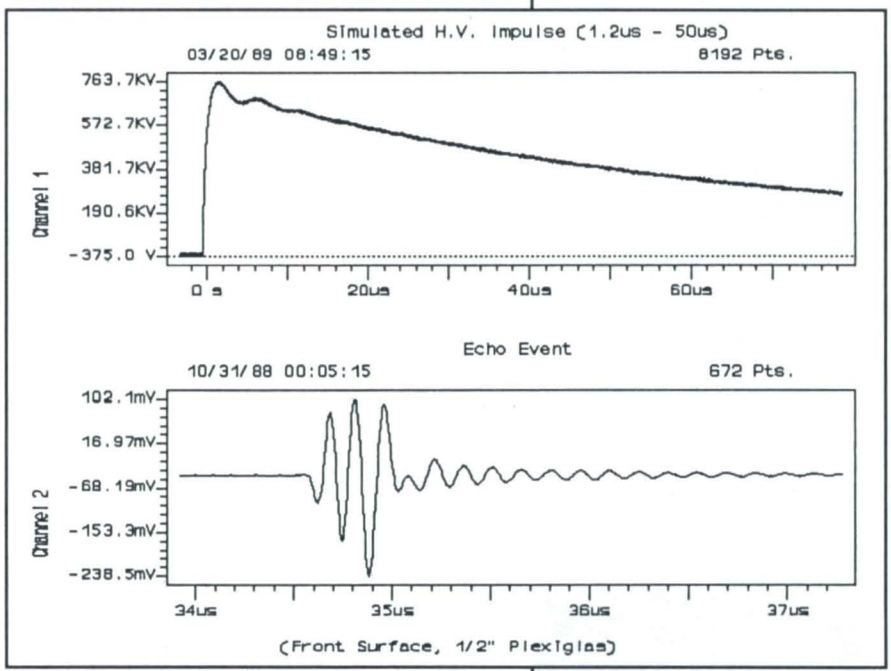
Analysis of transient and periodic waveforms is supported through routines that extract a large number of time and amplitude parameters. Timing measurements can be made on one or several waveforms with flexible control over event determination. An FFT magnitude and phase function provides frequency domain information with a number of scaling and display options.



FFT Magnitude Display



Time A-B on Video Signal



Typical Display of Transient Events

DISPLAY

High-performance display capabilities of the PEP 301 controller are well supported with many flexible graphing formats. The user can select single or multiple waveform displays and graphs with a variety of axis styles. Hardcopy support for a large number of output devices is provided.

STORAGE & RECALL

Waveform data, instrument settings, measurement environment information and user macros can all be stored and recalled from files. This reduces the time it takes to set up the system and make accurate, repeatable measurements.

MEASUREMENT SOLUTIONS

The TD2301 system provides a solution to many measurement problems in research and development applications. Flexible, efficient software and MS-DOS compatibility provide support for today's needs as well as future requirements.

ORDERING INFORMATION

TD2301 Waveform Acquisition and Analysis System — **$34,900**
Includes: RTD 710A; 620 Monitor; PEP 301 Controller; Interactive Software (S45D010); Cables; Mounting Hardware; Accessories and Cabinet.

TD1301 Waveform Acquisition and Viewing Package — **$24,500**
Includes: RTD 710A; 620 Monitor; Cables; Mounting Hardware; Accessories and Cabinet.

S45D010 Interactive Measurement Software — **$1,495**
Includes: Interactive Software on 5-1/4" Floppy Disk; Documentation;Function Key Overlays.

INSTRUMENT OPTIONS

Opt. 1D – Delete Cabinet — **–$750**

Opt. 2D – Delete RTD 710A Front Panel (Blank Panel) — **–$500**

Opt. 05 – Add RTD 710A TV Trigger — **+$1,495**

Opt. 1H – Add HC100 Plotter (120V) — **+$990**

Opt. 2H – Add HC100 Plotter (240V) — **+$990**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 - A5 – Available — **NC**
See page 488 for description.

RELATED SOFTWARE

SPD Signal Processing and Display Library – **$995**
Order S3FG130

Transient-Digitizing Oscilloscope

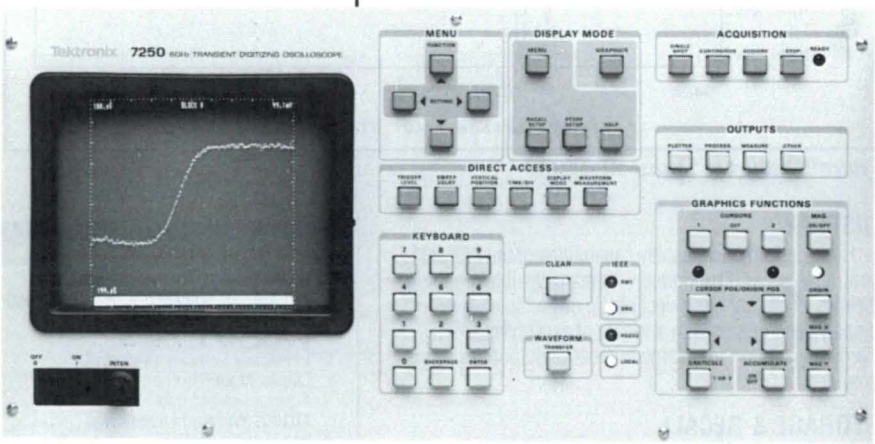
- *50-ps Rise Time*
- *11-Bit (2048-Point) Vertical Resolution*
- *9-Bit (512-Point) Horizontal Resolution*
- *50-ps/Div Fastest Sweep*
- *5-V Full-Scale Sensitivity*
- *Fully Programmable Via GPIB*
- *Internal Memory that Saves 15 to 31 Waveforms*
- *Built-In Waveform-Parameter Measurements*
- *Sinusoidal Sweep (Rossi) Input Capability Up To 3 GHz*

7250 6-GHZ TRANSIENT DIGITIZING OSCILLOSCOPE

The 7250 Transient-Digitizing Oscilloscope is an instrument that can acquire fast single-shot or repetitive signals and display them digitally. It is designed specifically to capture and record very high-frequency, fast rise-time, single-shot pulses. The instrument provides a dc to 6 GHz (3 dB) bandwidth, 50-ps rise time, and is fully programmble via an IEEE Standard 488 Interface.

TRANSIENT DIGITIZING LETS YOU VIEW AND DIGITIZE SINGLE-SHOT EVENTS OR NONREPETITIVE WAVEFORMS

The scan conversion used in the 7250 lets you do all this at very high frequencies and fast rise times, something most digitizing oscilloscopes cannot do. Waveforms are processed for display on a raster scan type monitor.



6-GHz Transient-Digitizing Oscilloscope

GPIB* IEEE-488

Other major features of the 7250 are menu-driven operation and on-screen cursors for ease of operation. Fast setup, immediate feedback with the built-in monitor, and interactive controls also contribute to operating ease.

Split-screen operation lets you compare a stored waveform with a newly acquired waveform or display two acquisitions on the same screen simultaneously. The ability to measure important waveform parameters is built-in. Also, the instrument is designed to rigorous standards for modularity, easy repair, and ruggedness. It is built to maintain its performance in adverse environments.

APPLICATIONS

Particle Physics Research

The challenge in this type of research is the recording of nonrepetitive, high-voltage, fast-rise, narrow pulses. The 7250 was built specifically for these kinds of measurements and handles them with ease. These types of signals cannot be measured on most digitizers or digital-storage oscilloscopes because of the high frequencies and fast transition times involved.

High-Power Laser Research

A transient-digitizing oscilloscope is the ideal instrument for capturing transient electrical phenomena in laser research as well. The 7250 can capture and digitize this data and, because the instrument is fully programmable and GPIB compatible, the data can be fed directly to a computer for fast analysis after each laser shot.

CHARACTERISTICS

VERTICAL

Bandwidth – DC to 6 GHz (3 dB).

Rise Time – 50 ps ±5 ps.

Sensitivity – 5 V ±15%, full scale.

Input Impedance – 50 Ω ±2 Ω.

Input VSWR – Less than 1.5 (DC to 2 GHz), less than 2.5 (2.5 to 7 GHz).

Loopthrough Transmission-Line Loss – 2 dB (0 to 5 GHz).

Maximum Input Voltage – 2 kV (1-µs duration).

Vertical Position – 0 to 100% in 1% steps.

HORIZONTAL

Sweep Rates – 1 µs to 50 ps/div, 14 ranges in a 1-2-5 sequence.

Sweep Accuracy – 2% over center 8 divisions.

Sweep Linearity – 1.5% of full scale on center 8 divisions. No worse than 0.15 division in any one division.

TRIGGERING

Source – External triggering only. Requires a pretrigger signal with a time duration of 50 ns, ±1 time/div setting. Optional delay line provides trigger pickoff.

Coupling – direct.

Trigger Level – Programmable 10 mV to 10 V in two ranges.

Modes – Normal: pulse duration greater than 10 ns; Fast: pulse duration greater than 400 ps and less than 20 ns.

Input Impedance – 50 Ω ±5%.

Maximum Input – 250 mW, 500 V peak-to-peak at 1 µs duration.

Jitter – 100 ps or less (peak-to-peak).

Delay Drift – ±500 ps, over the period of 10 minutes to 1 hour at 50 ps/div and 100-ns sweep delay.

Sweep Delay – Minimum delay 50 ns ±2 ns. Adjustable in 5 ranges: 50 to 100 ns (50-ps resolution), 100 to 150 ns (100 ps resolution), 150 to 500 ns (500 ps resolution), 500 ns to 1 µs (1 ns resolution), and 1 to 5 µs (5 ns resolution).

DIGITIZER

Resolution – 11 bits vertical, 9 bits horizontal (2048 vertical points, 512 horizontal points).

Memory – Internal memory to save 15 waveform acquisitions (31 acquisitions with optional extended memory) with five-year battery backup. Can also save 4 front-panel setups.

**With minor exceptions, the 7250 complies with IEEE Standard 488.1-1987 and with Tektronix Standard Codes and Formats.*

WAVEFORM PROCESSING

Target Defect Correction – Corrects for defects in the reading-tube image target.

Filtering – Redundant Y values are suppressed and missing Y values are created (interpolation).

Smoothing – Mathematical smoothing operation based on averaging over adjacent points.

ACQUISITION MODES

Single Shot – Acquires and displays a waveform one time.

Continuous – Continuously acquires and displays waveforms.

Burst – Acquires and stores several waveforms in successive memory blocks. Number of acquisitions is set by the user up to the maximum memory locations.

Average – Acquires and averages a number of waveform acquisitions, then displays the averaged waveform. Number of averages is set by the user, 256 maximum.

Envelope – Acquires a number of waveforms set by the user, 256 maximum. After the last acquisition, the envelope is updated, and the waveform is displayed.

Defects Correction – Acquires a waveform a number of times set by the user. A table of faults from the waveform is updated in memory for subtraction from any stored waveform.

Electrical Zero – Allows acquisition of an electrical baseline.

WAVEFORM MEASUREMENT

Graticules – Full screen or border only.

Cursors – Two vertical cursors with CRT readout of x and y coordinates of cursor and waveform crossing point, plus delta time and voltage between cursors.

Magnifier – Cross-hair type cursors for setting display window to be magnified. Provides up to 16 times magnification both vertically and horizontally.

Automatic Measurement – Min/max, peak-to-peak, average value, RMS value, rise time/fall time, pulse width, delay time, delta time.

INPUTS/OUTPUTS

Signal Input, Signal Output – N-type connectors.

GPIB – For use with controller.

Control Video – BNC connector.

Trigger Input – BNC connector.

RS-232-C – Plotter output only.

Video Monitor – CCIR output and sync input.

External Sweep Input – Allows use of sinusoidal (Rossi) sweep to 3 GHz.

OPT. 01 EXTERNAL DELAY LINE

Bandwidth – ≥ 4.5 GHz.

Attenuation – 4.5 dB ±0.5 dB.

Delay – 55 ns ±2 ns.

Rise Time – ≤75 ps.

Maximum Input Voltage – 5 V dc.

Maximum Pulse Input – 60 V.

Input Impedance – 50 Ω ±5%.

Input/Output Connectors – N type.

Trigger Pickoff – Attenuation, 20 dB ±1 dB; rise time, 300 ps; connector, BNC.

ENVIRONMENTAL

Temperature – Operating: 0°C to 40°C. Nonoperating: -10°C to 70°C.

Altitude – Operating: 3,048 m (10,000 ft). Nonoperating: 12,192 m (40,000 ft).

Humidity – Operating: 90% at 40°C.

POWER REQUIREMENTS

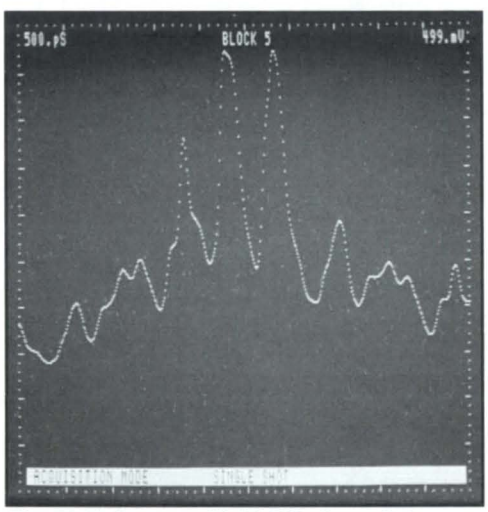
Line Voltage – 115 V ±10%, 220 V ±10%.

Line Frequency – 50 to 60 Hz ±4%.

Power Consumption – 200 W.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width	483	19.0
Height	222	8.7
Depth	915	36.0
Weight ≈	**kg**	**lb**
Net	60	132.3
Shipping	110	242



The 7250 Captures Multi-GHz Laser Pulses.

ORDERING INFORMATION

7250 6-GHz Transient-Digitizing Oscilloscope **$104,000**
Includes: operators manual (070-6401-01); service reference manual (070-7133-00).

INSTRUMENT OPTIONS

Opt. 01 – External delay line **+$12,500**
Opt. 2D – Extended memory **+$2,400**
Opt. 1D – Fast Acquisition **+$4,995**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro, 220 V, 50 Hz **NC**
Opt. A2 – UK 240 V, 50 Hz **NC**
Opt. A5 – Switzerland 220 V, 50 Hz **NC**

ACCESSORIES

HC01 – 4 x 5 in. Video Copier **$1,300**
HC02 – 8 x 10 in. Video Copier **$1,710**

RECOMMENDED SOFTWARE

See page 488.

FEATURES/BENEFITS

- ***Transient Event Capture at 200 GS/s***
- ***High Analog Bandwidth*** *– 4.5 GHz with SCD5000 –1 GHz with SCD1000*
- ***Time Resolution to 5 psec/ Point***
- ***Record Lengths from 256 to 1024 Points***
- ***Self-Calibration for Highest Accuracy***
- ***Optional Detachable Touch-Screen Front Panel with Cursors***

SCD5000/SCD1000 TRANSIENT DIGITIZERS

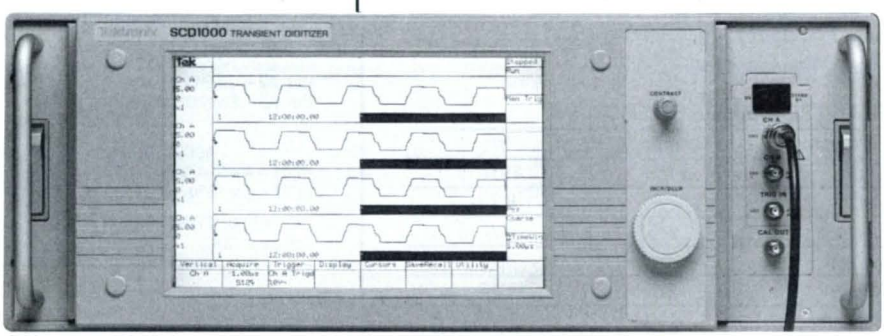
- Ultra High Bandwidth Transient Capture
- Extremely Fine Time Resolution
- Detachable Touch-Screen Front Panel with Cursors

HIGH PERFORMANCE DIGITIZERS

The NEW *SCD5000* with 4.5 GHz analog bandwidth and *SCD1000* with 1 GHz bandwidth are a family of high bandwidth, fast sample rate digitizers for accurate capture of transient pico second information.

CAPTURING THE ELUSIVE SIGNAL

With time windows from 5 nsec to 100 µsec, the SCD5000 and SCD1000 provide detailed time resolution for the event of interest. The waveform record length is selectable among 256, 512, or 1024 data points. The SCD5000 uses direct access with an input range of 5 volts. The SCD1000 provides quality conditioning of the input signal with 100 mV to 10 V full scale ranges , DC offset and DC and AC input coupling.



SCD1000 Waveform Digitizer with optional front panel

GPIB* IEEE-488

The SCD5000 has 9 bits and the SCD1000 has 11 bits of vertical resolution after centroid processing. Raw target data is also available for viewing or transfer for user defined processing.

**The SCD5000/SCD1000 Series of Digitizers complies with the IEEE Standard 488.1 and Tektronix Codes and Formats*

SYSTEM SUPPORT

The SCD5000 and SCD1000 are designed for system use with a fast GPIB interface and commands to make data acquisition flexible and fast. With 16 waveform storage locations, multiple trigger events can be stored into separate storage locations. Each record is time and date stamped for later comparison.

INTERFACING TO THE OUTSIDE WORLD

The SCD5000 is a direct access digitizer with 50 Ω impedance. The SCD1000 has two input paths to the converter, channels A or B. The user can select to digitize channel A or channel B or the addition of signals A+B. The add mode allows for time-tieing signals from multiple units or referencing event timing to another event by algebraically adding the two signal inputs. The external trigger input offers a bandwidth of 1.0 GHz, adjustable level selectable slope and 50 Ω input impedance. A VGA compatible video output port allows viewing waveform data on a larger monitor or monitoring several units from a single location.

OPTIONS EXPAND CAPABILITY

The optional detachable front panel uses a touch screen and a parameter entry knob for easy waveform viewing, instrument control and local cursor measurements. It can be used by the GPIB controller to display operator prompts and indicate choices. Service contract options extend the warranty of the SCD5000 and SCD1000 and provide scheduled calibrations.

SCD5000 CHARACTERISTICS

VERTICAL

Input Range – ±2.5 v direct access.

Analog Bandwidth – DC coupled; DC to 4.5 GHz (< 80 psec risetime)

Input Impedance – DC coupled; 50 Ω.

Maximum Input Voltage – 5V RMS 0.5 W or 0.25 W-s. Pulses not exceeding 25 V peak.

VSWR – ≤ 1.5 @ ≤ 3.5 GHz

HORIZONTAL

Time per Point – 5 ps/point (200 GS/s) (5 ns time window with 1024 point record length) to 400 ns/point (2.5 MS/s) (100 µs time window with 256 point record length).

Time Windows – 5 ns to 100 µs in a 1, 2, 5 sequence of 14 steps.

DIGITIZING

Vertical Resolution – 9 bits (512 discrete levels).

Record Length – 256, 512 or 1024 waveform data points.

Self-Calibration – Internal signal standards for increased time and amplitude acuracy.

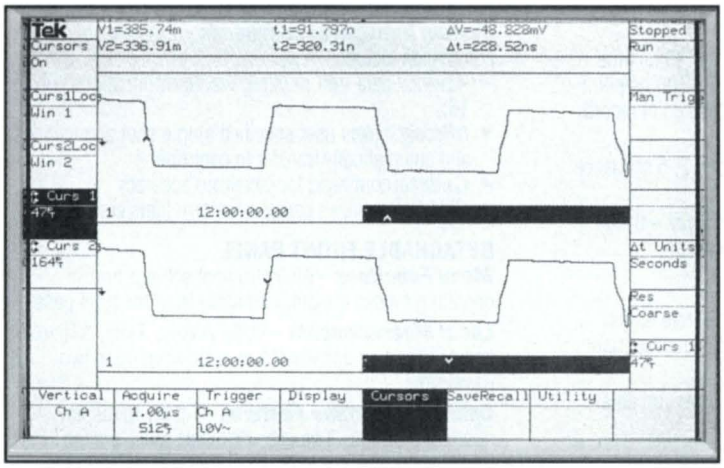
Multiple Records – 16 waveform locations.

Time Stamping – Time and date stored with each record.

TRIGGERING

Sources – External analog, GPIB command and manual trigger key with detachable front panel (optional).

Trigger Level Range – External analog; ±1.25 V in 10 mV steps.



Touch Screen Front Panel with Two Waveforms Displayed

Trigger Sensitivity (Sine wave) –

External input:	50 mV, 20 kHz to 50 MHz
	150 mV, 50 MHz to 500 MHz
	350 mV, 500 MHz to 1 GHz

Trigger Sensitivity Pulse – Minimum of 500 ps HAD (half amplitude duration) pulse, 150 mV.

Coupling – External; AC only

Slope – Positive or Negative

COMPUTER INTERFACE

GPIB – IEEE-488.1 Interface is standard for instrument control and waveform data transfer. Maximum transfer rate ≥ 500K bytes/second. All instrument functions, settings, and operating modes are programmable, with the exception of the power switch.

System Throughput Commands – Examples include:

- *Advance* data into multiple waveform locations up to 16).
- *NRepeat* makes user specified single shot acquisitions and automatically transfer to controller.
- *Calibrate* command for increased accuracy
- *Data Count* allows partial waveform transfers

DETACHABLE FRONT PANEL

Menu Functions – Instrument settings and operating modes are programmable from the front panel.

Local Measurements – Volts, ΔVolts, Time, ΔTime, and 1/ΔTime on one waveform or between up to four waveforms.

Operator Interface Features – Ability to display operator prompts. Two user-definable touch screen keys for allowing operator to control program flow from the SCD1000 front panel. Operator prompts can be written to the waveform area using ASCII and special characters.

SIGNAL CONNECTIONS

Chan A Input, and External Trigger In Connectors – Type N connectors on front panel.

Gate Out – Single BNC connector on back panel, output is coincident with start of sweep.

Video Out – TTL VGA compatible video signal output on back panel.

Cal Out – BNC on back panel

ENVIRONMENTAL (STANDARD INSTRUMENT)

Temperature Range – Meets Mil-T-28800D type III, Class 5.
Operating: – 0°C to + 50°C.
Non-operating: – 55°C to + 75°C.

Humidity – Meets Mil-T-28800D type III, Class 5, Up to 95% relative humidity, (Non-Condensing).

Altitude – Exceeds Mil-T-28800D type III, Class 5.
Operating: 4,250 m (15,000 ft.) maximum.
Non-operating: 15,240 m (50,000 ft.) maximum.

Electromagnetic Compatibility – FCC, VDE, and Mil-Std-461B/462.

POWER

Line Frequency – Operational from 48 Hz to 440 Hz.

Power Consumption – < 250 W maximum fully optioned.

Line Voltage Range – 90 to 132 V RMS (115 V); 180 to 250 V RMS (230 V).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width	482.6	19
Height	177.8	7
Depth	762	30
Weight ≈	**kg**	**lb**
Net	24.5	54

SCD1000 CHARACTERISTICS

VERTICAL

Input Range – 100 mV to 10 V full scale input in a 1, 2, 5 sequence (7 steps).

Input DC Offset range – ±2.5 times input range (peak to peak).

Input DC Offset resolution – 0.05 times input range (101 steps).

Analog Bandwidth – DC coupled; DC to 1.0 GHz (< 350 ps risetime), AC coupled; 100 kHz to 1.0 GHz.

Input Impedance – DC coupled; 50 Ω , AC coupled; 50 Ω in series with 2.2 µf, Power Off/Coupling Off; provides a 500 KΩ impedance to the signal input and grounds the input amplifier.

TYPICAL APPLICATIONS

- ***Impulse Phenomena***
  - *EMP and Radiation Testing*
  - *Analysis of Fast Pulsed Events*
  - *Laser Induced Phenomena*
  - *High Energy Physics*
  - *Nuclear Effects*
  - *Lightning Research*
- ***Ultra High Speed***
  - *High Energy Pulsed Power Sources*
  - *Semiconductor/Hybrid Characterization*
  - *Communications*
- ***Pulse Echo Events***
  - *RADAR & LIDAR*
  - *High Frequency Ultrasonics*

NEW

SCD5000/SCD1000 *ULTRA HIGH SPEED TRANSIENT DIGITIZERS*

ORDERING INFORMATION

SCD5000 Waveform Digitizer *1
Includes: Standard configuration without detachable front panel; Power cord (161-0123-00); Instruction Manual; Instrument Interfacing Guide; Rackmount hardware; and spare fuses.

SCD1000 Waveform Digitizer *1
Includes: Standard configuration without detachable front panel; Power cord (161-0123-00); Instruction Manual; Instrument Interfacing Guide; Rackmount hardware; and spare fuses.

OPTIONS

Opt. 19 – Add detachable touch-screen front panel *1
Opt. 25 – Add PEP301 GPIB Instrument Controller *1
Opt. 1E – (SCD1000 only) Type II probe interface *1
Opt. 2E – SMA Input Connectors *1

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 - A5 Power Cord Available NC
See page 488 for description.

***WARRANTY-PLUS* SERVICE OPTIONS**

Opt. M1 – 2 years plus 2 cals *1
Opt. M9 – 2 years *1
Note: Options M1 and M9 available only at time of purchase.

OPTIONAL ACCESSORIES

SCD1000 – Service Manual. Order 070-7316-00 *1
GPIB Cable – 2 meters. Order 012-0991-00 $160
SMA to BNC Adaptor – Order 015-1018-00 $11

*1 *Contact your local sales representative*

Maximum Input Voltage – 5 V RMS (0.5 W) or 0.25 W-sec. Pulses not exceeding 25 V peak. Input circuit protection of amplifier and attenuators are provided.

Delay Line – Permits viewing of pretrigger at faster sweep speeds.

HORIZONTAL

Time per Point – 5 ps/point (200 GS/s) (5 ns time window with 1024 point record length) to 400 ns/point (2.5 MS/s) (100 µs time window with 256 point record length).

Time Windows – 5 ns to 100 µs in a 1, 2, 5 sequence of 14 steps.

Time Window with Respect to Trigger – 0% to 500% of time window with 0.06% resolution.

DIGITIZING

Vertical Resolution – 9 bits (512 discrete levels). Minimum 195 µV per point using most sensitive input range (100 mV / 9 bits).

Record Length – 256, 512 or 1024 waveform data points.

Self-Calibration – Internal signal standards for increased time and amplitude accuracy.

Multiple Records – 16 waveform locations.

Time Stamping – Time and date stored with each record.

TRIGGERING

Sources – Channel A or B input, external analog, GPIB command and manual trigger key with detachable front panel (optional).

Trigger Level Range – Internal: ±125% of input range in 1% steps. External Analog: ±1.25 V in 10 mV steps.

Trigger Sensitivity (Sine wave) –

Ch A & B inputs:	0.05 x range, DC to 250 MHz 0.15 x range, 250 MHz to 1 GHz
External input:	50 mV, 20 KHz to 50 MHz 150 mV, 50 MHz to 500 MHz 350 mV, 500 MHz to 1 GHz

Trigger Sensitivity Pulse – Minimum of 500 ps HAD (half amplitude duration) pulse.

Ch A & B inputs:	0.05 x range, DC to 250 MHz 0.15 x range, 250 MHz to 1 GHz
External input:	50 mV, 20 KHz to 50 MHz 150 mV, 50 MHz to 500 MHz 350 mV, 500 MHz to 1 GHz

Coupling – Internal; AC or DC, External; AC only

Slope – Positive or Negative

COMPUTER INTERFACE

GPIB – IEEE-488.1 Interface is standard for instrument control and waveform data transfer. Maximum transfer rate ≥ 500K bytes/second. All instrument functions, settings, and operating modes are programmable, with the exception of the power switch.

System throughput commands – Examples of commands include:

- *Advance* data into multiple waveform locations (up to 16).
- *NRepeat* makes user specified single shot acquisitions and automatically transfer to controller.
- *Calibrate* command for increased accuracy
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Altitude – Exceeds Mil-T-28800D type III, Class 5. Operating: 4,520 m (15,000 ft.) maximum. Nonoperating: 15,240 m (50,000 ft.) maximum.

Electromagnetic Compatibility – FCC, VDE, and Mil-Std-461B/462.

POWER

Line Frequency – Operational from 48 Hz to 440 Hz

Power Consumption – < 350 W maximum fully optioned.

Line Voltage Range – 90 to 132 V RMS (115 V); 180 to 250 V RMS (230 V).

PHYSICAL CHARACTERISTICS

Dimensions	**mm**	**in**
Width	482.6	19
Height	177.8	7
Depth	762	30
Weight ≈	**kg**	**lb**
Net	24.5	54

ANALYTEK 2000 SERIES DIGITIZING SYSTEM

HIGH CHANNEL DENSITY

The Analytek Series 2000 provides many acquisition channels in a compact package. The new Series 2000 family of products offer an unmatched combination of high acquisition rates and input channel density with low power requirements.

MULTIPLE ACQUISITION CHANNELS AND HIGH THROUGHPUT SAMPLING

Each 2004S Sampling Module has four simultaneous acquisition channels with sampling rates of 500 Megasamples/second (MS/s). With external precision signal splitters, this same Sampling Module can provide either two channels at 1 Gigasamples/second (GS/s) or one channel at 2 GS/s. (These signal splitters also provide an acquisition range for each module from 1 microsecond/point at 1 MS/s to 500 picoseconds/point at 2 GS/s.)

The 2008S Sampling Module provides 8 simultaneous acquisition channels with sampling rates of 250 MS/s.

The 2004HS, a high throughput version of the 2004S Sampling Module, incorporates fast electronics in a companion Accelerator Module. The Sampling and Accelerator Modules are coupled by a fast dedicated bus and common front panel in a double height module occupying two standard single-width VME slots. (The sampling module capacity of the 2000 Series Chassis is therefore halved with the incorporation of the double height 2004HS Module.)

Throughput of the 2004HS occurs at a rate of aproximately 250 ns per sample point. The 2004HS has a short cycling capability; however, the throughput rate, expressed as a function of records per unit time, depends directly on the record length. For example, the 2004HS can process 488 waveforms per second (at 8192 points per waveform). Alternately at 1024 points per waveform, the throughput is increased to approximately 3900 waveforms per second.

The 2004S, 2008S and 2004HS Sampling Modules provide a high bandwidth, wide dynamic range input amplifier for each channel. This provides accurate conditioning of signals to the analog signal memory units. These memory units provide the fast input required to support high acquisition rates.

SUPERIOR VERTICAL RESOLUTION

Data from the analog signal memory is clocked out at a slower rate to a 12-bit Analog to Digital Converter (ADC). The 12-bit ADC supports a high level of precision and dynamic range to maximize useful information from the captured signals.

LOW COST PER CHANNEL

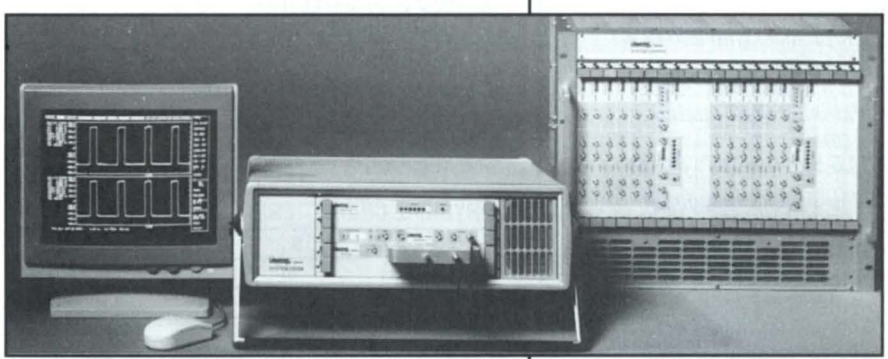
As the number of signal acquisiton channels increase, additional Sampling Modules may be added without the need to add Timing or Processing Modules. As the number of channels increase, the total cost per channel becomes significantly lower.

TIMING & TRIGGERING

The 2000T Timing Module provides the data clocking signals and triggering signals for the capture of data from the sampling modules. It also supports both pre-trigger and post-trigger acquisition modes. One 2000T is required for each unique grouping of one to six Sampling Modules.

AUTO-CALIBRATION

AC, DC and baseline calibration is provided by the Sampling Module to achieve the highest signal fidelity among the large number of possible channels. The Timing Module generates the source signal for AC calibration.



Analytek 2000 Series

PROCESSING AND PROGRAMMABILITY

The 2000P Processor Module provides instrument control for up to six Sampling Modules and corresponding Timing Module. The Processor Module also provides GPIB (IEEE-488.2), RS-232C, and VME interfacing capability to external computers. Since these interfaces are supported by a wide range of computers, the acquisition unit can be matched to the unique system requirement, rather than being the limiting or driving factor in system selection.

LOCAL INSTRUMENT CONTROL, WAVEFORM DISPLAY, & ANALYSIS

The Analytek 2000DM1 Monitor and 2000MC Mouse operate directly with the 2000 Series mainframes to provide an easy-to-use human interface. This interface provides high resolution display of captured waveforms and access to on-screen menus. In addition with this interface, all aspects of the acquisition units are accessible. (Similarly, all setup, control and display functions are controllable via GPIB.)

Local intelligence available on the 2000P Processor Module allows for complete instrument control; waveform data viewing; time and amplitude analysis with cursors; and waveform transforms.

BENEFITS

- *High Channel Density*
- *High Speed Transient Capture*
- *Low Cost per Channel*
- *Easy to Use Mouse-Driven Interface*
- *Expandable VME Based System (with GPIB and RS-232C Support)*
- *Portable Standalone System and Modular System Applications*

GPIB* IEEE-488

APPLICATIONS

Impulse Phenomena
- *High Energy Physics*
- *Laser Induced Phenomena*
- *EMP and Radiation Simulators*
- *Nuclear Effects*
- *High Voltage Breakdown*

Pulse Echo Events
- *RADAR*
- *LIDAR*

Laboratory Testing
- *Solid State Devices*
- *Detectors*
- *Lasers*
- *HighSpeed and rf Circuits*
- *Automated Test Equipment*

FEATURES

2000 Series Mainframe
- *2000B: Standard VME 5-card Benchtop with Horizontal Mounting Chassis*
- *2000RV1: Standard VME 10-slot Rackmount*
- *2000RV2: Standard VME 20-slot Rackmount*

(continued on page 170)

**The Analytek 2000 Series of Digitizers complies with the IEEE Standard 488.2 and Tektronix Codes and Formats*

SERIES 2000 *ANALYTEK WAVEFORM CAPTURE SYSTEMS*

2004S, 2008S and 2004HS Sampling Modules
- ***500 MS/s Max Sample Rate*** *(2004S & 2004HS)* ***250 MS/s Max Sample Rate*** *(2008S)*
- ***Up to 2 GS/s with Signal Splitter*** *(2004S & 2004HS only)*
- ***Up to 4 Channels per Module*** *(2004S & 2004HS)* ***Up to 8 Channels per Module*** *(2008S)*
- ***300 MHz Analog Bandwidth*** *(150 MHz with 2008S)*
- ***12 bit Vertical Resolution***
- ***8K Acquisition Memory per Module*** *(2K/Channel with 2004S & 2004HS)* *(1K /Channel with 2008S)*
- ***Patented VLSI Analog Memory***
- ***10.5 Bits Dynamic Range***

2004HS High Throughput Sampling Module
- ***Throughput of 500 Waveforms/sec. at 8K Points/Waveform***
- ***Short Cycle Capability for Shorter Record Lengths (e.g., 4000 Waveforms/sec. at 1K points/waveform)***

2000T Timing Module
- ***Supports Up To 6 Sampling Modules***
- ***Source of Clocking & Triggering for Sampling Modules***
- ***Multiple Acquisition Rates 1 MS/s to 2 GS/s***

CHARACTERISTICS

CHASSIS (MAINFRAMES)

2000B Benchtop – Standard size VME 5-card horizontal mounting chassis

2000RV1 Rackmount – Standard size VME 10-slot rackmount. Accepts:
1 - 2000T Timing Module
1 - 2000P Processor Module
6 - 2004S Sampling Modules
2 - Spare Slots

2000RV2 Rackmount – Standard size VME 20-slot rackmount . Accepts:
2 - 2000T Timing Modules
2- 2000P Processor Modules
12 - 2004S Sampling Modules
4 - Spare Slots

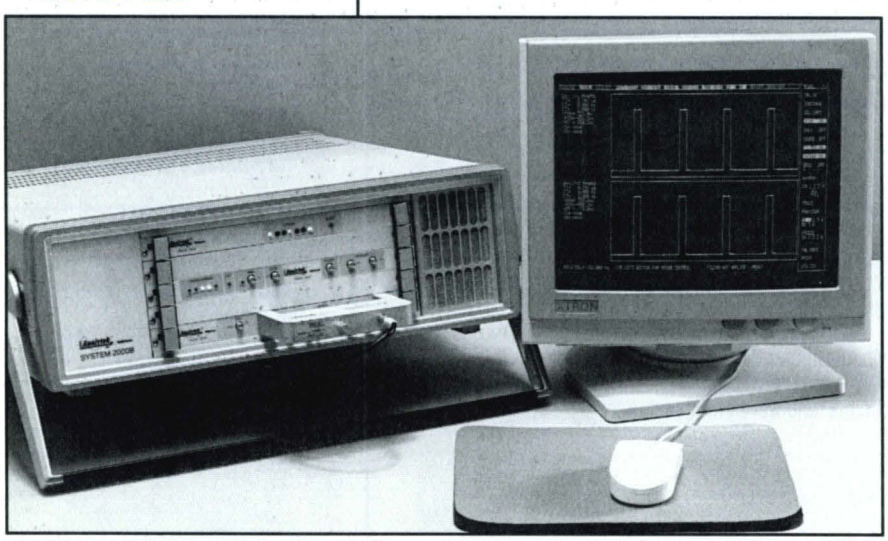
Computer Interfaces –
IEEE-488.2 (GPIB)
2 each RS-232C
VME (Optional)

PHYSICAL CHARACTERISTICS

	B	RV1	RV2
Dimensions	**in**	**in**	**in**
Width	20	19	19
Height	7.4	17.5	17.5
Depth	19	26	26
Weight	**lb**	**lb**	**lb**
	31	35	48

POWER REQUIREMENTS

Voltage Range – 90 to 132 V ac or 180 to 250 V ac.
Line Frequency – 50 Hz to 60 Hz



A high resolution monochrome monitor and mouse make the 2000B mainframe with its powerful ROM-resident software a fully standalone system.

2000 SERIES MODULES AND SYSTEM COMPONENTS

2004S, 2008S AND 2004HS SAMPLING MODULES

Sampling modules are available in either 4 channel (2004S), 8 channel (2008S), or 4 channel high throughput (2004HS) configurations.

Input Channels – SMA connectors

Input Range – Full Scale 1.0 Volt (0 ±0.5 V) with a ±950 mV offset capability. DC offset can be set on each channel.

ΔV DC Accuracy – ±0.5% Full Scale ±0.2% of Signal after auto-calibration.

Offset Accuracy – ±0.5% Full Scale ±0.5% of Offset after auto-calibration.

Input Bandwidth (–3 dB) – 300 MHz.

Input Impedance and Coupling – 50 Ω DC Coupled.

ADC – 12 bits providing resolution of 1 part in 4096.

Dynamic Range – ≥ 60 dB.

Record Length –

Module	Operating Mode (Post Trigger)	Waveform Data Samples Each Channel
2004S 2004HS	4 Channels 2 Channels 1 Channel	2048 4096 8192
2008S	8 Channels	1024

Signal Output – Signal output from channel 1 of each module is available for trigger signal to 2000T Timing Module or as signal conditioning for other instrumentation.

Auto Calibration – Provides AC (signal from Timing Module), DC, and Baseline Calibration.

Packaging – Single width standard size VME module.

Nominal Power – 45 Watts per Sampling Module.

2000T TIMING MODULE

A single Timing Module is required for each unique group of 1 to 6 sampling modules. The Timing Module provides the acquisition rate clocking signal, the waveform triggering, and the AC calibration source signal.

Internal Clock – 1 GHz maximum, programmable rates, stability ±0.01%. Clock signal output is available as ECL level from 50 Ω.

Internal Clock Range – 1 MHz to 1 GHz in 200 steps.

External Clock – 1 GHz maximum. 1 V peak to peak nominal, AC coupled, 50% duty cycle into 50 Ω.

External Clock Accuracy – (Required for specified operation) ±0.01%

Clock Dividers – (For internal or external clock) Allows setting of a wide range of sample intervals and delays.

Gated Clock Input – TTL high input enables External Clock.

External Arm – TTL high enables Trigger Circuit.

External Trigger Input – ±2.5 V programmable for level and slope: Resolution: 19.5 mV
Accuracy: ±35 mV
Slope: Positive or Negative

Trigger Modes – Free-run, External, and Single-Shot

Trigger Delay – Time (in sample intervals) -32 clock cycles from trigger event until it becomes effective.

Trigger Out Signal – Buffered ECL level output (high=true) synchronized to sample clock. High True level remains until ready to accept next trigger.

Packaging – Single width standard size VME module.

Nominal Power – 23.5 W.

2000P PROCESSOR MODULE

The Processor Module provides the control and processing for one 2000T Timing Module and up to six 2004S or 2008S Sampling Modules. The Processor Module is based on a fast, 32-bit CPU with accompanying floating-point processor and fast memory.

On-board processing also supports local viewing and analysis of waveform data. It provides instrument control, via a Hercules compatible monitor and a mouse interface. The Processor Module has built-in routines for setting data conditions. Optional routines include:

- FIR (Finite impulse response) programmable low pass filter
- Sin(x)/x interpolation algorithm
- Signal integration
- Signal averaging

The Processor Module uses data correction algorithms, which are applied to data generated from the acquisition units. One 2000P Processor Module is required for each 2000T Timing Module and the accompanying (1-6) Sampling Modules.

Packaging – Single width standard size VME module.

Nominal Power – 40 W.

SERIES 2000 SIGNAL SPLITTERS

These signal splitters and appropriate time delays adapt a 2004S sampling module to a variety of system sampling rates, record lengths and numbers of channels. One splitter is required for each sampling module.

Signal Splitter	Number of Channels	Sampling Rate	Word Length
2000SS1	2	1 GS/s	4K
2000SS2	2	2 GS/s	8K
2000SS3	2	1 GS/s	8K
2000SS4*[1]	2	500 MS/s	4K
2000SS5*[1]	1	500 MS/s	8K

*[1] *Sampling rate is programmable*

2000BBM BATTERY BACKED-UP MEMORY MODULE

The Memory Module provides 1 megabyte of battery back-up static RAM via an on-board lithium battery. Write and read access times are 70 ns and 200 ns respectively. Write protection switches and a RUN/LOCAL switch for the VME bus interface are provided.

Nominal Power – 17 W.

2000DM1 MONITOR

14 inch monochrome Hercules-compatible display monitor for waveform viewing and instrument control.

2000MC MOUSE

Serial Mouse interface device for use with the 2000DM1 display monitor.

TYPICAL SYSTEM REQUIREMENTS

ENVIRONMENTAL

Temperature – Operating: 10°C to 50°C with 400 lfpm airflow. Nonoperating: –10°C to 70°C

Humidity – 10 to 90% noncondensing.

Altitude – Operating: 15,000 ft. maximum. Nonoperating: 30,000 ft maximum.

POWER REQUIREMENTS

Line Frequency – 50 Hz to 60 Hz.

Voltage Range – 90 to 132 V ac or 180 to 250 V ac.

Electromagnetic Compatibility – FCC Part 15, subpart J Class A; VDE 0871 Class B.

Safety – U.L. 1244; CSA Bulletin 556B.

2000P Processor Module
- ***Supports Up To 6 Sampling Modules and Corresponding Timing Module***
- ***Provides Local Instrument Control, Waveform Display and Analysis***

2000B Portable Benchtop System
1 - 2000B Chassis
2 - 2004S Sampling Modules
1 - 2000T Timing Module
1 - 2000P Processor Module
1 - 2000SS2 2 GS/s Splitter
1 - 2000 DMI Monitor
1 - 2000MC Mouse

2000RV1 Rackmount System
1 - 2000RV1 Chassis
6 - 2004S Sampling Modules
1 - 2000T Timing Module
1 - 2000P Processor Module
2 - Spare Slots Remaining

2000RV2 Rackmount System
1 - 2000RV2 Chassis
12 - 2004S Sampling Modules
2 - 2000T Timing Modules
2 - 2000P Processor Modules
4 - Spare Slots Remaining

ORDERING INFORMATION

Tektronix, Inc. has an exclusive distribution agreement with Analytek Ltd.

2000B Benchtop 5 slot horizontal chassis	**$4,500**
2000RV1 Vertical 10 slot rackmount chassis	**$7,200**
2000RV2 Vertical 20 slot rackmount chassis	**$9,000**
2004S Sampling Module	**$9,950**
2008S Sampling Module	**$13,950**
2004HS Sampling Module	**$16,950**
2000T Timing Module	**$3,395**
2000P Processor Module	**$5,995**
2000SS1 1 GS/s Signal Splitter	**$700**
2000SS2 2 GS/s SignalSplitter	**$700**
2000SS3 1 GS/s, 8K Signal Splitter	**$700**
2000SS4 4K Signal Splitter	**$700**
2000SS8 8K Signal Splitter	**$700**
2000BBM Battery Backed-up Module	**$3,750**
2000DM1 14 inch monochrome monitor	**$250**
2000MC Mouse	**$200**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 - A5 – Available **NC**

See page 488 for description.

WARRANTY

The Analytek 2000 Series carries a standard Tektronix one-year warranty covering labor and replacement parts.

ADDITIONAL INFORMATION

For additional information or the address and phone number of the Tektronix Sales Office nearest you, contact:
(800) 835-9433 ext. 170 or
Analytek, Ltd.
10261 Bubb Road
Cupertino, California 95014
(800) 366-5060
(408) 725-2560

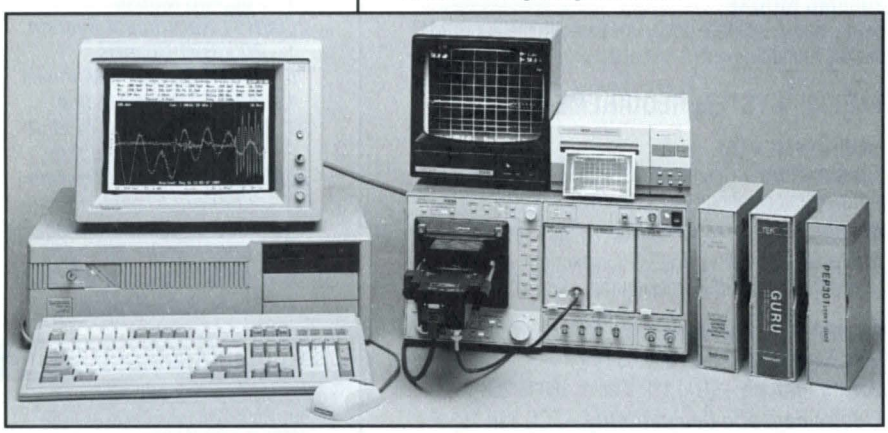
Digitizers, Imagers

TYPICAL APPLICATIONS

- *High-Energy Physics*
- *High Speed Transients*
- *Laser Research*
- *Electrostatic Discharge Tests*
- *High-Speed Logic Testing*
- *ECM Research*
- *Imaging*
- *Surveillance*
- *Remote Monitoring*
- *Presentations/Training*

DIGITIZING CAMERA SYSTEM

The Digitizing Camera System (DCS) integrates the analog oscilloscope and the personal computer into a leading-edge waveform digitization and analysis system. By combining significant advances in optics, signal-processing hardware and software, with Tektronix long-standing leadership in high-performance analog oscilloscope technology, the DCS builds complete signal acquisition systems that capture repetitive and transient signals at the scope's full bandwidth. Systems with Tektronix scopes employing Micro Channel Plate (MCP) CRT technology like the 2467B, 11302A, and 7104/R7103 offer digitizing bandwidths of 400MHz, 500MHz and 1 GHz, respectively, with nominal vertical digitizing resolution of up to 12 bits for repetitive signals and 9 bits for single-shot signals.



The Digitizing Camera System consists of a C1002 Video Camera, frame store board inside the PC, DCS waveform analysis and graphical software, cables. The system shown includes the DCS02, TEK 11302A scope under GBIP control from the DCS software, HC01 video printer, and a DX05 video monitor.

FEATURES

- *Turns Most Analog Scopes into Digitizers*
- *1-GHz Single-shot with 7104 Scope*
- *Trigger on Light or External Trigger*
- *Imaging Utilities Available*
- *GPIB Support for 2467B and 11302A*
- *Higher Accuracy with SineCal™*
- *Captures 2 Non-crossing Waveforms*
- *Mouse Compatible*
- *Waveform Analysis*
- *PCs can Support 16 DCS Boards, and MUX's up to 256 DCS Boards.*
- *1 Year Software Subscription Included with Each Software Package.*

A Digital Camera System consists of a DX01 or DX03 frame store board for a PC, the C1002 high resolution CCD video camera, DCS waveform analysis and graphic software, interconnecting cables, scope adaptor, and an operator's manual.

Mouse or key-operated menus lets the user quickly select commands that provide instant control of the software's many signal-analysis and processing functions. One may simultaneously acquire two noncrossing waveforms and display them with CGA, EGA or VGA resolution on the PC screen. One can acquire waveforms from up to 16 cameras and frame store boards in a PC (with expansion chassis).

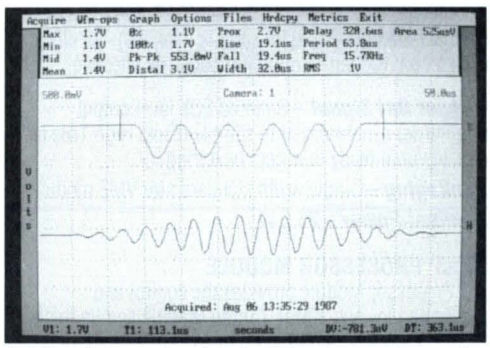
Software functions enable the user to control scope settings as well as set up and calibration via GPIB. Other functions graph the waveforms in color and provide parametric values such as rise and fall time, frequency, and area under the curve.

Single shot events can be easily captured using an external trigger, or the "Save on Light" feature for the acquisition when the camera "sees" light, i.e. a trace.

Waveform data can be stored or transferred in Binary, ASCII, or Tek's ADIF format. The raw video image can also be saved to disk, video tape, or transferred in a Binary format.

DCS provides the Save-On-Delta™ feature as a menu choice to allow you to easily set comparative tolerances for capturing and analyzing transient waveforms.

Other software features allow you to manually or automatically save waveforms to disk, and print them on Tek's HC100 Color Plotter, HC01 and HC02 Video Copier, HC-200 printer, or other compatible printers like Epson FX, IBM Pro Printer, and HP Laser Jet.



DCS software can simultaneously acquire and display two noncrossing waveforms.

DCS UTILITY software is available upon request to all DCS owners. This software has routines such as:

- EDGES OR SHADES which convert the 256 levels of grey to 16 colors.
- STREAK which uses cursor control for obtaining Z axis data.
- RAM DISK will let the user access the frame store board's memory.
- TIME SHIFT will allow waveforms to be shifted.
- LABELING will let the date/time and text to be added to the video files.

There are many more. See the TEK IMAGER newsletter for more details.

HIGHER ACCURACY WITH SINECAL™

Nominal data accuracies to ±.1% can be obtained from most analog scopes using the DCS and the SineCal™ calibration procedure. This method allows the DCS/scope system to be calibrated at the voltage and sweep speed settings used to acquire the data. The digitized waveform is corrected for:

- Voltage amplifier gain and linearity errors.
- Time base linearity errors.
- CRT geometric distortions.
- Optical geometric distortions.

The SineCal™ calibration system consists of:

- SineCal™ software, with GPIB instrument control
- Calibrated mixer (supplied with software)
- Programmable sinewave generator with suitable frequency and accuracy (User supplied)
- Programmable precision DC voltage generator (User supplied)

More information is available in the Fall 1989 issue of the TEK IMAGER newsletter.

DCS01 vs DCS02 Feature Comparison		
	DCS02	**DCS01 (w/C1002)**
Camera pixel size	728(h) x 490(v)	728(h) x 490(v)
Camera sensitivity	2.5 LUX	2.5 LUX
Record length (Data Points)	1024	512
Analog BW (Scope dependent)	1GHz w/7104	1GHz w/7104
Maximum acquisition rate (Sweep speed dependent)	500 GS/sec. (Single shot w/7104)	250 GS/sec. (single shot w/7104)
Norminal data accuracy w/ SineCal™	.1%	.1%
Vertical resolution rep (single shot)	12 bits (8 to 9 bits)	12 bits (8 to 9 bits)
RAM	VRAM	DRAM
DSP (on board) processing	yes	no
On board data memory:		
Battery backed-up	Option 03	no
WFM data file	yes	no
Compressed video Image	yes	no
Throughput	30 Hz (into 64K memory)	3 Hz (into PC memory)
Computer Compatibility	IBM AT/PEP 301	IBM PC/XT/AT, PEP 301

CHOICE OF TWO DCS SYSTEMS

TEK offers two DCS configurations depending on the record length, throughput, processing power, and the data memory back up requirements. (See chart above.)

CCD VIDEO CAMERAS

Both DCSs use the same C1002 or C1002R video cameras that have a 490 (V) by 728 (H) pixels optically coupled to a CCD. In front of the CCD is a TEK designed, seven-element lens. The .3% distortion lens eliminates keystoning and other optical geometric-distortion problems. The focal range of the lens allows the DCS to not only capture images from instrument CRTs, but also test set ups, and other objects.

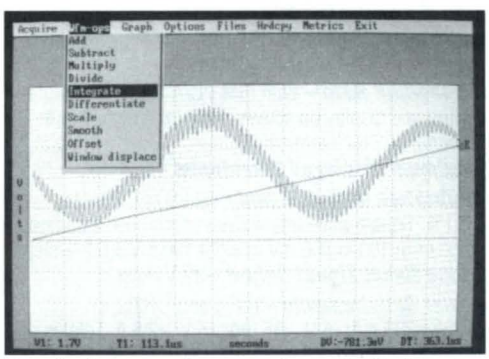
The electronic specs for the cameras are the same. The mechanical specs are different: the C1002R has a heavy duty front mount. Set screws replace "mag" and "lock" thumb wheels.

The cameras can be attached to most analog scopes by swing-away adaptors. The C1002 uses C-30 series adaptors. The C1002R accepts only C-50 series adaptors, and comes standard with the (016-0249-00) adaptor for 5K, 7K, and 11300 series scopes. (See the camera section for C-30 and C-50 series adaptor to instrument compatibility.)

A DX02 camera power supply/video interface will allow as many as two cameras to be used without a DCS frame store board. Camera's video outputs can be fed to an HC01/2 video copier, a VCR, or a TV monitor for remote display, or to a classroom.

DCS01/DX01

The frame store board links the camera and the DCS software. It stores the camera's signal in its video RAM and processes it to produce a waveform array. The frame store boards require a full length slot in the PC. The board produces a system calibration signal, provides camera power, remote triggering capability, single-sweep reset and RS170 video output. Real-time comparison and summing of video data are other functions supported by the frame store board.



Manipulate waveforms mathematically by using such procedures as integration, differentiation, addition, and subtraction.

DCS02/DX03

The DX03 has an on-board DSP chip (TI's TMS 320C25) that is used to process the waveform data up to a 30 Hz rate. By harnessing the power of the DSP this board will open new areas in waveform and imaging processing.

The DCS02 has 1,024 bit record length.

The board is equipped with 64K of on-board data memory. (Option 03 for battery back up. A new lithium battery maintains the 64K of data memory for 90 days.) This allows the DSP to process and store at a 30Hz rate. This memory can not only store the processed waveform, but it can store a "compressed" raw video image, i.e. it stores a user selected number of pixels that contain waveform information.

SCOPE COMPATIBILITY

The DCS may be used with most analog scopes that have 7.2 x 9.0 cm or 8.0 x 10.0 cm CRT image areas.

DCS02 FEATURES

- *1,024 bit Record Length*
- *30Hz Throughput*
- *Has On-Board DSP Processor*
- *64K of On-Board Data Memory*
- *Optional Battery Back Up for Data Memory*

ORDERING INFORMATION

DCS02 HIGH PERFORMANCE SYSTEM

DCS02 High Performance System **$7,400**
Includes: C1002 Camera; DX03 Video Processor/Frame Store Board; DCS02 software on 5 1/4" and 3 1/2" disks; camera cable (174-0449-00); operator's manual; three BNC to SS cables (174-0430-00). The C1002 requires optional camera adaptor(s). See options.

DCS02 OPTIONS

Opt. 1A – Adaptor for 11301/11302, 5K and 7K scopes (016-0248-01) **+$95**
Opt. 2A – Adaptor for Tek 2400 Series and scopes with 8x10 cm CRTs (016-0269-03) **+$105**
Opt. 03 – Provides battery back-up for board's data memory. **+$375**
Opt. 05 – Deletes C1002 and replaces it with the C1002R, includes adaptor for 7K and 11301/2 (016-0249-00) **+$355**
Opt. 06 – SineCal™ capability for PC.
Includes: SineCal™ software, manual and caibrated mixer. **+$675**

FRAME STORE BOARD

DX03 High performance DCS video processor frame store board. **$4,300**
Includes: Frame store board; three BNC to SS cables (174-0430-00); operator's manual.
Opt. 01 – DCS02 software on 5 1/4" and 3 1/2" disks **+$850**
Note: A C1002 or a C1002R and a DX03 with Option 01 is equivalent to a DCS02.
Opt. 03 – Provides battery back-up for board's data memory. **+$375**

DCS01 CAMERA SYSTEM

DCS01 Digitizing Camera System **$6,550**
Includes: C1002 Camera; DX01 Frame Store Board; DCS01 software on 5 1/4" and 3 1/2" disks; DCS cable (174-0449-00); three BNC to SS cables (174-0430-00); and operator's manual (070-6175-00). Requires optional camera adaptors, see options.

DCS01 OPTIONS

Opt. 1A – Same as for DCS02 **+$95**
Opt. 2A – Same as for DCS02 **+$105**
Opt. 3A – Adaptor for Tek 485 Series and scopes with 7 x 9 cm CRTs (016-0306-01) **+$105**
Opt. 06 – SineCal™ capability for PC.
Includes: SineCal™ software, manual, and calibrated mixer. **+$675**

ORDERING INFORMATION

FRAME STORE BOARD

DX01 DCS Frame Store Board **$2,820**
Includes: DCS frame store board, three BNC to SS cables (174-0430-00), operators manual

DX01 OPTION

Opt. 01 – DCS01 Software **+$800**
(A C1002/R and DX01 with Option 01 is equivalent to a DCS01)

VIDEO CAMERAS

C1002 High Resolution CCD Video Camera **$2995**
Includes: Camera Cable (174-0449-00), Instruction manual. Requires optional camera adaptor(s) and external power (Option 04).

C1002 OPTIONS

Opt. 1A – Adaptor for 5K, 7K, and 11300 Series (016-0248-01) **+$95**
Opt. 2A – Adaptor for TEK 2400 series scopes and scopes with 8 x 10 cm. CRT's (016-0269-03) **+$105**
Opt. 04 – DX02 Camera Power Supply and Video Interface **+$285**

C1002R Ruggedized Camera For 7000 Series and 11300 Series **$3,350**
Includes: Same as C1002 except adaptor (016-0249-00) is added.

C1002/C1002R OPTION

Opt. 04 – DX02 Camera Power Supply and Video Interface **+$285**
(Note: When ordering either the C1002 or the C1002R with Option 04, please select one of the A0 through A5 power plug options. For example, a C1002 with Option 04 and A0 includes a DX02 set for 120V.)

INTERNATIONAL POWER PLUG OPTIONS FOR DX02

Opt. A0-A5 – Available **NC**
See page 488 for description.

SOFTWARE for DCS01/DX01

S58DC01 – DCS01 Functional library with source code*1 **$400**
S58DC06 – SineCal™ PC software for DCS01/DX01, includes special calibrated mixer *1 **$675**
Opt. 01 – Deletes PC software and adds VAX/VMS software.*2 **+$500**

SOFTWARE for DCS02/DX03

S58DC08 – DCS02 Functional library with source code*1 **$500**
S58DC09 – SineCal™ software for DCS02/DX03, includes special calibrated mixer*1 **$675**
Opt. 01 – Deletes PC software and adds VAX/VMS software.*2 **+$500**

**1 On 5 1/2" and 3 1/2" disks.*
**2 Specify if on reel or cartridge*
Note: The DCS01 and DCS02 software are not interchangeable, i.e., S58DC01 cannot be used with the DCS02/DX03.

CHARACTERISTICS

The following DCS specifications are valid when the camera system is operated at a temperature between 0 and 40°C. (See chart on page 173 for other specs.)

DCS01/DX01

DIGITIZING TECHNIQUE – SCAN CONVERSION

System Writing Speed – MCP Scopes: To bandwidth of the scope (single shot and repetitive). Non-MCP scopes: Single shot, dependent on scope's photographic writing speed; repetitive, to bandwidth of scope. Note: an analog scope's writing speed varies depending on the age of the scope/CRT, phosphor, CRT filters, intensity settings, accelerating potential, etc. Usually, if one can see the entire waveform, the DCS can capture it.

Nominal Digitizing Resolution – 12 bits of vertical resolution, nominal data accuracies to 1%, .1% with SineCal.™

Record Length – 512 data points.

Number of Traces/Acquisition – 1 or 2 for each frame store board present.

Number of Channels – Up to 16 with PC expansion chassis, up to 256 with 16 MUX16's.

Throughput Rate – With IBM PC/AT: time to capture, digitize and display on screen is approximately 2 to 4 seconds, or 3 Hz into memory.

Maximum Displayed Waveforms – 6.

Calibration Output Signal – Into 50 Ω: 20 kHz ±0.1%. Square wave with software controlled amplitude range from 100 to 800 mV in eight 100 mV ±0.2% steps.

Scope Reset Signal Output – 12 V Pulse.

Power Requirements – DX01 and C1002: +12 V: <300 mA; -5 V: <35 mA; +5 V: <2.5 A. Total is less than 16.5 W.

DCS02/DX03

All the specifications for the DCS02/DX03 match the DCS01/DX01 except as follows:

Record Length – 1,024 data points.

Throughput Rate – Up to 30 Hz into the 64K of on-board data memory, otherwise it is limited by the time to write to disk, floppy, PC memory, or the processing time of the CPU.

Computer Compatibility – Works only in 16 bit bus machines with 512K of expanded memory. See table at right.

Power Requirements – Same as DCS01 except + 5 V: < 4.0 A. Total is less than 24 W.

On Board Memory – DX03 has 64K of DSP program memory, and 64K of data memory.

Option 03 Battery Back Up for Data Memory – A new replaceable Lithium battery will maintain the 64K of data RAM for approximately 90 days.

DX02 CAMERA POWER SUPPLY AND VIDEO INTERFACE

Number of Cameras Supported – 1 or 2.

Output per Camera – +12V ±5% at 0 to 600 mA with 1MV ripple or less at 500 mA load.

Video Out – 75 Ω feedthrough from each camera.

Input Power Requirements – At 88 to 270V ac, 40 to 440Hz, 24 W maximum.

Safety Certifications – U.L., CSA, VDE.

EMI Compliance – Qualifies under test limits specified for VDE 0871, Class B, emissions limitations.

COMPUTER AND CONTROLLER COMPATIBILITY

Tek has verified the operation of the DCS01/02 with the following machines:

	IBM PC*3	XT*3	AT*3	80386*3	PEP-301*3
DCS01/DX01	X	X	X	X	X
DCS02/DX03*4			X*4	X*4	X*4

**3 Or compatible*
**4 Requires 512K of expanded memory.*

The DCS requires the following base configuration for the PCs listed above: 640K of memory (512K of expanded memory needed with DCS02/DX03), MS-DOS V2.1 or higher, 5 1/4" (360K) or 3 1/2" disk drive, a hard disk is desirable, a co-processor, color graphics card (EGA is preferred), a compatible color or monochrome PC monitor, National Instruments GBIP board if used with GPIB instruments. A black and white video monitor (DX05) is recommended.

Note: PC expanded memory is required if more than one DCS frame store board is used in a PC or if DCS02/DX03, or if a PC is used with a MUX mainframe.

C1002/C1002R

Focal length – 10 mm at 5200 A.

F Number at Infinity – F/1.3.

Object-to-Image Distance – 1633.542 mm at 0.075X, 144.723 mm at 0.833X.

Field of View (Variable Mag.) – 7.2 cm x 9.0 cm and 8.0 cm x 10.0 cm.

Spectral range – 400 nm to 600 nm within 3dB.

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.

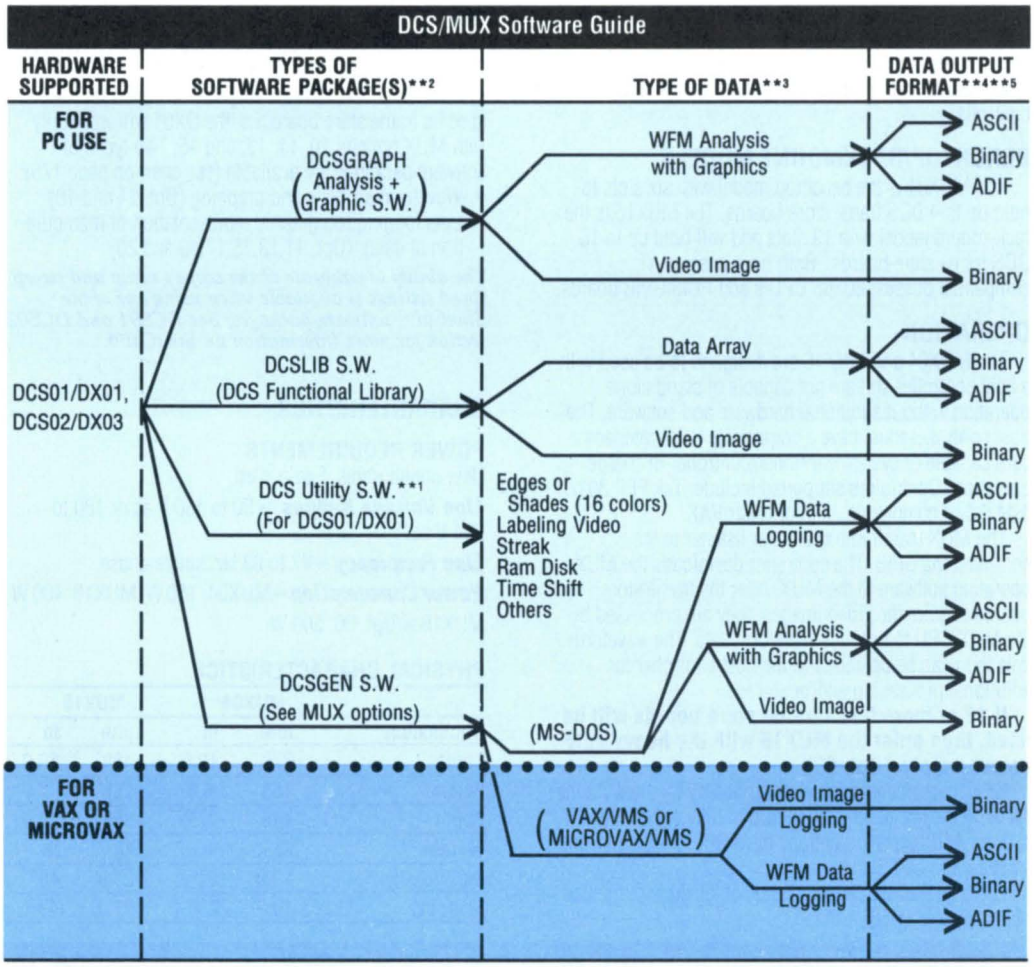
S/N Ratio – Typical: 52dB; minimum 50dB. Gamma=1.

Sensitivity – 2.5 LUX

Video Output – 1V p-p composite video, 75 Ω.

PHYSICAL CHARACTERISTICS

	C1002		C1002R	
Dimensions	**mm**	**in**	**mm**	**in**
Width	120	4.8	120	4.8
Height	104	4.1	152	6.0
Depth	241	9.5	234	9.25
Weight	**kg**	**lb**	**kg**	**lb**
With scope mounting adaptor	1.4	3.0	1.7	3.8



**1 *To DCS/MUX owners upon request.*

**2 *See chart below for hardware compability.*

**3 *WFM Data is available either calibrated or uncalibrated except the functional library which has an array.*

**4 *DCS Graph supports these hardcopy products: HC200, Epson FX, IBM Proprinters, HP Laser Jet and HC-100/Plotter.*

**5 *RS 170 Video is available via the frame store board's video output port. The HC01 or HC02 can be used to make hard copies.*

DCS SOFTWARE/HARDWARE COMPATIBILITY

	Hardware			
Software	**DCS01**	**DX01**	**DCS02**	**DX03**
DCS01 DCSGRAPH	X	X		
S58DC01 DCSLIB	X	X		
S58DC06 SineCal™	X	X		
MUX Opt. 10, 11, 13, 15	X	X		
DCS Utility	X	X	**6	**6
DCS02 DCSGRAPH			X	X
S58DC08 DCSLIB			X	X
S58DC09 SineCal™			X	X
MUX Opt. 17, 18, 19, 20			X	X

Note: DCS01/DX01 and DCS02/DX03 software cannot be interchanged.

**6 *In development.*

SINECAL™ COMPATIBILITY

	Order One of These Software Packages			
With This Hardware	**DCS01 w/Opt. 06**	**DCS02 w/Opt. 06**	**S58DC06 *4**	**S58DC09 *4**
DCS01/DX01	X *3		X	
MUX Mainframe w/ Opt. 10*1*3, 11*1*3, 13*2*4, or 15*2*4			X	
DCS02/DX03		X *3		X
MUX Mainframe w/ Opt. 17*1*3, 18*1*3, 19*2*4 or 20*2*4				X

*1 *Available on 5 1/4" or 3 1/2" disks.*

*2 *VAX or MICROVAX on reel or cartridge, please specify which.*

*3 *For PC only.*

*4 *For VAX/MICROVAX support order S58DC06 or S58DC09 with Option 01.*

ORDERING INFORMATION

CAMERA POWER SUPPLY AND VIDEO INTERFACE

DX02 – C1001/2/2R Power Supply/Video Interface, 110V **$300**
220 V Version – A1 through A5 power plug options available. See page 488. **NC**

VIDEO MONITOR

DX05 – 9 inch B & W Video Monitor 110V. **$300**
220 V Version – Opt. A1 Univ. Euro 220 V, 50 Hz. **NC**

DCS PACKAGES

Note: Contact your local Tektronix Sales office for additional information.
DCS P10 DCS01, DX05, and PEP 301 **$15,010**
DCS P11 DCS01, DX05, PEP 301 and 2467B **$29,050**
DCS P12 DCS01, DX05, PEP 301, 7104, 7A29, & 7B10 **$49,870**
DCS P13 DCS01, DX05, PEP 301, 11302A, 11A71 **$31,920**

OPTIONAL INSTRUMENTATION

2467B – 400 MHz Portable MCP Scope. See page 108. **$13,045**
7104 – 1 GHz Scope Mainframe. See page 72. **$29,995**
11302A – 500 MHz Scope Mainframe. See page 60. **$14,500**
HC100 – Four Color Plotter. See page 384. **$895**
HC01 – 4x5 inch Thermal Video Copier. See page 386. **$1,300**
HC02 – 8x10 inch Thermal Video Copier. See page 386. **$1,710**
Thermal Paper – 4 rolls per box
(For HC01) Order 016-0867-01 **$49**
(For HC02) Order 016-0868-01 **$90**

WARRANTY

The DCS01, DCS02, and both MUX mainframes carry the standard Tektronix one year warranty covering labor and replacement parts.

SOFTWARE SUBSCRIPTION SERVICE

An automatic one year software update subscription comes with each DCS or MUX software package. To qualify for the service the owner has to return the software registration card or register at the time of purchase.
Any DCS or MUX owner can sign up at any time, contact your Tek Representative for details.

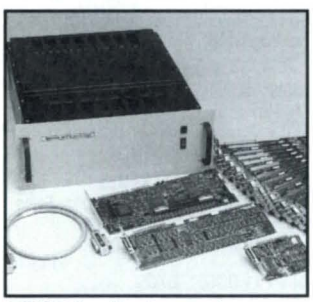
***TEK IMAGER* NEWSLETTER**

The newsletter provides a forum for DCS users to share application information or to have their questions about the DCS answered. This quarterly publication is free to DCS users. Contact your TEK representative for details.

Mainframes for DCS Frame Store Boards

- ***One host can control up to 256 DCS frame store boards (16 MUX16s)***
- ***MUX04 supports up to 4 DCS boards***
- ***MUX16 supports up to 16 DCS boards***
- ***MUX is fully programmable over GBIP***

Note: DX01 and DX03 frame store boards cannot be intermixed in the same MUX mainframe.



MUX16 – Rackmount

GPIB IEEE-488 *

** The MUX04 and MUX16 comply with IEEE 488.2-1987 and with Tektronix Standard Codes and Formats*

The DCS, MUX04, MUX16, in conjunction with a host controller, is part of a programmable multiple-channel digitizer system. Users can control up to 256 DCS frame store boards and/or GPIB instruments with one host controller.

BENCHTOP/RACKMOUNT MODELS

The MUX04 is the benchtop model with six slots to hold up to 4 DCS frame store boards. The MUX16 is the rack-mount model with 19 slots and will hold up to 16 DCS frame store boards. Both have passive AT compatible busses, 80286 CPU's and PCIII GPIB boards.

OPERATION

The MUX04 and MUX16 are designed to be used with a host controller and are not capable of stand alone operation without additional hardware and software. The host controller must have a compatible GPIB interface card capable of system controller/controller in charge operation. Controllers supported include: Tek PEP 301/, IBM PC or compatible, VAX or MicroVAX.

The MUX mainframe is a talker listener to the controller via GPIB. The controller downloads the MUX operating software to the MUX. After the frame store boards acquire the video images, they are processed by the MUX CPU to produce waveform data. The waveform data then can be uploaded to the host controller for additional processing and/or storage.

If 12 or more DX03 frame store boards will be used, then order the MUX16 with the heavy duty power supply (Opt. 06).

GPIB instruments can be controlled by the host via the MUX by the use of a PC-IIA board to interface to the scopes. MUX software options have GPIB support for the 11302A and 2467B scopes.

Faster processing speed can be obtained with the use of an optional 80386 CPU.

SOFTWARE

One of the software packages, specifically compiled in the proper format, is required for operation of the MUX system. Order the software that was designed for the specific frame store board, i.e. the DX01 will work only with MUX options 10, 11, 13, and 15. Two types of software packages are available (see chart on page 175):

- Waveform analysis and graphing (Opt. 11 and 18)
- Data logging (no graphic representation or manipulation of data). (Opt. 11,13,15,17,19 and 20).

The ability to calibrate at the scope's v/div and sweep speed settings is available when using one of the SineCal™ software packages. See DCS01 and DCS02 section for more information on SineCal™.

CHARACTERISTICS

POWER REQUIREMENTS

User configurable. Fan cooled.

Line Voltage Ranges – 90 to 130 V ac or 180 to 264 V ac.

Line Frequency – 47 to 83 Hz, single phase.

Power Consumption – MUX04: 150 W, MUX16: 400 W, MUX16 w/Opt. 06: 500 W.

PHYSICAL CHARACTERISTICS

	MUX04		MUX16	
Dimensions	**mm**	**in**	**mm**	**in**
Width	270	10.6	483	19.0
Height	165	6.5	178	7.0
Depth	448	17.6	985	38.0
Weight	**kg**	**lb**	**kg**	**lb**
Net	10.9	24	21.8	48
Shipping	10.4	23	21.3	47

ORDERING INFORMATION

MUX04 Benchtop Multi-Channel DCS Mainframe, 110V **$4030**
Includes: 4 open slots; 80286 CPU; PC-III; Instruction manual; power cord; 1m GPIB cable.

MUX16 Rackmount Multi-Channel DCS Mainframe, 110V **$6050**
Includes: 16 open slots; 80286 CPU; Chassis slide; PC-III; Instruction manual; power cord; 2 m GPIB cable.

MUX04/MUX16 OPTIONS

Opt. 01[*1] – 80286 board is deleted and 80386 CPU board is added **+$950**
Opt. 02[*2] – 2M memory board (used with 80386 option only) **+$1,800**
Opt. 03[*2] – 4M memory (two 2M boards) used with 80386 only. **+$3,600**
Opt. 04 – GPIB low-speed interface card (PCIIA) for MUX **+$495**
Opt. 05 – Extra GPIB high-speed interface card (PCIII) for use in the host controller PC **+$795**
Opt. 16 – MUX server and image software **NC**
Note: If none of the MUX software options are purchased with a MUX Mainframe, then Option 16, server and image, must be ordered with each mainframe.

MUX16 ONLY

Opt. 06 – Replaces 400 W power supply with 500 W supply **+$500**

MUX04/16 SOFTWARE OPTIONS

Supports DCS01 and DX01 hardware
Opt. 10 – MS-DOS MUX Data Logging software for a PC[*3] **+$1,000**
Opt. 11 – MS-DOS waveform analysis and graphing software for a PC[*3] **+$1,200**
Opt. 13 – VAX/VMS MUX Data Logging software[*4] **+$2,500**
Opt. 15 – MicroVAX/VMS MUX Data Logging software[*4] **+$2,500**
S58DC01 – DCS01 Functional library with source code[*3] **$400**
S58DC06 – SineCal™ PC software for DCS01/DX01, includes calibrated mixer.[*3] **$675**
Opt. 01 – Deletes PC software and adds VAX/VMS software[*4] **+500**

Supports DCS02 and DX03 hardware
Opt. 17 – MS-DOS MUX Data Logging software for a PC[*3] **+$1,200**
Opt. 18 – MS-DOS waveform analysis and graphing software for a PC[*3] **+$1,400**
Opt. 19 – VAX/VMS MUX Data Logging software[*4] **+$2,800**
Opt. 20 – MicroVAX/VMS MUX Data Logging software[*4] **+$2,800**
S58DC08 – DCS02 Functional library with source code[*3] **$500**
Note: The DCS01 and DCS02 software are not interchangeable, i.e. S58DC01 cannot be used with the DCS02/DX03.

S58DC09 – SineCal™ PC software for DCS02/DX03 includes calibrated mixer[*3] **$675**
Opt. 01 – Deletes PC software and adds VAX/VMS software[*4] **+$500**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1-A5 – See page 488 for description.

OPTIONAL ACCESSORIES

Extra length C1002/2R to DX01/3 cables –
(4 meter) Order 174-1368-00 **$150**
(6 meter) Order 174-1369-00 **$150**
GPIB Board Kits – GPIB driver software has been modified to operate with either MUX mainframe.
(PC-IIA GPIB board and driver)
Order 021-0452-00 **$495**
(PC-III GPIB board and driver)
Order 021-0453-00 **$795**
80386 CPU – (MUX04 only)[*1]
Order 672-0251-00 **$1,500**
80386 CPU – (MUX16 only)[*1] Order 672-0256-00 **$1,500**
Memory Board –
(2M for 80386) Order 672-0252-00[*2] **$2,000**
(4M for 80386) Order 672-0253-00[*2] **$4,000**

*[*1] Memory board is required for use with the 80386.*

*[*2] Only order either Option 02 or 03 – one cannot use both options together to get 6MB of memory.*

*[*3] On 5 1/4" and 3 1/2" disks*

*[*4] Available on either reel or cartridge, please specify which.*

LOGIC ANALYZER FAMILY

Tektronix offers a wide range of logic analyzers to solve the problems of today's complex designs. This support ranges from the DAS 9200, which is the highest performance digital instrumentation system on the market today, to the 1230, the most cost effective modular logic analyzer available. And now, the newest concept in digital instrumentation is available from Tektronix – the Prism 3000 series.

NEW PRISM 3000 DIGITAL INSTRUMENTATION SYSTEM

The Prism 3000 system is the newest addition to Tek's logic analyzer family. It's modularity and wide range of application specific plug-in modules allows it to be specifically configured to solve system debug, integration, and verification problems.

MICROPROCESSOR DEVELOPMENT SYSTEMS

Tek's modular microprocessor development systems provide complete support for 8, 16, or 32 bit microprocessors. Tools include real-time in-circuit emulators, C, Pascal, and Ada language development systems, source level debuggers, and embedded debug monitors.

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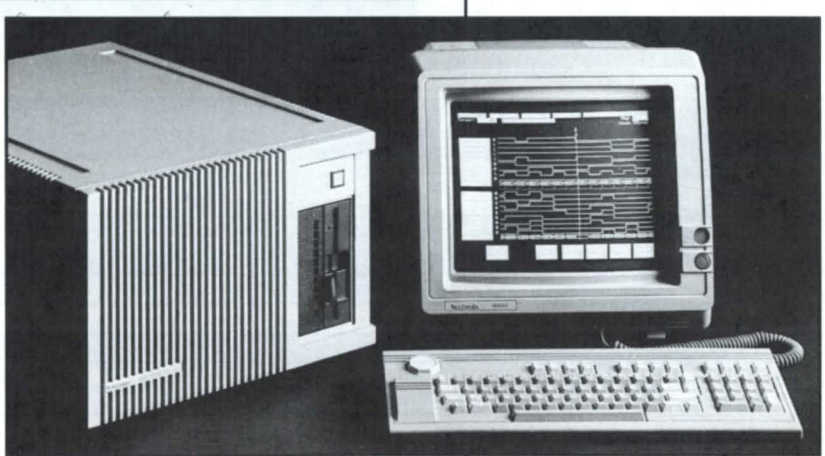


Tek Offers a Wide Range of Microprocessor Support:

- *Multiple Disassembly Formats*
- *Simultaneous State and Timing Analysis*
- *Time Correlated Displays*
- *Performance Analysis*
- *Superior Microprocessor Probing*
- *Multiple Microprocessor Analysis*
- *Real-Time Emulation*
- *C/Pascal/Ada Support*
- *Source Level Debug*

MICROPROCESSOR SUPPORT

DAS 9200

The DAS 9200 offers support for up to 6 microprocessors at one time with a memory depth up to 128K acquisitions per channel. The DAS has built in capability to keep up with the fastest and most complex CISC or RISC microprocessors available today. And with 200 MHz state analysis capability, it has the power for the microprocessors of the future.

NEW PRISM 3000

The PRISM 3000 system offers several unique features to designers of microprocessor based systems. The PRISM 3000 has integrated high speed data acquisition, microprocessor analysis, microprocessor control, and real-time performance analysis on one module. Multiple modules can be combined for multiple microprocessor based designs. Other modules offer very high speed acquisition (up to 2 GHz) and digitizing oscilloscope capabilities. The PRISM 3000 architecture has been designed to integrate multiple application specific modules so that they can work together to solve complex problems.

1241

The 1241 is a leading logic analyzer for microprocessor designs. It supports 50 microprocessors and offers 50 MHz state analysis capability. The 1241 was the first logic analyzer to use a liquid crystal color shutter display and incorporates many new concepts that make logic analyzers easier to use. The portable 1241 is a proven solution for today's problems.

1230

The 1230 logic analyzer is the first low cost modular logic analyzer. The 1230 can be configured with as few as 16 channels and expanded up to 64 channels in increments of 16 channels. With up to 100 MHz of timing analysis and 25 MHz state analysis, the 1230 is the ideal choice for many 8 and 16 bit microprocessor designs. Now, a 2 channel 100 MS/s digitizing oscilloscope module is also available.

MICROPROCESSOR DEVELOPMENT SYSTEMS

In addition to logic analysis support for microprocessors, Tektronix also offers a broad line of real-time in-circuit emulators, language development tools, source level debuggers, and embedded debug monitors. For those doing large software designs and integrating them into complex microprocessor based systems, Tek's development systems offers hardware and software productivity tools to reduce your time-to-market and increase your product's reliability.

MICROPROCESSOR SUPPORT SELECTION GUIDE

	DAS 9200 page 188	PRISM 3000 page 198	1241 page 202	1230 page 204	Development Systems page 182
Intel Microprocessors					
8080	max*2		max*2		
8031/8051	12 MHz	12 MHz*1	12 MHz	12 MHz	
8085	max*2		max*2	max*2	max*2
8086 (DIP)	12.5 MHz	12.5 MHz	8 MHz	10 MHz	8 MHz
8088 (DIP)	12.5 MHz	12.5 MHz	8 MHz	10 MHz	8 MHz
8096/7			12 MHz	12 MHz	
80C196				12 MHz	
80186 (LCC/PGA)	12.5 MHz	12.5 MHz	8 MHz	10 MHz	8 MHz
80188 (LCC/PGA)	12.5 MHz	12.5 MHz	8 MHz	10 MHz	8 MHz
80286 (LCC/PGA)	20 MHz	20 MHz	10 MHz	12.5 MHz	
80386	25 MHz	25 MHz			
80386SX	25 MHz	25 MHz		12.5 MHz	
80486	33 MHz*1				
80860	40 MHz				
Zilog Microprocessors					
Z80	8 MHz	8MHz	8 MHz	8 MHz	6 MHz
Z8001/3	10 MHz		10 MHz		10 MHz
Z8002/4	10 MHz		10 MHz		10 MHz

*1 *Under development*
*2 *max = Maximum CPU clock speed supported*

MICROPROCESSOR SUPPORT SELECTION GUIDE					
	DAS 9200 page 188	PRISM 3000 page 198	1241 page 202	1230 page 204	Development Systems page 182
Motorola Microprocessors					
6800			max*2	max*2	
6801			max*2		
6802			max*2	max*2	
6805E2/E3			max*2		
6808			max*2		
6809	max*2		max*2	max*2	
6809E	max*2		max*2	max*2	max*2
68HC11	max*2	max*1*2	max*2	max*2	
68000 (DIP/PGA)	16 MHz	16 MHz	16 MHz	16 MHz	12 MHz
68008			16 MHz		12 MHz
68010 (DIP/PGA)	16 MHz	16 MHz	16 MHz	16 MHz	12 MHz
68020	33 MHz	33 MHz	25 MHz		25 MHz
68030	33 MHz	33 MHz	25 MHz		
68040	25 MHz*1				
68332				12.5 MHz	
88100	25 MHz				
DSP560000/1			50 MHz		
Hitachi Microprocessors					
6301/3			max*2		
64180R0/R1			max*2		
T.I. Microprocessors					
TMS32010			max*2		
TMS32020	20 MHz		20 MHz		
TMS320C25	25 MHz		20 max*2		
TMS320C30	33 MHz				
Other Microprocessors					
6502/C02			max*2	max*2	
1802/4/5/6			max*2		
ADSP2100			max*2		
F9450	40 MHz		40 MHz		40 MHz
MII-Std 1750A	40 MHz		40 MHz		40 MHz
NSC800			max*2		
GM ECM			max*2		
BUS Support					
VAXBI			max*2		
GPIB			max*2	10 MHz	
STD				12.5 MHz	
RS-232	19.2 k baud	19.2 k baud	19.2 k baud	19.2 k baud	

*1 *Under development*
*2 *max = Maximum CPU clock speed supported*

Note: New or higher speed microprocessors are constantly being introduced and our support is constantly expanding. Contact your local sales office if the device or operation speed that you are using is not listed.

LOGIC ANALYZER SELECTION CHART

Tek's Logic Analyzers Have Led the Industry with Innovative Features to Solve Complex Problems.

- *2 GHz Acquisition*
- *100 MHz Pattern Generation*
- *User Configurable Systems*
- *Time Correlated Acquisitions/Displays*
- *Low Capacitance Probing*
- *Performance Analysis*
- *Ethernet Interfaces*
- *Color Displays*

LOGIC ANALYSIS SYSTEMS

Tek's family of logic analyzers have led the industry in innovative features. Tektronix introduced the world's first modular logic analyzers that can be expanded as your needs increase; the highest speed acquisition module that can acquire data at up to 2 GHz; time correlated data acquisitions; 100 MHz pattern generators; and probes with less than 1pF loading.

LOGIC ANALYZER SUPPORT SELECTION GUIDE

	DAS 9200 page 188	PRISM 3000 page 198	1241 page 202	1230 page 204
Timing Analysis (Maximum Channels/Depth)				
2 GHz sampling rate	160/8K	40/120K		
400 MHz sampling rate		200/24K		
200 MHz sampling rate	384/4K	90/2K		
100 MHz sampling rate			36/512	16/2K
50 MHz sampling rate			72/512	32/2K
Glitch Detection(ns)	1.5	2	6	5
Triggering:				
– Levels/States	4	2	14	14
– Timers/Counters	Yes	Yes	Yes	Yes
State Analysis (Maximum Channels/Depth)				
300 MHz sampling rate		180/18K		
200 MHz sampling rate	384/4K			
50 MHz sampling rate			72/2K	
33 MHz sampling rate	270/128K			
25 MHz sampling rate				64/2K
20 MHz sampling rate	540/128K			
16 MHz sampling rate		960/8K		
Triggering:				
– Levels/States	16	7	14	14
– Range Recognizers	Yes	Yes		
– Timer/Counters	Yes	Yes	Yes	Yes
– Timestamp	Yes	Yes		
Performance Analysis				
Statistical	Yes	Yes	Yes	
Real-Time		Yes		
Microprocessor Support				
Disassembly Formats	5	4	3	2
Multiple uP Support	Yes	Yes		
Register Deduction	Yes			
Microprocessor Control		Yes		
Pattern Generation (Maximum Channels/Depth)				
100 MHz	504/16K			
50 MHz	1008/8K			
System Features				
Modular	Yes	Yes	Yes	Yes
Portable		Yes	Yes	Yes
I/O: RS-232	Yes	Yes	Yes	Yes
GPIB	Yes	Yes*1	Yes	Yes
Ethernet	Yes			
Printer Support	Yes	Yes	Yes	Yes
Multiple Time bases	Yes	Yes	Yes	Yes
Time Correlated Data	Yes	Yes	Yes	
Auto Compare	Yes	Yes	Yes	Yes
Save Setups	Yes	Yes	Yes	Yes
Digitizing Oscilloscope (Maximum Channels/Depth)				
500 MS/s		1/32K*1		
250 MS/s		2/16K*1		
100 MS/s				2/2K

*1 *Under Development*

REAL-TIME EMULATION SYSTEMS

Tektronix emulation systems include V Systems for 8 bit and 16 bit microprocessors and Multi-V Systems for 32 bit microprocessors. These systems provide you an easy-to-use connection to your prototype. Operation without a prototype is also possible, giving engineers a known good environment for testing new software. Program memory can be added to your emulator, replacing deficient prototype memory resources. Real-time trace looks back at software program execution, giving you a window into assembly or high-level code execution.

Tektronix also provides you with an easy-to-use connection to your host computer or workstation, with both RS-232 and industry standard Ethernet interfaces.

LANGUAGE DEVELOPMENT SYSTEMS

Tektronix offers a complete software cross-development environment. The Tek Language Development System (LANDS) is an integrated set of code development and debug tools, first offered in 1982 and enhanced since then with support for C, PASCAL, and Ada. LANDS includes a Language Directed Editor (LDE), a cross-compiler, an Integration Control System (ICS), a macro assembler/linker, and a symbolic and source level debugger.

Tek's LANDS tools integrates with Tek's emulators and logic analyzers to provide both software development and complete system integration. This popular solution for microprocessor support is the result of over 12 years of experience in supporting embedded microprocessor applications.

HIGH PERFORMANCE RUN-TIME DEBUG MONITORS

To complement the microprocessor development systems, Tek now offers a high performance embedded debug monitor solution for those who do not need full emulation. The TekDB Monitor includes TekDB, the most powerful source level debugger available today, a small embedded monitor for your prototype, and links to cross compilers and logic analyzers.

Tek's Development Tools Are Used for the Development of Embedded Microprocessor Applications.

- *Real-Time Emulators*
- *C/Pascal/Ada Compilers*
- *Source Level Debuggers*
- *Embedded Monitors*
- *Hosts/Workstation Support*
- *Ethernet and RS-232 Communications*
- *Ada Support*

DESIGN PHASE SUPPORT

Design Stage	Product	Purpose
CODE	C LANDS, Ada LANDS PASCAL LANDS Assemblers S/W Executers	Translate software designs to code modules
TEST	TekDB, Debuggers Debug Monitors Emulators S/W Executers	Verify code in a known good hardware environment
INTEGRATION	TekDB, Debuggers Debug Monitors Emulators Logic Analyzers	Verification of code in the actual prototype

Tektronix hardware and software products support designers during the CODE, TEST, and INTEGRATION phases of the software development lifecycle.

SOFTWARE SUPPORT

Processor	Emulation	VAX/VMS	VAX/Ultrix	SUN-3	Tek 4300	IBM PC/XT/AT
68030		Assembler CLANDS II Monitor	Assembler CLANDS II Monitor	Assembler CLANDS II Monitor	Assembler CLANDS II Monitor	
68020	MV6820	Assembler CLANDS II Ada LANDS*1 Monitor	Assembler CLANDS II Ada LANDS*1 Monitor	Assembler CLANDS II Monitor	Assembler CLANDS II Monitor	
68000 68008 68010	V68000A V68008 V68010	Assembler CLANDS I,II Pascal LANDS Monitor	Assembler CLANDS I,II Pascal LANDS Monitor	Assembler CLANDS I,II Pascal LANDS Monitor	Assembler CLANDS I,II Monitor	Assembler*1 C*1 Pascal*1
8086/88 80186/188	V8086/88 V80186/188	Assembler CLANDS I Pascal LANDS	Assembler CLANDS I Pascal LANDS			Assembler*1 C*1 Pascal*1
1750A Pace1750AE	V1750A	Assembler Ada LANDS*1	Assembler Ada LANDS*1	Ada Composer*1		Ada Composer*1 Assembler*1
Z80	VZ80	Assembler C*1, Pascal*1	Assembler C*1,Pascal*1			Assembler*1 C*1, Pascal*1
8085	V8085	Assembler C*1, Pascal*1	Assembler C*1,Pascal*1			Assembler*1 C*1, Pascal*1
6809	V6809	Assembler	Assembler			
Z8001/2	8540A	Assembler	Assembler			

*1 *Third Party Software Products*

MULTI-V 68020 DEVELOPMENT SYSTEM

The Multi-V System Provides High Performance Tools for Developing Complex 68020 Based Applications.

- *25 MHz 68020 Real Time Emulation*
- *Full Speed State Analysis*
- *Up to 12 MB Program Memory*
- *Performance Analysis*
- *Software Executer*
- *TekDB Source Level Debugger*
- *Ethernet Communications*

68020 MULTI-V SYSTEM

The Tektronix Multi-V System is a complete software/hardware toolkit for developing embedded 68020 applications. It supports large design teams from initial code development to final software/hardware integration.

The Multi-V system consists of:

- A *Software Executer* for developing code before a prototype is available
- A *25 MHz Real-time Emulation System* with 128 KB of no wait-state program memory
- A *Trigger State Analyzer* for real-time, bus state and timing analysis
- A *Performance Analyzer* for optimizing code
- Up to *12 MB of program memory* for developing large applications
- An *Ethernet connection* for fast downloads

Multiple emulators can be installed in a single Multi-V mainframe and each can be accessed via a local area network, making the Multi-V System a multi-user development system.

SOFTWARE EXECUTER

The Software Executer provides a cost-effective known good environment for developing code before your hardware is available. Early in the design cycle, users can start developing their code using CLANDS II and running it on the Software Executer at processor speeds. When your software is ready to be tested with a prototype, the Software Executer can be upgraded to full emulation by adding an emulator pod. Since the Software Executer uses the same TekDB user interface and source level debugger as the emulator, transition time is minimal.

68020 EMULATORS

Two 68020 emulators are available; a 16.67 MHz version for less demanding applications and a 25 MHz emulator for the ultimate in performance. The 25 MHz emulator includes all of the functionality of the 16.67 MHz emulator plus 128K of real-time, no wait-state memory.

REAL-TIME TRACE/TIMING ANALYSIS

The Trigger State Analyzer (TSA) is a real-time bus state analyzer that makes it easy to solve complex software and hardware problems. The TSA can be used as a timing analyzer to fine-tune time critical routines, or as a bus state analyzer that displays both C and assembly code to help trace program execution.

PERFORMANCE ANALYSIS

For quickly characterizing application programs a Performance Analyzer (PA) is included that runs on both 68020 emulators or the Software Executer. The PA displays timing characteristics for the selected ranges (2048 ranges available) in a bar-line format that shows execution times as a percentage of total time. A key feature of the PA is that it can be automatically set up from the output of the CLANDS II compiler.

TekDB SOURCE LEVEL DEBUGGER

TekDB, a standard feature of the Multi-V System, is a state-of-the-art source code and assembly level debugger. It's windowed user interface displays source code in the C, Pascal, or Ada language as applications are debugged.

ETHERNET/RS-232 COMMUNICATION

The traditional bottleneck in using microprocessor development systems has been downloading code from the host computer into the prototype. While RS-232 is the most convenient interface for downloading code, it is also the slowest. Tektronix has solved this problem by adding an industry standard Ethernet connection to its development systems.

MULTI-USER/MULTI-TOOL SYSTEM CONFIGURATION

With a simple expansion cable, up to four mainframes can be connected together providing control of up to eight emulators or software executers. Alternatively, up to eight users can each control their own emulator or software executer.

ORDERING INFORMATION

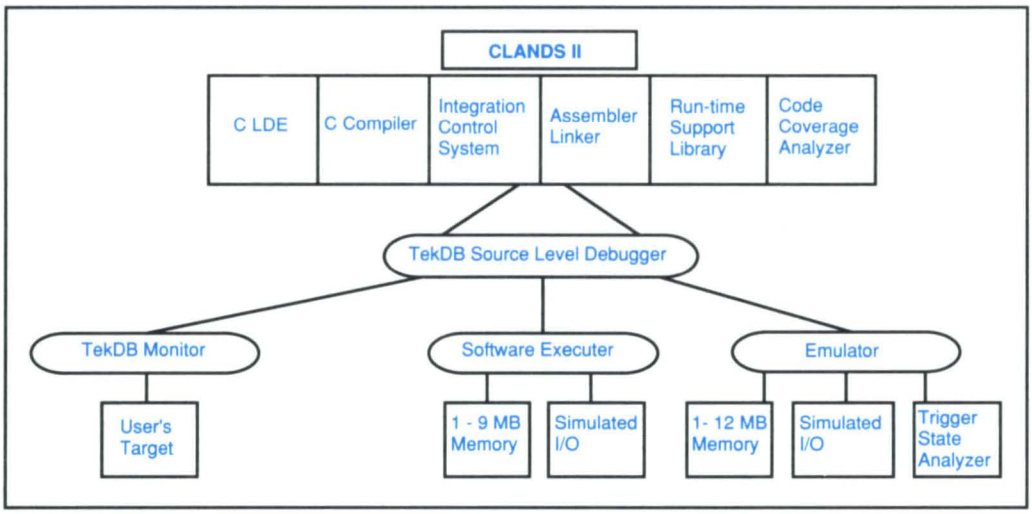
MULTI-V SYSTEM

MV6820 68020 Development System Includes: Mainframe, Power Supply, Controller Card, and TEKDB User Interface/Debugger	**$6,900**

OPTIONS

Opt. 06 – Software Executer	**+$6,400**
Opt. 08 – 16 MHz Emulator and Controller	**+$13,500**
Opt. 09 – 25 MHz Emulator and Controller	**+$16,500**
Opt. 10 – Trigger State Analyzer	**+$6,000**
Opt. 11 – Mainframe Expansion and I/O Probe	**+$1,250**
Opt. 12 – 2nd I/O Probe	**+$1,000**
Opt. 15 – 1 MB Program Memory	**+$3,000**
Opt. 16 – 2 MB Program Memory	**+$4,600**
Opt. 17 – 3 MB Program Memory	**+$6,200**
Opt. 18 – Ethernet Interface	**+$2,500**
Opt. 1C – VAX 780/8xxx Ultrix	**NC**
Opt. 1F – VAX 780/8xxx VMS	**NC**
Opt. 1L – MicroVAX II/III Ultrix	**NC**
Opt. 1N – MicroVAX II/III VMS	**NC**
Opt. 1P – VAXstation Ultrix	**NC**
Opt. 1Q – VAXstation VMS	**NC**
Opt. 1R – SUN Series 3	**NC**
Opt. 1U – Tektronix 43xx	**NC**
Opt. 3S – 1 Year Software Service	**+$600**

CLANDS® II LANGUAGE DEVELOPMENT SYSTEM



68K FAMILY C DEVELOPMENT SYSTEM (CLANDS II)

The Tektronix 68K Family ANSI C Language Development System (CLANDS II) is a complete software development environment for developing software intensive embedded applications for the 68000/08/10/20 and the 68030 microprocessors. The ANSI C compiler has been optimized for the development of embedded applications. Applications written with CLANDS II run up to 22% faster and produces 12% to 20% smaller code modules when benchmarked against other popular 68K C cross compilers on the market today.

C LANGUAGE-DIRECTED EDITOR (LDE)

The C Language Directed Editor combines the text manipulation functions of a general purpose screen editor with the syntax checking function of a compiler. The time saving features of LDE will shorten the learning time for designers new to the C language, and make experienced programmers more productive.

68K FAMILY C COMPILER

The high-performance requirements of many embedded applications demand a compiler that makes full use of the processor's capabilities to generate fast and compact code.

The 68K Family C compiler uses many techniques to produce fast compact code. These include constants folding, efficient addressing mode usage, automatic register allocation, dead code elimination, passing parameters in registers rather than on the stack, and in-line expansion of many library routines.

For those who need to generate code that can be loaded anywhere in memory at load time, PC (Program Counter) relative code can be generated. This feature is useful for developing applications that will be loaded off of disk.

CODE COVERAGE ANALYZER

Testing of software is one of the most time consuming and difficult tasks facing today's programmers. The Code Coverage Analyzer (CCA) is a powerful tool to help analyze the effectiveness of your test programs. To use the CCA, you compile your application with the CCA option, load it, and run it for the desired amount of time. The CCA then generates a report that identifies code that was never executed and how many times each line of code was executed.

ASSEMBLER AND LINKER

The CLANDS II full-function assembler is also designed for embedded applications. The assembler will optimize instructions and addressing modes wherever possible in order to reduce code size and speed execution.

INTEGRATION CONTROL SYSTEM

The Integration Control System (ICS) was designed to help automate the task of software/hardware integration by serving as the central coordinator for the compile/assemble/link process. Rather than add hardware-specific information to your program modules, the information is stored in one ICS file. The compiler, assembler and linker then extract specifics from this configuration file to automatically control the creation of load modules.

By locating hardware specific information in one file, it is much easier to write portable code. Routines can be ported to new hardware by simply changing the ICS file.

TekDB COMPATIBILITY

The CLANDS II compiler produces a comprehensive load module that contains a wealth of debug information which is loaded into TekDB for true source level debug when using the Multi-V system or the TekDB Monitor. With this information, TekDB can debug the highly optimized code generated by the CLANDS II compiler.

CLANDS II Provides the Best C Tools on the Market Today for Developing 68K Based Embedded Applications.

- *Integrated Set of ANSI C Development Tools*
- *68000/08/10/20 and 68030 Support*
- *Code Coverage Analyzer*
- *TekDB Source Level Debugger*
- *Debug Optimized Code*
- *Generates Fast and Small Code*
- *Improves System Performance by up to 22%*

ORDERING INFORMATION

CLA6820 **$10**
Includes: 68000/08/10/20/30 C Compiler, CLDE, Assembler/Linker, ICS, CCA

OPTIONS

Opt. 1C – VAX 780/8xxx Ultrix	**+$10,990**
Opt. 1F – VAX 780/8xxx VMS	**+$10,990**
Opt. 1L – MicroVAX II/III Ultrix	**+$9,340**
Opt. 1N – MicroVAX II/III VMS	**+$9,340**
Opt. 1P – VAXstation Ultrix	**+$3,840**
Opt. 1Q – VAXstation VMS	**+$3,840**
Opt. 1R – SUN Series 3	**+$3,840**
Opt. 1U – Tektronix 43xx	**+$3,840**
Opt. 3S – 1 Year Software Service	**+$1,100**

ASM6820 **$10**
Includes: 68K Family Assembler/Linker/ICS

OPTIONS

Opt. 1C – VAX 780/8xxx Ultrix	**+$3,490**
Opt. 1F – VAX 780/8xxx VMS	**+$3,490**
Opt. 1L – MicroVAX II/III Ultrix	**+$2,990**
Opt. 1N – MicroVAX II/III VMS	**+$2,990**
Opt. 1P – VAXstation Ultrix	**+$1,490**
Opt. 1Q – VAXstation VMS	**+$1,490**
Opt. 1R – SUN Series 3	**+$1,490**
Opt. 1U – Tektronix 43xx	**+$1,490**
Opt. 3S – 1 Year Software Service	**+$350**

TekDB® MONITOR

TekDB Monitor Offers a High Performance, Cost Effective Debug Environment for Software Application Development.

- *Develop Real-Time Embedded Software*
- *68000/08/10/20 and 68030 Support*
- *TekDB Source Level Debugger*
- *Links to C, Pascal, Ada Compilers*
- *4 KB Embedded ROM Monitor*
- *Compatible with Logic Analyzers*
- *Compatible with Real-time Operating Systems*
- *Ideal for Use with Single Board Computers*

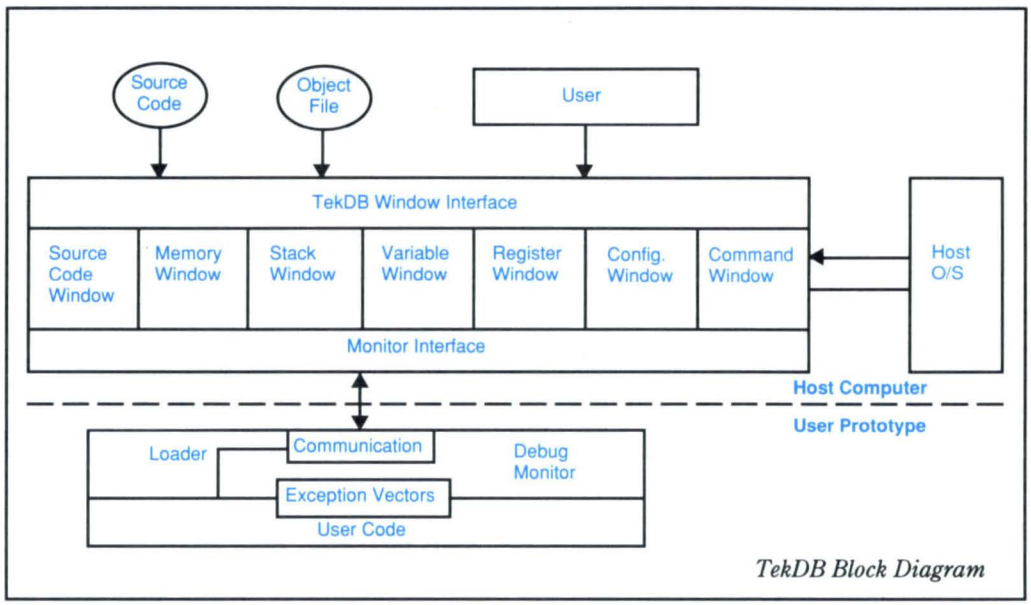
ORDERING INFORMATION

MV68KM 68K Debug Monitor	**$10**
MV68KMS 68K Debug Monitor Source and Right-to-Use License	**$10**
MV68KMK Monitor Development Kit	**$10**
Includes: TekDB, Debug Monitor, CLANDS II, Monitor Source	

OPTIONS

Opt. 1C – VAX 780/8xxx Ultrix	
(MV68KM)	**+$6,990**
(MV68KMS)	**+$2,990**
(MV68KMK)	**+$17,540**
Opt. 1F – VAX 780/8xxx VMS	
(MV68KM)	**+$6,990**
(MV68KMS)	**+$2,990**
(MV68KMK)	**+$17,540**
Opt. 1L – MicroVAX II/III Ultrix	
(MV68KM)	**+$3,990**
(MV68KMS)	**+$2,990**
(MV68KMK)	**+$13,490**
Opt. 1N – MicroVAX II/III VMS	
(MV68KM)	**+$3,990**
(MV68KMS)	**+$2,990**
(MV68KMK)	**+$13,490**
Opt. 1P – VAXstation Ultrix	
(MV68KM)	**+$2,490**
(MV68KMS)	*1
(MV68KMK)	**+$7,640**
Opt. 1Q – VAXstation VMS	
(MV68KM)	**+$2,490**
(MV68KMS)	*1
(MV68KMK)	**+$7,640**
Opt. 1R – SUN Series 3	
(MV68KM)	**+$2,490**
(MV68KMS)	**+$2,990**
(MV68KMK)	**+$7,640**
Opt. 1U – Tektronix 43xx	
(MV68KM)	**+$2,490**
(MV68KMS)	**+$2,990**
(MV68KMK)	**+$7,640**

*1 *Contact your local sales engineer.*



TekDB Block Diagram

TekDB MONITOR

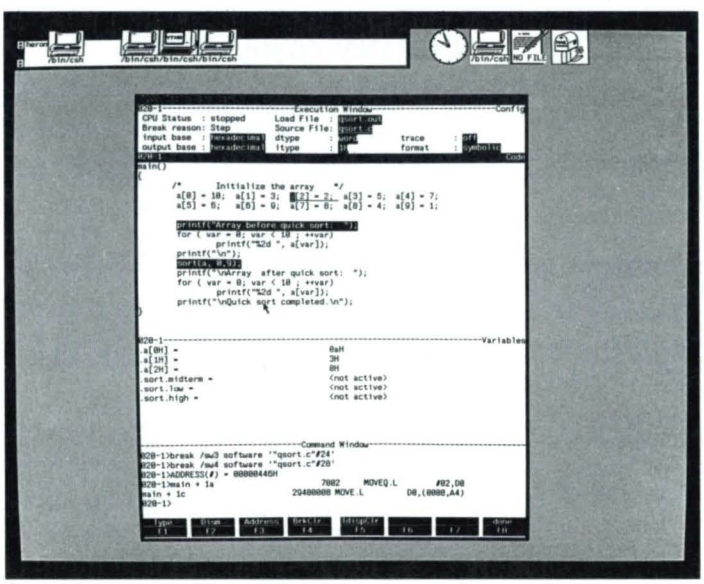
Debug monitors have been a favorite way to debug embedded software for years. However, they generally offered only rudimentary debugging capability–stop at an address, examine/patch memory, and go at an address. Tektronix has expanded on this concept and developed a debug monitor with the functionality of an in-circuit emulator and integrated it with TekDB, a proven C source level debugger. This powerful combination of products provides the software engineer a new and flexible low-cost software development environment.

TekDB C SOURCE LEVEL DEBUGGER

TekDB is a state-of-the-art windowed source code debugger and user interface that provides you with complete control over your embedded code. This user interface and debugger works with the TekDB Monitor and the 68020 Multi-V Development System. TekDB display windows include:

- Source Code
- Registers
- Memory
- Configuration
- Stack
- User Program
- Variables
- Command

Each window is updated with new information whenever a breakpoint is reached. Three or four windows appear on the screen at any one time and each can be resized to meet your requirements.



TekDB's window interface displays a wealth of information on the screen at one time. This display can be modified to show the information you need.

TekDB MONITOR

The TekDB Monitor is about 4 kbytes of code that a user programs into his prototype's EPROM. This monitor performs two basic functions: 1) it establishes communications with a host computer, and 2) it links your embedded software to the TekDB debugger.

The TekDB Monitor provides the debug capabilities of an in-circuit emulator except for hardware breakpoints or real-time functions such as real-time trace, timing analysis, or performance analysis. However, with the addition of a logic analyzer, even these emulator functions can be performed.

8540 BASED 8/16 BIT V SYSTEMS
C/PASCAL LANDS® I LANGUAGE DEVELOPMENT SYSTEM

8540 BASED V SYSTEMS

MODULAR AND UNIVERSAL SYSTEMS

To support the test and integration phases of a user's project, Tek offers V Systems–complete 8 and 16 bit microprocessor development systems. Modularity and universality are key features of the V Systems enabling them to be configured to meet your needs. Modular options include:

- 8/16 bit Real-time Emulators
- Program Memory–64K to 2 M Bytes
- Trigger Trace Analyzer (TTA)
- Memory Allocation Controller
- Ethernet Connections

REAL TIME AND TRANSPARENT EMULATION

Real time emulation, standard on all Tektronix emulators, is accomplished by executing code on a processor identical in function to the one targeted for the prototype hardware. The emulator processor is run under the control of powerful debug software that allows control and tracing of the code's execution. Tek's superior emulators allow your code to execute in real time, with no wait-states inserted or clock pulses stretched. This means the emulator is fully transparent to the user, therefore, you do not spend time "working around" the development system.

TTA CAPTURES REAL TIME EVENTS (STANDARD WITH V SYSTEMS)

A powerful option to Tek emulators is the Trigger Trace Analyzer (TTA), which uses a high speed trace buffer to capture real time software and hardware logic events, with the prototype running at the design's full specified operating speed. The TTA's data qualification allows you to capture only the data you wish to see.

LOCAL AREA NETWORK CONNECTIONS

Downloading of code has always been a bottleneck when using microprocessor development systems. A new Ethernet connection is now available to connect 8540 based systems to industry standard networks. With this option you can download code up to 40 times (from 20 minutes to 30 seconds) faster than over standard RS-232.

LANGUAGE DEVELOPMENT SYSTEMS (LANDS I)

C/PASCAL LANDS I

LANDS I is an integrated set of 16 bit language development tools consisting of a:

- Language Directed Editor (LDE)
- C/Pascal Cross Compiler
- Integration Control System (ICS)
- High Level Language Debugger
- Macro Assembler and Linker

LANGUAGE DIRECTED EDITORS (LDE)

The Language Directed Editors for C and Pascal combine the text manipulation functions of a general purpose screen editor with the syntax checking function of a compiler. The time saving features of LDE will shorten the learning time for designers new to the C or Pascal language, and make experienced programmers more productive.

C AND PASCAL CROSS COMPILERS

For high level language programming, the LANDS I C and Pascal cross compilers contain many enhancements for microprocessor programming. These enhancements include interrupt handling, bit level data manipulation, assignment of variables to specific hardware addresses, and direct access to I/O ports without having to resort to assembly language code. The LANDS I C compiler supports Kernighan and Ritchie's standard C and the proposed ANSI C standard.

INTEGRATION CONTROL SYSTEM (ICS)

LANDS I includes a unique tool for implementing the hardware/software interface called the Integration Control System. The user fills in a brief source file with parameters defining the software modules and hardware configuration. From this source file, ICS automatically handles the details and generates the necessary code and command files to execute code in the target system.

HIGH LEVEL DEBUG–C AND PASCAL

Tek's LANDS I debug system increases your productivity by enabling you to debug code at the source code level. Your program and variables can be displayed in high level source form. Breakpoints can be set on statement numbers, procedure and function names, or on variables to halt program execution. This approach completely eliminates the time consuming requirements of translating assembly level debug information into its high level counterpart.

8 AND 16 BIT ASSEMBLERS AND LINKERS

Tek assembler packages consist of an assembler for the specific microprocessor, a sophisticated linker for locating code, and a library generator for creating source code for object modules and reusing object modules previously created. Tektronix' assemblers and linkers include many features that are normally associated only with high-level coding.

Tek's 8/16 Bit Emulation and Language Tools Provide a Seamless Host-Based Design Environment.

8540 BASED V SYSTEMS

- *8 and 16 Bit Real Time Emulation*
- *Modular and Universal Systems*
- *Ethernet/RS-232 Connections*

C/PASCAL LANDS I

- *Complete Code Generation Systems*
- *C/Pascal Compilers*
- *High Level Debuggers*
- *Editors*
- *Assemblers/Linkers*

ORDERING INFORMATION

8540 BASED V SYSTEMS

Includes: 8540A Integration Unit, 8 or 16 Bit Emulation Support, 128 KB Memory, and Trigger Trace Analyzer

V68000A Emulation	**$24,900**
V68008 Emulation	**$24,900**
V68010 Emulation	**$24,900**
V6809 Emulation	**$14,500**
V80186 Emulation	**$24,900**
V80188 Emulation	**$24,900**
V8085 Emulation	**$14,500**
V8086 Emulation	**$24,900**
V8088 Emulation	**$24,900**
VZ80 Emulation	**$14,500**

OPTIONS

Opt. 11 – 512 KB Total Memory	**+$2,900**
Opt. 12 – 768 KB Total Memory	**+$4,000**
Opt. 13 – 1 MB Total Memory	**+$6,000**
Opt. 14 – 2 MB Total Memory	**+$12,000**
Opt. 19 – LAN Connection	**+$2,500**

LANDS I LANGUAGE DEVELOPMENT SYSTEMS

Includes C or Pascal Compiler, Assembler,LDE, ICS, HLL Debugger

CLAN68K 68000/08/10 C Compiler	**$10**
CLAN86 8086/88/186/188 C Compiler	**$10**
PLAN68K 68000/08/10 Pascal Compiler	**$10**
PLAN86 8086/88/186/188 Pascal Compiler	**$10**

OPTIONS

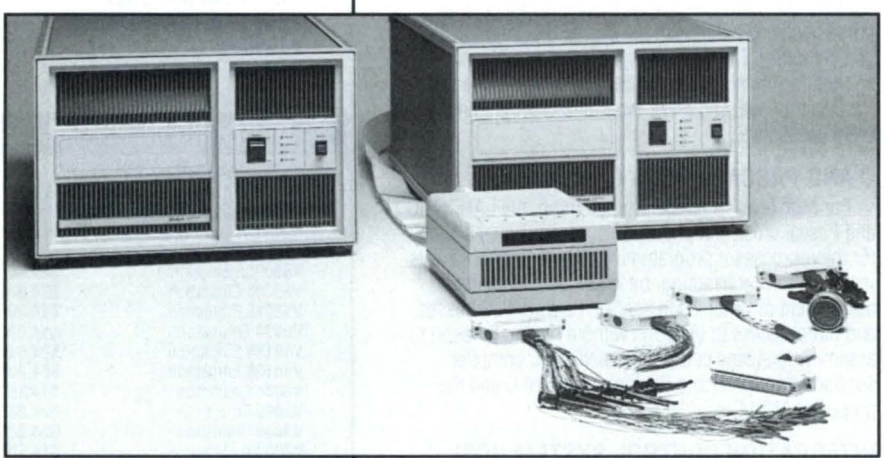
Opt. 1C – VAX 780/8xxx Ultrix	**+$10,990**
Opt. 1F – VAX 780/8xxx VMS	**+$10,990**
Opt. 1L – MicroVAX II/III Ultrix	**+$9,340**
Opt. 1N – MicroVAX II/III VMS	**+$9,340**
Opt. 1P – VAXstation Ultrix	**+$3,840**
Opt. 1Q – VAXstation VMS	**+$3,840**
Opt. 1R*1 – SUN-3 Unix	**+$3,840**
Opt. 1U*1 – Tektronix 4300	**+$3,840**
Opt. 3S – 1 Year Software Service	**+$1,100**

*1 *CLAN68K only*

Assemblers, Communication packages (ICOM40A), and IBM PC support are also available. Contact your local Tektronix sales representative for additional information.

Cost Effective Software and Hardware Tools for Mil-Std-1750A Embedded Applications

- *Real-Time Software Execution*
- *30 MHz PACE1750 Support*
- *Surface Mount and in Socket Probing*
- *Ada Source Level Debuggers*
- *Fast Ethernet Interface*
- *VAX Family Host*
- *Worldwide Service and Support*



ORDERING INFORMATION

V1750A Software Integration System Includes: 8540A, 128 KB Program Memory, TTA, 1750A-2 Emulator and Probe	**$36,300**
V1750S Software Execution System Includes: 8540A, 128 KB Program Memory, 1750 S/W Executer (88M1750)	**$26,300**
OPTIONS	
Opt. 10 – 256 KB Total Prog Mem	**+$1,000**
Opt. 11 – 512 KB Total Prog Mem	**+$2,900**
Opt. 12 – 768 KB Total Prog Mem	**+$4,000**
Opt. 13 – 1 MB Total Prog Mem	**+$6,000**
Opt. 14 – 2 MB Total Prog Mem	**+$12,000**
Opt. 19 – Ethernet Interface	**+$2,500**
88M1750 Software Execution Unit	**$8,500**
Opt. 05 – Expanded Memory Support	**$2,000**

MIL-STD 1750A SUPPORT SYSTEM

The Tektronix V1750A and V1750S Systems are high-performance, cost-effective tools for developing, testing, debugging, and integrating embedded software and target hardware. Because the 1750A military standard is an Instruction Set Architecture (ISA), no single 1750A processor exists. Each implementation of the standard is different, including single-chip, multi-chip, bit-slice, and board-level processors; all with different speed, size and weight characteristics. The Tektronix V1750A System adapts to many different MIL-STD 1750A system configurations. It can be used with different processors or different configurations of the same processor. Some of the popular 1750A processors that the V1750A supports are the F9450, MAS-281, MDC-281, PACE1750A, PACE1750AE, Delco M-372, Tracor RH1750, SBC-50 board, and the PACERunner board.

The V1750A System is supported by an integrated communications package (ICOM40) for popular mainframes and workstation systems. This provides a turnkey interface between the host software tools (such as assemblers and compilers) to allow run-time modules to be transferred quickly and efficiently into the target. Source-level debuggers also use the ICOM40 package to form a tightly integrated link to the V1750A System.

NEW ADA SUPPORT FOR THE V1750A

Ada support has also been integrated with the V1750A system. A number of 1750 Ada compiler systems are available from partner vendors. These systems provide direct support for the V1750A Software Integration System (emulator) and V1750S Software Execution System. These compiler systems include source level debuggers that are interfaced directly to the V1750A system. Debugging and verification of Ada run-time software is accomplished under control of the source level debugger without any need to translate machine code or assembly language. Downloads are extremely fast because of the V1750's ethernet interface. See the ADA SUPPORT section on the next page of this catalog for more information on Ada vendors and Ada/1750 products.

NEW PERFORMANCE SEMICONDUCTOR PACERUNNER 1750 BOARD

Tektronix has expanded its MIL-STD 1750A program by announcing V1750A Software Integration System support for the 30/40 MHZ Performance Semiconductor PACERunner board. The PACERunner board is a single board computer based on the PACE1750 CPU chip set, and includes support for the expanded memory option. The PACERunner board has a built-in interface for the V1750A system so it can be used without designing any additional hardware. At 30 MHz the V1750A system will track program execution in real-time without adding any wait-states.

1750A SOFTWARE EXECUTER, 88M1750

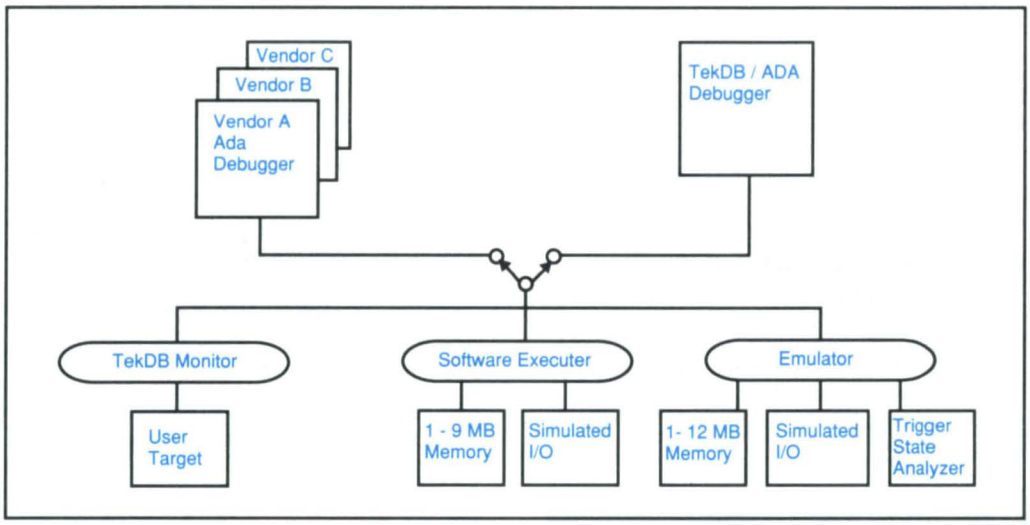
When the target hardware isn't available, the 88M1750 Software Executer (SWE) can be used in its place. The 88M1750 SWE provides a MIL-STD 1750A compliant environment for testing and debugging software. Programs can be loaded and tested with the SWE processor before they are transferred into the target environment. I/O systems on the target can be simulated by using SVC calls to access host resources like file systems and peripheral hardware. Several MIL-STD 1750A options are supported by the SWE including the expanded memory option. The 88M1750 can be added to a V1750A, or is available in the preconfigured V1750S system.

LOCAL AREA NETWORK ETHERNET CONNECTIONS

Downloading the code has always been a bottleneck when using microprocessor development systems. While RS-232 is the most convenient interface for downloading code it is also the slowest. A new Ethernet connection is now available to connect the V1750A to VAX/VMS, SUN-3, and Tek 43xx systems. With this option you can download code up to 40 times faster than over standard RS-232 (from 20 minutes to 30 seconds).

Ada Support Tools for the 68K Family and Mil-Std-1750A Systems

- *Integrated Source Level Debuggers*
- *Emulator, Executer and Monitor*
- *TekDB/Ada Debugger*
- *Ethernet Connection*



Ada BACKGROUND

Ada was originally developed to reduce the high cost of developing embedded software for defense and aerospace applications. It was intended to replace the over 400 languages that were in use by the DoD and its contractors. Ada is now being adopted in many commercial applications, especially in the European electronics industry. Ada was not intended as just another programming language. Ada incorporates many characteristics that support modern software engineering principles. Tektronix has made a significant commitment to developing Ada support for its customers.

Tek's Ada support has been modeled around the LANDS (LANguage Development System) concept that was introduced for the "C" LANDS products in 1982. The basic concept of LANDS is to provide a seamless connection between the host and the target during the development of embedded software. Tektronix, through its Integrated Solutions Program, has encouraged Ada vendors to provide support for Tektronix integration systems.

INTEGRATED SOURCE LEVEL DEBUGGING

Tektronix is integrating high-performance emulation and execution technology with a variety of Ada development systems. Using the LANDS concept, the Tektronix integration system interfaces directly to the Ada source level debugger. This means programs can be loaded, debugged and verified right on the target system. If the target isn't available, then the software executer can be used in its place. Two levels of support are provided by Tektronix and its Integrated Solution Vendors. On-line source level debugging with the compiler vendor's debugger, and integration using the Tektronix TekDB/Ada debugger system.

ON-LINE SOURCE LEVEL DEBUGGING

Source level debuggers are available with most Ada development systems. These debuggers usually depend on other components of the compiler system to be active, so they are referred to as "on-line" (i.e., they cannot be used standalone, or "off-line"). Interfaces have been developed that connect these debuggers to the Tektronix system. The chart below lists all of the Ada Vendors that offer integrated interfaces for the Tektronix systems. Check with you local Tektronix representative for information on additional vendors that offer support.

NEW TekDB/Ada

Tektronix also offers another level of source level debugging with TekDB/Ada. TekDB/Ada is a Tektronix source level debugger that offers support for Ada. TekDB/Ada is optimized for use in embedded systems and is tightly integrated with Tektronix emulation technology. TekDB/Ada can be used with TekDB monitor, the 68020 executer, or the 68020 emulator. This gives Ada developers a range of price performance options in integrating software into the target environment. TekDB can also be used standalone, or "of-line", so debugging and verification can proceed without activating the compiler system. TekDB uses the newly developed IEEE-695 interface standard to transfer load modules and debug information. The following table lists Integrated Solution Vendors that support Tektronix Systems. New products are currently under evaluation so check with your Tektronix representative for up to date information.

ADA SUPPORT FROM TEKTRONIX

Integrated Solutions Vendor	On-Line Vendor Debugger		TekDB/Ada Debugger
	V1750	MV6820 or TekDB Monitor	MV6820 or TekDB Monitor
Alsys			Yes
Tartan Labs	Yes	Yes	
Telesoft (Ready)	Yes*1		Yes
TLD Ltd.	Yes		
Systems Designers	Yes*1		Yes*1
Verdix	Yes	Yes	

*1 *Products are under development. Check with your Tektronix representative for availability.*

The Standard By Which All Others Are Compared

- *Up to 160 Channels with 500ps Resolution*
- *Up to 384 Channels with 5ns Resolution*
- *More Than 500 Channels of 100 MHz Pattern Generation*
- *Memory Depth to 128K*
- *Broad Based Support for Popular Microprocessors*
- *Multiprocessor Support for up to 6 CPUs at Once*

DAS9200

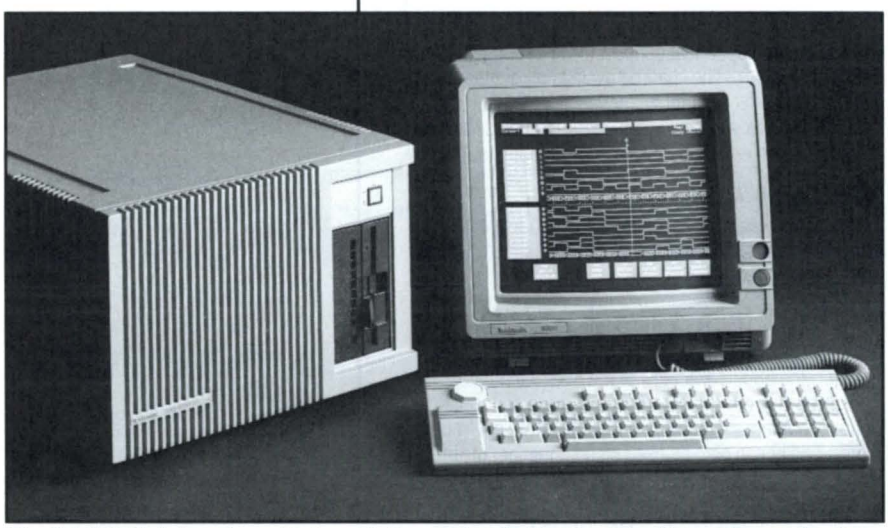
The 9200 Series Digital Analysis System (DAS9200) is a powerful, user configurable system designed to meet the needs of a broad range of digital design, debug, and test requirements. The advanced architecture of the DAS9200 allows you to install data acquisition and pattern generation modules you need today and easily expand or reconfigure as your requirements grow and change.

MAINFRAMES THAT OFFER CHOICES NOT COMPROMISE

There are three mainframes available for you to choose from. The high performance DAS9220 is composed of a 68010 CPU, 8 M bytes of system RAM, 40 M byte Hard Disk, and 1.2 M byte Floppy Drive.

The lower cost DAS9219 is composed of a 68010 CPU, 2 M bytes of system RAM, 20 M byte Hard Disk, and 400 K byte Floppy Drive. Each of these mainframes provides three RS-232 I/O ports and seven instrument card slots. Industry standard GPIB and Ethernet LAN interfaces are optionally available.

A 14-inch color display, the 9201T, can be added for stand-alone operation of either the DAS9220 or DAS9219.



The DAS9200 integrates a high resolution, color display to make it easy for you to view acquired data and a full ASCII keyboard so that it's operation is as familiar as operating a PC.

The DAS92E9 is used for expanding the number of instrument card slots available in either the DAS9220 or DAS9219, it can not be used alone. The expansion mainframe includes an expansion receiver card and cabling. It offers eight additional instrument card slots. A system maximum of 28 card slots are available in a fully expanded DAS9200 system. This would include either a DAS9220 or DAS9219 and three DAS92E9s.

INSTRUMENT TYPES THAT SPAN A BROAD RANGE OF APPLICATIONS

Multiple data acquisition and pattern generation modules can be added to a DAS9200 system. The modules are chosen by the number of channels, operating speed, and analysis features that you require. Each sub-system allows you to increase the channel width by adding expansion boards. Refer to the DAS9200 Instrument Card Selection Guide for an overview.

Most any combination of data acquisition and pattern generation cards may be installed in a DAS9200 system. The user may have these cards interact in real time. For instance, two acquisition modules can be set up to run at different clock speeds yet display the acquired data in a "time correlated" format. This feature enhances the debugging of multi-processor designs. Or you could set an acquisition module to monitor the Unit Under Test (UUT) for a specific "event" to occur. When that event is recognized, the acquisition module could then instruct a pattern generator to begin or enable another acquisition card to begin sampling.

Timing Analysis and High Speed State Analysis

For timing analysis there are the 92A16 and 92HS8 families. The 92A16 is a 16-channel acquisition card that samples at 200MHz (5ns). It has 4 k bits of memory per channel. Each single card can be expanded to a system total of 384 channels with no memory depth or speed trade-offs. The input probes have a programmable setup and hold time for high speed (up to 200 MHz) synchronous acquisition and provide an incredibly low 2.5pf capacitive load. Four-state triggering, glitch capture (2ns typically), auto-run, and other features combine to help you find even the most elusive problems.

Sub-Nanosecond Timing Resolution

The 92HS8 family can sample up to 2 GHz (500ps) across as many as 160 channels. The extremely high bandwidth probes are guaranteed to capture pulses as small as 1ns and has been proven to reliably capture pulses as small as 700ps! These probes exhibit extremely low input capacitance; less than 1pf. Un-challenged in it's class, the 92HS8 offers the only solution when you require the greatest accuracy from your instrumentation.

State Analysis and Advanced Microprocessor Support

For state analysis or microprocessor support there is the 92A60/A90 family. These acquisition cards are available in either 32K or 128K deep versions. The 92A60 is 60 channels wide. The 92A90 is 90 channels wide. The extremely sophisticated triggering of this family offers power beyond measure. And a pre-programmed library of useful triggering scenarios (including the ability for you to add library entries) adds both convenience and assurance that you can get the job done quickly.

Pattern Generation Up To 100 MHz

For stimulus requirements you can choose between the 92S16/S32 and the new 92SX109/SX118. These sub-systems offer 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 callable subroutines. These pattern generators can be combined with any of the acquisition cards to provide powerful stimulus/response systems.

MULTITASKING BRINGS THE POWER OF MULTIPLE INSTRUMENTS TO A SINGLE DISPLAY

The DAS9200 allows you to define "clusters" of cards, either acquisition, stimulus, or both. By defining two "clusters" you effectively create two logic analyzers that can be operated independently or simultaneously. This allows you to "baby-sit" your design for an intermittent failure with one cluster and at the same time use the second cluster for other work.

INTUITIVE OPERATION SO YOU CAN FOCUS ON THE PROBLEM, NOT THE TOOL

All of this power doesn't come at the expense of your frustration. You control all of the DAS9200 operations through a set of intelligent, well organized menus. Each menu selection field is actually a pop-up menu that lists every item available for that field. Additionally, every menu entry or pop-up menu item is backed with a context-sensitive, on-line help system called NOTES. You can ask for NOTES on any item, at any time by pressing the "NOTES" key on the keyboard.

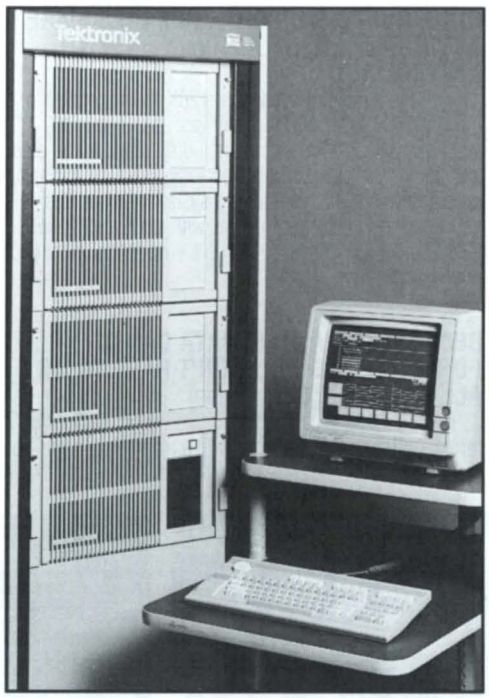
GETTING THE MOST OUT OF YOUR INVESTMENT

The data you acquire can be easily documented for future reference. The DAS9200 supports color as well as Epson graphics compatible line printers.

You can substitute 9201PC, IBM compatable PC software, for the standard display, the 9201T.

There is a removable hard disk when data security is required.

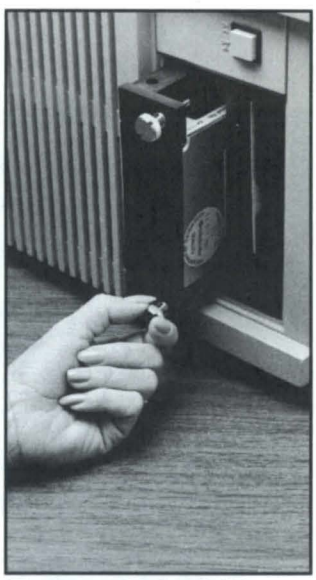
A complete, high-level remote control language (PCL) allows you to easily integrate the DAS into your testing environment.



Up to three expansion mainframes can be connected to the DAS9219 or DAS9220 expanding the system to 28 instrument card slots. For automated test (ATE) applications, the DAS9200 can be setup and controlled via RS-232 or GPIB interfaces.

And every DAS9200 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.) The warranty period can be extended to two or three years at the time you purchase your system. In addition, a toll-free, telephone "Hot Line" (U.S. only) is accessable as part of the Software Subscription Service offered for the DAS9200.

All of this and more makes the DAS9200 "The Standard By Which All Others Are Compared."



The removable hard disk option provides an added measure of convenience and security.

CONFIGURED SUPPORT PACKAGES MAKE MICROPROCESSOR ACTIVITY EASY TO UNDERSTAND

If you join the unprecedented 128K memory depth of the DAS9200's 92A90D with the vast assortment of symbolic data format options including register and data deduction, stack simulation, and easy-to-follow performance analysis, what you get is a system that handles your toughest analysis problems with ease, and makes those problems seem easy to solve – no matter what your application.

BECAUSE IT'S A DAS, DATA CAN BE FORMATTED SO YOU DON'T HAVE TO DO ALL THE ANALYSIS

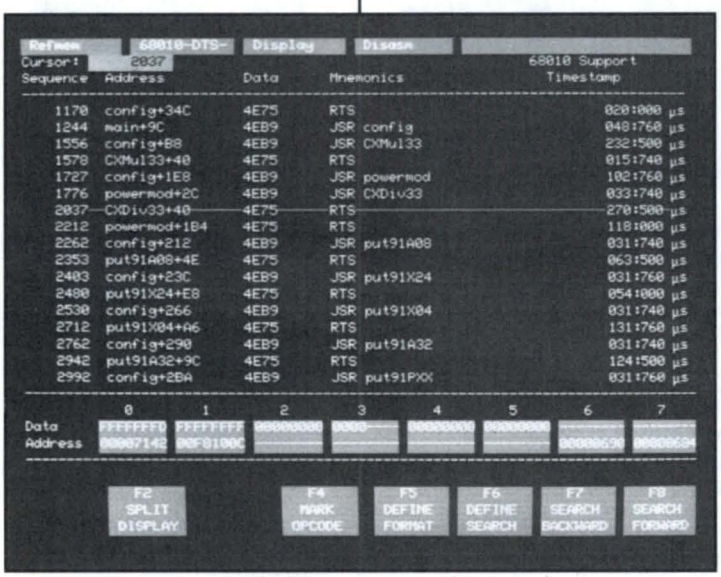
The DAS9200 provides you with a variety of display format options. You can start with a macroscopic view of symbolic subroutine entry and exit points. Then, without reacquiring, gradually zoom in on specific activities and values. You can view control flow, assembly instructions, and cycle-by-cycle bus activity.

Hardware display format helps you track problems specific to hardware or to hardware/software interaction by showing you every bus transaction in order of occurrence. Software display format shows you just what would be found in an assembly listing, with data transfers optionally included.

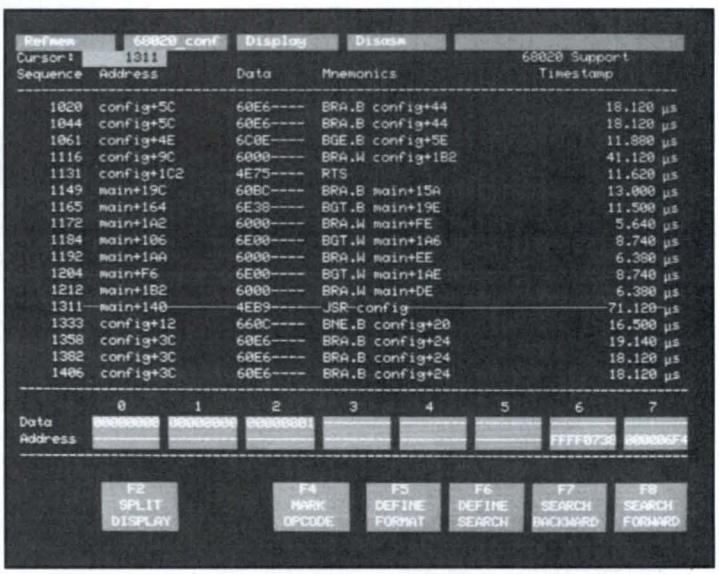
In control flow mode, you follow your program's direction smoothly with a display of only the instructions that cause program branching. And in subroutine trace mode, you see exclusively subroutine calls and returns, obtaining a high-level overview of program execution without losing sight of specifics.

Available for selected microprocessors, register deduction lets you examine most register contents at any point in program execution. Unlike an emulator, the DAS9200 performs this task without affecting microprocessor operations through interrupts, wait states, or debug code. Data deduction shows variables and how they are changed as your program executes. And stack simulation simplifies debugging where stack-related problems occur.

With histograms and other statistical tools, the DAS9200's accurate software performance analysis helps you optimize systems by showing you when your code is efficient and when it's not. Software performance analysis also supports optimization by providing plot profiles of code activity and response times of interrupt handlers.



The subroutine trace display format can condense several thousand cycles of processor bus activity into a single screen of meaningful information.



Control flow display format provides a condensed overview of program operation within specific code modules.

THE NAME OF THE GAME IN DESIGNING TODAY'S ADVANCED PRODUCTS IS INTEGRATION

Hardware is linked to microprocessors, software to hardware, and multiple processors to one another. Up to dozens of engineers may be working together on a project. Multiple components, multiple designs, and multiple levels of complexity all too often mean problems built-in from the very beginning.

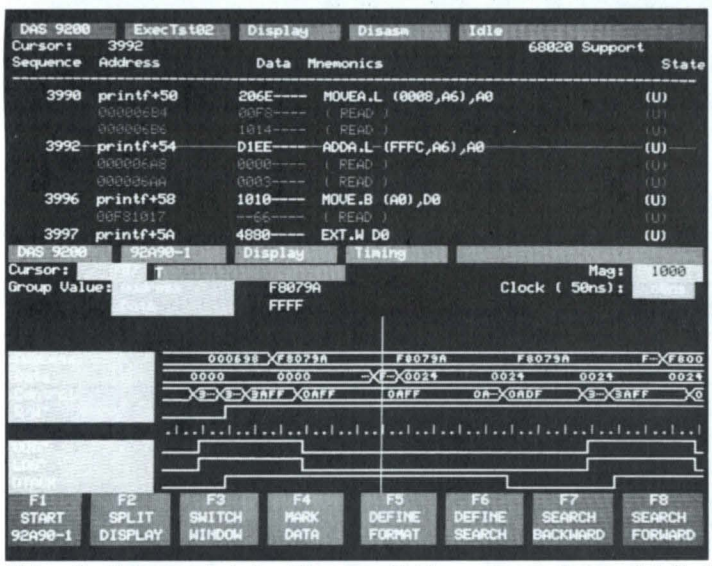
What's more, these problems usually are not discovered until the integration stage, when the interactions of many components and many engineers' designs are tested and debugged. At this point, they're more difficult and more expensive to correct, and they have a more critical impact on your project schedule.

The DAS9200 addresses the challenge of project complexity and the built-in problems it can bring by providing tools that let you look at the interaction of multiple components and designs all at one time.

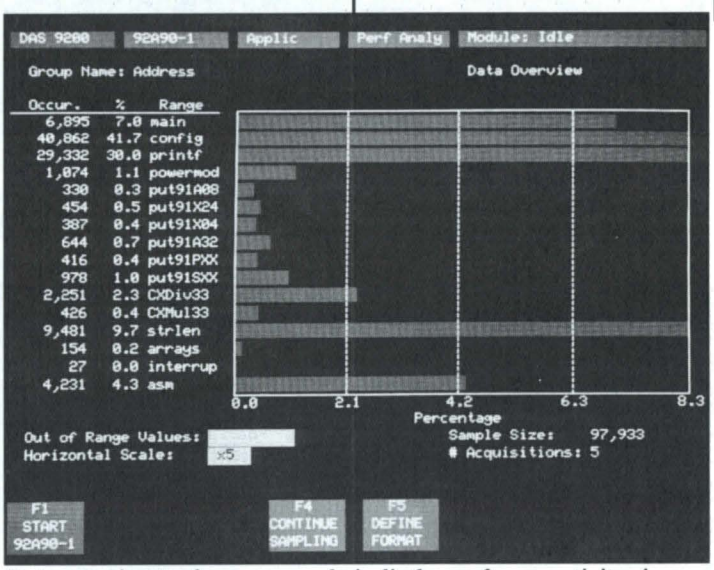
A time-correlated, split-screen display lets you scroll through disassembly of timestamped data acquired from any two processors, and quickly understand what each is doing at a single point in time. You can lock the cursors in separate display windows so both screens scroll together in accurate time alignment.

Real-time event handshaking between the different instrument cards lets you identify specific data across multiple acquisition modules and trigger them simultaneously to acquire the overlapping data necessary for time alignment. And pattern generation lets you simulate interactions of hardware that's not yet available or not currently working.

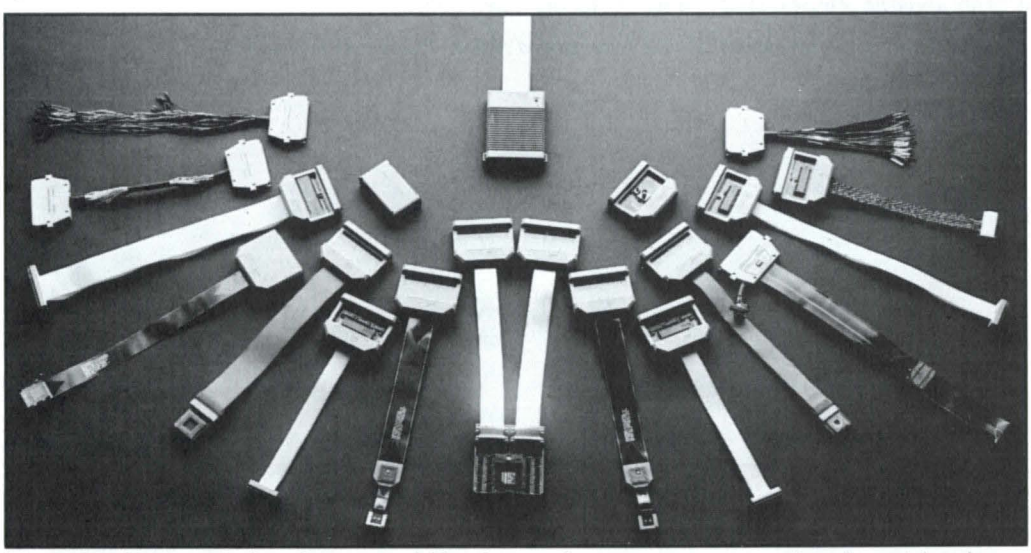
Perhaps best of all, you can debug hardware and software components and their system interactions using the same card modules, and reconfiguring them from the keyboard without having to physically move them.



Using the time correlated, split-screen display, you can observe detailed system interractions in any format you choose.



Data overview performance analysis displays software activity via a histogram of address ranges of bus activity.



The 92A60/A90's probe interface can quickly adapt to almost any processor and package style using the 92DM family of probe adaptors. There is also a general purpose lead set for custom applications.

STANDARD CONFIGURATIONS

Model Number	Recommended Application	Composed of:	Performance Overview	Price
DAS9230	General purpose HW analysis with 8- or 16-bit processor support.	1 92A16 with P6460 probes 1 92A60 without leadset 1 92S16	16-Ch 200 MHz async/100MHz sync Supports one 8- or 16-bit processor 18-Ch, 50 MHz stimulus	**$31,230**
DAS9232	General purpose HW analysis with 8-, 16-, or 32-bit processor support.	1 92A16 with P6460 probes 1 92A16E with P6460 probes 1 92A90 without leadset 1 92S16 1 92S32 with P6465 probes	32-Ch 200 MHz async/100MHz sync Supports one 8-, 16-, or 32-bit processor 50-Ch, 50 MHz stimulus	**$52,780**
DAS9240	Timing Analysis	1 92A16 with P6461 probes 1 92A16E with P6461E probes	32-Ch 200 MHz async/sync	**$31,400**
DAS9241	Wide Timing Analysis	2 92A16 with P6461 probes 2 92A16E with P6461E probes	64-Ch 200 MHz async/sync	**$44,000**
DAS9242	High Speed Timing Analysis	1 92HS8 1 92A16 with P6461 probes 1 92A16E with P6461E probes	8-Ch 2GHz async 32-Ch 200 MHz async/sync	**$56,940**
DAS9250	Single 8- or 16-bit Processor Support	1 92A60 without leadset	60-Ch, 20 MHz asnyc/sync Supports one 8- or 16-bit processor	**$16,410**
DAS9252	Single 8-, 16-, or 32-bit Processor Support	1 92A90 without leadset	90-Ch, 20 MHz asnyc/sync Supports one 8- , 16-, or 32-bit processor	**$18,180**
DAS9253	Dual 8- or 16-bit Processor Support	2 92A60 without leadset	120-Ch, 20 MHz asnyc/sync Supports two 8- or 16-bit processor	**$26,640**
DAS9254	Dual 8-, 16-, or 32-bit Processor Support	2 92A90 without leadsets	180-Ch, 20 MHz asnyc/sync Supports two 8- , 16-, or 32-bit processors	**$30,550**
DAS9255	180 Channel Software Analysis for 8- or 16-bit Processors	3 92A60 without leadsets	180-Ch, 20 MHz asnyc/sync Supports three 8- or 16-bit processors	**$36,750**
DAS9256	270 Channel Software Analysis for 8-, 16-, or 32-bit Processors	3 92A90 without leadsets	270-Ch, 20 MHz asnyc/sync Supports three 8-, 16-, or 32-bit processors	**$45,330**
DAS9257	240 Channel Software Analysis for 8- or 16-bit Processors	4 92A60 without leadsets 1 DAS92E9 Expansion Mainframe 1 GPIB/Expansion Interface	240-Ch, 20 MHz asnyc/sync Supports four 8- or 16-bit processors	**$55,015**
DAS9258	360 Channel Software Analysis for 8-, 16-, or 32-bit Processors	4 92A90 without leadsets 1 DAS92E9 Expansion Mainframe 1 GPIB/Expansion Interface	360-Ch, 20 MHz asnyc/sync Supports four 8-, 16-, or 32-bit processors	**$66,955**

Each standard configuration includes a 9201T color display and DAS9219 mainframe with 2 Mbytes system RAM, 20 Mb-Hard Disk, 400 kb-Floppy Drive, and three RS-232 I/O ports. Additional options are available. Please consult with your local sales representative.

Options A1-A5, International Power Plugs, are available as no charge options for each preconfigured system. *Please refer to page 488.*

ORDERING INFORMATION

DAS9200 MAINFRAMES

DAS9219 Basic Mainframe
Includes: 2 Mbyte RAM, 20 Mb Hard Disk, 400 kb Floppy Drive — **$9,970**
Opt. 07 – Sub. 8 Mbyte System RAM for 2 Mbyte — *1
Opt. 10 – Sub. 1.2 Mb FD for Std. 400 kb FD — **+$250**
Opt. 13 – Sub. 40 Mb HD for Std. 20 Mb HD — **+$700**
Opt. 14 – Sub. 20 Mb Removable HD for Fixed HD — **+$1,200**
Opt. 16 – Sub. 80 Mb HD for Std. 20 Mb HD — **+$1,550**
Opt. 2C – GPIB/Expansion Interface (92C02) — **+$1,950**
Opt. Q0 – On-Site Installation — *1
Opt. Q5 – +1 Year Additional Warranty — *1
Opt. Q6 – +2 Years Additional Warranty — *1

DAS9220 High Performance Mainframe
Includes: 8 Mbyte RAM, 40 Mb Hard Disk, 1.2 Mb Floppy Drive — **$13,970**
Opt. 14 – Sub. 20 Mb Removable HD for Fixed HD — **+$1,220**
Opt. 16 – Sub. 80 Mb HD for Std. 40 Mb HD — **–$250**
Opt. 2C – GPIB/Expansion Interface (92C02) — **+$1,950**
Opt. Q0 – On-Site Installation — *1
Opt. Q5 – +1 Year Additional Warranty — *1
Opt. Q6 – +2 Years Additional Warranty — *1
DAS9229 Includes: 9201T Display and 9219 Mainframe — **$12,420**
Opt. 01 – Sub. DAS9220 Mainframe for DAS9219 Mainframe — **+$4,000**
Opt. 07 – Sub. 8 Mbyte System RAM for 2 Mbyte — *1
Opt. 10 – Sub. 1.2 Mb FD for Std. 400 kb — **+$250**
Opt. 14 – Sub. 20 Mb Removable HD for Fixed HD — **+$1,200**
Opt. 16 – Sub. 80 Mb HD for Std. 20 Mb — **+$1,200**
Opt. 2C – GPIB/Expansion Interface (92C02) — **+$1,950**
Opt. Q0 – On-Site Installation — *1
Opt. Q5 – +1 Year Additional Warranty — *1
Opt. Q6 – +2 Years Additional Warranty — *1

DAS92E9 Expansion Mainframe — **$6,705**
Opt. Q0 – On-Site Installation — *1
Opt.Q5 – +1 Year Additional Warranty — *1
Opt. Q6 – +2 Years Additional Warranty — *1

OPTIONS COMMON TO ALL DAS MAINFRAMES

Opt. 04 – VDE (German EMI Std., 220V Operation Only) — **+$1,200**
Opt. 05 – Rackmount Kit — **+$400**
Opt. 1B – 125V/208 V 3-Phase Power Supply — **+$180**
Opt. 3C – Expansion Only Interface (92C03) — **+$1,350**
Opt. Q9 – 1 Year DAS/OS Software Support
Includes Access to the US National Support Center and Telephone Hot Line. — **+$950**

DISPLAY AND DISPLAY SOFTWARE

9201T Color Graphic Display — **$3,635**
Opt. Q0 – On-Site Installation — *1
Opt. Q5 – +1 Year Additional Warranty — *1
Opt. Q6 – +2 Years Additional Warranty — *1

9201PC MS-DOS Compatible Display Software — **$1,000**
Requires MS-DOS Ver. 3.0 or higher, IBM Personal Computer AT or 100% Compatible; 512 kb RAM; EGA Display; One RS-232 I/O Port.
Opt. Q9 – 1 Year Software Support — *1
Includes Access to the US National Support Center and Telephone Hot Line.

COMMUNICATION INTERFACES

92C02 GPIB/Mainframe Expansion Interface — **$1,950**
Opt. Q5 – +1 Year Additional Warranty — *1
Opt. Q6 – +2 Years Additional Warranty — *1

92C03 Mainframe Expansion Interface Only — **$1,350**
Opt. Q5 – +1 Year Additional Warranty — *1
Opt. Q6 – +2 Years Additional Warranty — *1

92LAN Ethernet LAN Interface — **$3,450**
Opt. Q5 – +1 Year Additional Warranty — *1
Opt. Q6 – +2 Years Additional Warranty — *1

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1-A5 – Available — **NC**
See page 488 for description.

Option 88, Factory Installation and Test, is a no charge option available for all DAS9200 Instrument cards ordered with a new mainframe. This option assures that the card is installed in the mainframe and tested at the factory. The two components are then shipped together.

OTHER DAS9200 SYSTEM OPTIONS

92WBOOK DAS9200 Workbook/Tutorial, Software and Training Aid — **$95**

*1 *Contact your local sales engineer.*

Microprocessor Support Packages:

92DMxx and 92DMXxx, Preconfigured Microprocessor Support Packages are available as both system options and sold separately. Refer to The Microprocessor Support Chart on page 178–179 for a comprehensive list of the devices that are supported. Each 92DM package requires specific system configurations. Please consult with you local Sales Engineer for an up to date list and detailed ordering information.

DAS9200 INSTRUMENT CARD SELECTION GUIDE

The following instrument cards include probes. A maximum of seven instrument cards are installable in a DAS9220 or DAS9219 depending on type. A maximum of eight instrument cards are installable in a DAS92E9 depending on type . Each mainframe includes sufficient power for all card slots. Additional options are available, please consult with your local sales engineer.

Acquisition Cards	Description	Resolution Internal Clock	Resolution External Clock	Maximum Channels per Card	Maximum Channels per System	Memory Depth (per Chan.)	Price
92A16	Master	5 ns	5 ns	16	384	4K	**$9,750**
92A16E	Expander	5 ns	5 ns	16	NA	4K	**$9,340**
92A60	Master or Exp.	50 ns	50 ns	60	360	32K	**$9,860**
92A60D	Master or Exp.	50 ns	50 ns	60	360	128K	**$13,000**
92A90	Master or Exp	50 ns	50 ns	90	540	32K	**$12,470**
92A90D	Master or Exp	50 ns	50 ns	90	540	128K	**$16,470**
92HS8	Master	500 ps	1.43 ns	8	160	8K	**$25,980**
92HS8C	Expander	500 ps	NA	8	NA	8K	**$24,940**
92HS8E	Expander	500 ps	NA	8	NA	8K	**$25,980**
Pattern Generator Cards							
92S16	Algorithmic	20 ns	20 ns	18	936	1K	**$7,290**
92S32	Sequential	20 ns	20 ns	36	1008	8K	**$9,430**
92SX109	Algorithmic	10 ns	10 ns	9	468	2K	**$9,125**
92SX118	Sequential	10 ns	10 ns	18	504	16K	**$11,850**

ORDERING INFORMATION

DAS9200 ACQUISITION CARDS

92A16 16-Channel, 200MHz Sync/Async, Master Acq. Card, 4K deep
Includes: (2) P6461 probes and leadsets **$9,750**
Opt. 1D – Delete probes **–$3,000**
Opt. 2S – Sub. 2-P6460 probes for 2-P6461 **–$2,000**
Opt. Q0 – On-Site Installation *1
Opt. Q5 – +1 Year Additional Warranty *1
Opt. Q6 – +2 Years Additional Warranty *1

92A16E 16-Channel, 200MHz Sync/Async, Expansion Acq. Card, 4K deep
Includes: (2) P6461E probes and leadsets **$9,340**
Opt. 1D – Delete probes **–$2,600**
Opt. 2S – Sub. 2-P6460 probes for 2-P6461 *1
Opt. Q0 – On-Site Installation *1
Opt. Q5 – +1 Year Additional Warranty *1
Opt. Q6 – +2 Years Additional Warranty *1

92HS8 8-Channel, 2GHz Async/350MHz Ext. Async, Master Acq. Unit, 8K deep
Includes: Probes, leadsets, and MF Interface. **$25,980**
Opt. 05 – Rackmount Kit **+$300**
Opt. Q0 – On-Site Installation *1
Opt. Q5 – +1 Year Additional Warranty *1
Opt. Q6 – +2 Years Additional Warranty *1

92HS8C 8-Channel, 2GHz Async Expansion, Acq. Unit, 8K deep without MF Interface.
Includes: Probes, leadsets. **$24,940**
Opt. 05 – Rackmount Kit **+$300**
Opt. Q0 – On-Site Installation *1
Opt. Q5 – +1 Year Additional Warranty *1
Opt. Q6 – +2 Years Additional Warranty *1

92HS8E 8-Channel, 2GHz Async Expansion, Acq. Unit, 8K deep with MF Interface.
Includes: Probes, leadsets. **$25,980**
Opt. 05 – Rackmount Kit **+$300**
Opt. Q0 – On-Site Installation *1
Opt. Q5 – +1 Year Warranty *1
Opt. Q6 – +2 Years Warranty *1

92A60 60-Channel, 20MHz Sync/Async, Master/Slave Acq. Card, 32K deep
Includes: Probe and general purpose leadset **$9,860**
Opt. 1D – Delete leadset **–$450**
Opt. 88 – Factory Install in New Mainframe *1
Opt. Q0 – On-Site Installation *1
Opt. Q5 – +1 Year Additional Warranty *1
Opt. Q6 – +2 Years Additional Warranty *1

92A60D 60-Channel, 20MHz Sync/Async, Master/Slave Acq. Card, 128K deep
Includes: Probe and general purpose leadset **$13,000**
Opt. 1D – Delete leadset **–$450**
Opt. Q0 – On-Site Installation *1
Opt. Q5 – +1 Year Additional Warranty *1
Opt. Q6 – +2 Years Additional Warranty *1

92A90 90-Channel, 20MHz Sync/Async, Master/Slave Acq. Card, 32K deep
Includes: Probe and general purpose leadset **$12,470**
Opt. 1D – Delete leadset **–$450**
Opt. Q0 – On-Site Installation *1
Opt. Q5 – +1 Year Additional Warranty *1
Opt. Q6 – +2 Years Additional Warranty *1

92A90D 90-Channel, 20MHz Sync/Async, Master/Slave Acq. Card, 128K deep
Includes: Probe and general purpose leadset **$16,470**
Opt. 1D – Delete leadset **–$450**
Opt. Q0 – On-Site Installation *1
Opt. Q5 – +1 YearAdditional Warranty *1
Opt. Q6 – +2 Years Additional Warranty *1

Option 88, Factory Installation and Test, is a no charge option available for all DAS9200 Instrument cards ordered with a new mainframe. This option assures that the instrument card is installed in the mainframe and tested at the factory. The two components are then shipped together.

DAS9200 PATTERN GENERATOR CARDS

92S16 18-Channel, 50MHz Algorithmic Pat. Gen., 1K deep. Includes: 2-P6464 probe and leads. **$7,290**
Opt. 1D – Delete probes **–$2,700**
Opt. 02 – Add 1-P6460 External Conrtrol Probe *1
Opt. 2S – Sub. 2-P6465 probes for 2-P6464 probes **+$500**
Opt. Q0 – On-Site Installation *1
Opt. Q5 – +1 Year Additional Warranty *1
Opt. Q6 – +2 Years Additional Warranty *1

92S32 36-Channel, 50MHz Sequential Pat. Gen., 8K deep. Includes:
4-P6464 probes and leads. **$9,430**
Opt. 1D – Delete probes **–$5,400**
Opt. 1S – Sub. 1-P6465 probe for 1-P6464 probe **+$250**
Opt. 2S – Sub. 2-P6465 probes for P6464 probes **+$1,000**
Opt. 3S – Sub 4-P6463 probes for 4-P6464 probes **–$2,600**
Opt. 4S – Sub. 2-P6463 probes for 2-P6464 probes **–$4,000**
Opt. Q0 – On-Site Installation *1
Opt. Q5 – +1 Year Additional Warranty *1
Opt. Q6 – +2 Years Additional Warranty *1

92SX109 9-Channel, 100MHz Algorithmic Pat. Gen., 2K deep. Includes: 1–Pat. Gen. Multiplexer, and 1-P6464 probe and leads. **$9,125**
Opt. 09 – Add (1) P6464 Output Data Probe **+$1,350**
Opt. 11 – Add 1-P6460 External Control Probe **+$700**
Opt. Q0 – On-Site Installation **+$520**
Opt. Q5 – +1 Year Additional Warranty *1
Opt. Q6 – +2 Years Additional Warranty *1

92SX118 18-Channel, 100MHz Sequential Pat. Gen., 16K deep. Includes: 2-Pat. Gen Multiplerers, and 2-P6464 probe and leads. **$11,850**
Opt. 09 – Add (2) P6464 Output Data Probe **+$2,700**
Opt. Q0 – On-Site Installation **+$565**
Opt. Q5 – +1 Year Additional Warranty *1
Opt. Q6 – +2 Years Additional Warranty *1

*1 *Contact your local sales engineer.*

PRINTED CIRCUIT BOARD VERIFICATION SYSTEMS

92BV400

NEW

Complete PCB Characterization

- *Superior Signal Integrity*
- *Advanced Test Generation Tools*
- *Up to 50 MHz Digital Patterns*

PCB VERIFICATION SYSTEMS

Complex Printed Circuit Boards (PCBs) require thorough and systematic design verification. With the introduction of ever greater device densities, denser packaging, and higher speeds, many of today's designs are exceeding the verification tools available to the designer.

92BV400 is the new line of Tektronix PCB Verification systems. The systems provide a stable and repeatable instrument, fixturing and software environment that is necessary for verifying today's PCBs. Systematically used, these systems reduce the number and duration of PCB design turn-arounds, ease product transfer into manufacturing, and increase the quality of the shipped products. PCBs can be verified functionally, at the full operating speed. PCBs can be characterized to check the functionality within the normal variation of components or manufacturing processes.

92BV400 PCB Verification systems offer all the necessary instruments, versatile fixturing, and an efficient software environment for test program development. 92BV400 systems provide fast and flexible pattern/acquisition channels, logic analysis tools, fixturing, links to simulators, and compatibility with analog/digital solutions from Tektronix.

The widely accepted Tektronix DAS9200 Digital Analysis System is the core of the 92BV400 systems for PCB verification. The DAS9200s channel width, stimulus and response speed, memory depth, trigger capability, modularity, and ease of use make it an attractive digital tool for all verification needs.

ADVANCED TEST GENERATION

EZ-Test is a menu-driven test generation tool. This software provides all the necessary features to develop and run test system programs. The menu-driven environment provides an efficient and structured approach to test program generation. Test programs are created by systematically building instrument settings, delays, measurements, timeouts and branches. Syntactically correct programs are built by simple use of function keys.

STATE EDITOR

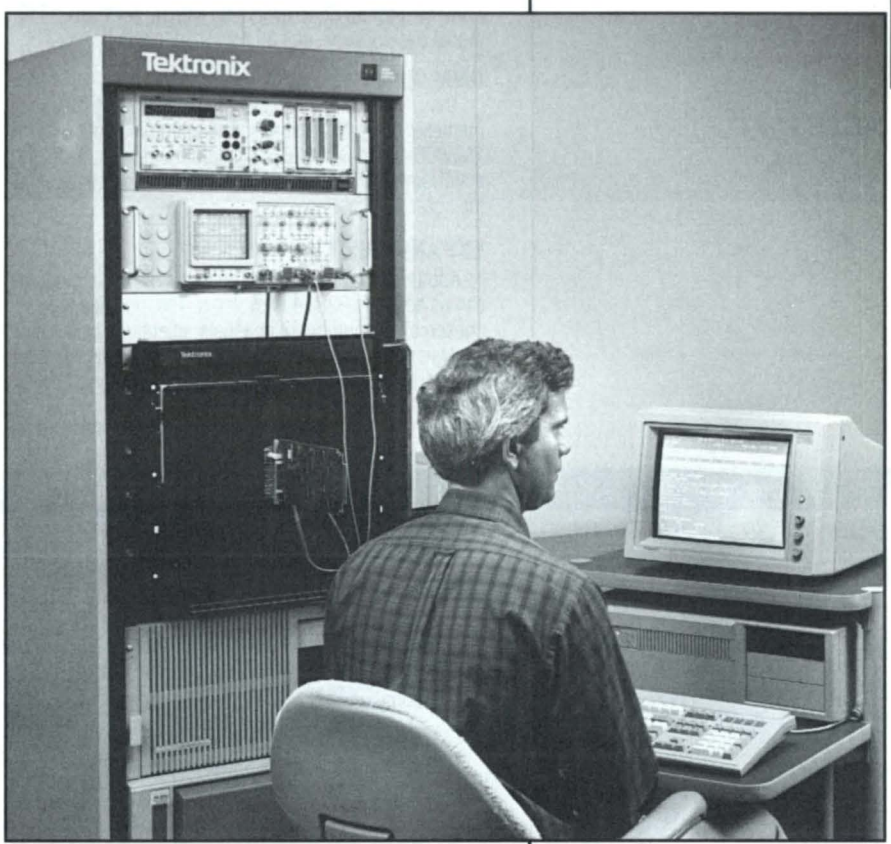
The state editor is a capable, yet simple tool for interactive and macro command state editing. The editor allows creating, editing, presenting, changing and saving state data. The editor provides the necessary search, replace, copy, paste, modify, insert, delete, convert and swap features.

SIMULATOR LINKS

Translators are available so that designers can download the same test vectors developed during the PCB design phase. These translators support simulators from Mentor, Daisy, Valid, Teradyne (LASAR), and GenRad (Hilo-3). The test vector translation and sampling can be used with other simulators because of intermediate ASCII file formats (TekEWAV and TekSWAV) and library support.

PCB VERIFICATION ENHANCEMENTS

PCB Verification Enhancement software enables margin verification through packaged sweeps, logging and presentation of the effects of variation in power supply voltage, timing, and other variables. The availability and ease of use of these PCB characterization tools is a key to the design quality.



HIGH PERFORMANCE FIXTURING

The fixturing provides convenient, reliable, and flexible Unit-Under-Test (UUT) interfacing. The fixture is optimized to preserve the superior electrical performance of the DAS9200 resources. The fixturing is compatible with Tek's TSI8150 signal routing and interface products. Mixed digital/analog applications can be accomplished by bringing additional resources to the test head receiver.

System Verification Fixture

The diagnostic Interchangeable Test Adapter enables quick, and complete system checkout.

Interchangable Test Adapter (ITA) Kit

An ITA kit provides all the necessary connectors, fixturing, and pins, so that a designer can quickly begin verifying the PCB. A single ITA kit covers the entire 92BV400 family. Additional ITA kits can be ordered.

NEW

92BV400 PRINTED CIRCUIT BOARD VERIFICATION SYSTEMS

OPTIONS

Numerous fully integrated options provide many necessary functions that make PCB Verification more complete and easy to use.

Oscilloscope Option

The Oscilloscope Option enables signal switching and digital oscilloscope measurement at 12 measurement points. The option includes a TSI8150 minframe, TSI8150-based TSS45 switching matrix, Tektronix 2440 digital oscilloscope, and all necessary cabling.

DMM Option

The DMM option enables differential voltage measurements on up to 20 points. The option includes TM5006-based DC5120 6 1/2 digit multimeter, TSI8150 mainframe, TSI8150-based TSS41 switching matrix, and the necessary cabling.

EXPANDABILITY

Additional acquisition and pattern generation modules can be added to 92BV400 systems. The modules are chosen by the number of channels, operating speed, and analysis features that are needed. These options can be fully wired, documented and tested at the factory, making a complete system.

STAND-ALONE PRODUCTS

The PCB verification Systems can be purchased as complete systems, as systems ready for additional DAS9200 instrument modules, or as separate components, ready for integration into systems. Examples of stand–alone products are the DAS Editor and 92BTA/BTARM fixturing.

Fixturing

The 92BTA and 92BTARM are mechanical assemblies that hold DAS9200 probes, connectors, and associated wiring. These fixtures also provide the test head receiver mechanism for physical connections to the UUT.

The 92BTA, the desk top version of the Board Test Adaptor is enclosed in a bench-top cabinet. The 92BTARM is a rackmount version of the 92BTA. It is identical to 92BTA, except it does not include the cabinet.

ORDERING INFORMATION

92BV400 PCB Verification System for Self-integrators without stimulus or acquisition channels. **$75,000**

92BV410 90 Channel 20 MHz PCB Verification System Inc. 96, 25 MHz stimulus and 90, 20 MHz acquisition channels **$106,000**

92BV420 64 Channel 50 MHz PCB Verification System Inc. 64, 50 MHz stimulus and 64, 100 MHz acquisition channels **$138,000**

92BV430 Full Function PCB Verification System Inc. 48, 50 MHz & 64, 25 MHz stimulus channels and 90, 20 MHz & 16, 100 MHz acquisition channels. **$126,500**

OPTIONS

Opt. 16 – Substitute 80 Mb Disk for 40 Mb Disk **+$1,200**
Opt. 2A – Oscilloscope Measurement , 12 Points **+$19,950**
Opt. 2D – DMM Measurement , 20 Points **+$8,450**
Opt. 2E – Delete PEP 301 Controller **–$3,500**
Opt. 2M – Oscilloscope/DMM Measurement , 12/20 Points **+$24,950**
Opt. 2R – Substitute Double-bay Rack for Single-bay Rack **+$2,400**
Opt. 2U – K318 Utility Cart for PEP 301 Controller **+$380**

ACCESSORIES

Options W2 and W3 (+1 year and +2 years on-site HW, SW subscription and Hot-Line Support – U.S.only) are available for any 92BV400 system.

020-1800-00 Interchangeable Test Adapter kit with all connectors, pins, wires **$1,500**
BWIRE30 Factory wiring, documentation, check-out for up to 30 signal pins *1
BWIRE90 Factory wiring, documentation, check-out for a single 92A90/92A60 *1

SYSTEM STANDARD EQUIPMENT

Digital I/O sub-system (DAS9220) containing: All instrument modules, 8 Mbytes System RAM, 40 Mb Hard Disk, 1.2 Mb floppy drive, GPIB interface, and 9201T color display.

Tektronix PEP 301 Host Controller (with GPIB, Mouse, Windows)
Test Generation Software (EZ-TEST, DAS Editor, Links to Simulators)
PCB Verification Enhancement Software
PCB Test Head Receiver Fixturing
Interchangeable Test Adapter Kit
System Verification Fixture
3 UUT Power Supplies
19" Rack Packaging, Power Controller and Power Distribution
Complete Factory Wiring, Checkout and Documentation
On-site Installation (U.S. only)
One Year On-site Software/Hardware System Maintenance (U.S. only)

STANDALONE FIXTURING PRODUCTS

92BTA Bench-top Board Test Fixture Inc. Cabinet and FANS **$8,658**
92BTARM Rackmount Board Test Fixture Includes: FANS. **$7,958**

92BTA/92BTARM PROBE CONNECTORS

92BTU30 30-Ch. Probe Connector, Uni-Directional **$285**
92BTB30 30-Ch. Probe Connector, Bi-Directional **$400**
92BTU90 90-Ch Probe Connector, Uni-Directional **$750**

92BTA/92BTARM OPTIONAL ACCESSORIES

020-1636-00 P6460/P6461 Interface Kit. **$12**
020-1749-00 10" Leadset for P6460 Interfacing to 92BTU30 *1
012-1236-00 10" Leadset for P6463 Interfacing to 92BTU30 **$45**

*1 *Contact your local sales engineer.*

- *As Many as 32 Channels of 2 GHz (500 ps) Timing Analysis*
- *True Synchronous Operation Up to 330 MHz (3 ns)*
- *Up to 192 Channels of 50 MHz (20 ns) Pattern Generation*
- *96-Channel Stimulus/ Response Capability*

THE ORIGINAL INDUSTRY STANDARD

The DAS9100 continues to offer performance and capabilities that have yet to be surpassed by even the newest of competitive instruments.

The DAS9129 mainframe has a fold-down keyboard and nine inch, color display. It contains six instrument card slots that you can populate with combinations of the nine available data acquisition and pattern generation modules.

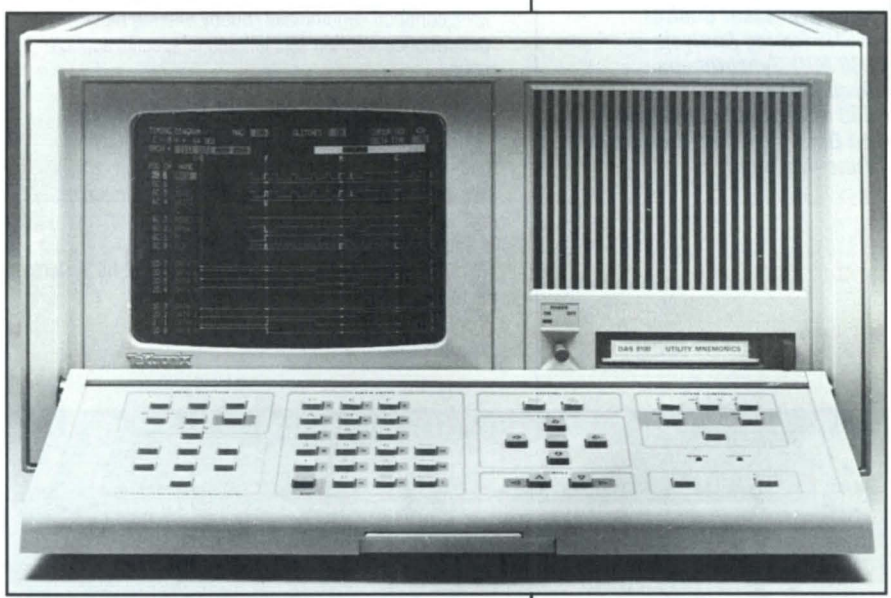
Local DC-100 tape storage is available for saving instrument setups, pattern generator programs, and acquired data.

The optional communication interface includes RS-232 host and printer ports and an industry standard IEEE-488 (GPIB) port.

There are four pattern generator modules available for this system. You can configure a DAS9129 with up to 192 channels of 50 MHz stimulus. A 96-channel stimulus/response system can be provided by using three 91S32s and three 91A32s.

There are five data acquisition modules for the DAS9129, each providing unique sampling speeds, memory depths, and triggering capabilities. For sub-nanosecond timing resolution, the 91HS8 can asynchronously sample at rates up to 2 GHz. The 91A04A continues to offer the world's fastest, true synchronous sampling rate at 330 MHz. Please refer to the Instrument Card Selection Guide below.

A broad range of microprocessors are supported with preconfigured packages which include mnemonics disassembly and processor specific interfaces. These packages are compatible with the 91A24 acquisition card. You can also use the standard mnemonic definition tool (EDM) for custom or proprietary applications.



DAS9100 INSTRUMENT CARD SELECTION GUIDE

The following instrument cards include probes. A maximum of six instrument cards can be installed in a mainframe. The mainframe includes sufficient power for two cards. One additional power supply (Option 03) is required for three or four cards. Two additional power supplies (Option 04) are required for five or six cards.

Acquisition Cards	Description	Resolution Internal Clock	Resolution External Clock	Maximum Channels per Card	Maximum Channels per System	Memory Depth (per Chan.)	Price
91A04A	Master	1.5ns	3ns	2/4	8/16	4K/2K	**$8,740**
91AE04A	Expander	1.5ns	3ns	2/4	8/16	4K/2K	**$6,540**
91A08	Master or Exp.	10ns	10ns	8	32	512	**$4,380**
91A32	Master or Exp	40ns	40ns	32	96	512	**$5,480**
91A24	Master	100ns	100ns	24	96	1K	**$5,480**
91AE24	Expander	100ns	100ns	24	96	1K	**$5,170**
91HS8	Master	500ps	NA	8	32	8K	**$25,000**
91HS8E	Expander	500ps	NA	8	32	8K	**$25,000**
Pattern Generator Cards							
91P16	Algorithmic	40ns	40ns	16	80	254	**$4,380**
91P32	Expander	40ns	40ns	32	80	254	**$7,590**
91S16	Algorithmic	20ns	20ns	16	176	1K	**$7,590**
91S32	Sequential	20ns	20ns	32	192	2K	**$11,440**

ORDERING INFORMATION

DAS9129 Color Mainframe **$9,240**

MAINFRAME OPTIONS

Opt. 01 – DC-100 Tape Drive **+$1,450**
Opt. 03 – Add One Power Supply **+$800**
Opt. 04 – Add Two Power Supplies **+$1,600**
Opt. 05 – Rackmount Kit **+$200**
Opt. 06 – GPIB, RS-232, and Printer Interface **+$1,550**
Opt. 88 – Install Instrument Cards and Test Prior to Shipment **NC**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1-A5 – Available **NC**

See page 488 for description.

PRISM 3000 *LOGIC ANALYZERS*

Exceptional Performance at Competitive Prices

- *Multiple Tools in One Modular Mid-Priced Instrument*
- *8/16/32-bit Processor State Analysis*
- *Real-time Performance Analysis*
- *Emulator-like Microprocessor Control*
- *2 GHz Timing Analysis*
- *300 MHz Synchronous Acquisition*
- *500 MS/s Digitizing Scope*
- *All Data Time-Correlated and Time–Stamped*

APPLICATION-BASED SOLUTIONS

Today's digital designs require more from engineers than ever before. From integrating multiple microprocessors in a system to optimizing the final code, the need is the same: find the right tool that solves problems quicker and easier.

The new Prism 3000 series deals with the wide diversity of engineering problems not by appealing to the least common denominator, but by offering high-performance solution sets tailored to specific applications.

MULTIPLE TOOLS IN ONE INSTRUMENT

The Prism 3000 series meets the needs of many engineering disciplines through its collection of application-specific modules. Using these modules, system designers and integrators can focus on:

- Software/firmware debug and optimization
- Hardware/software integration of 8/16/32-bit systems
- Multiple-microprocessor integration
- High-speed hardware analysis
- Digital waveform analysis

The Prism 3000 series offers high performance solutions tailored to specific applications at competitive prices.

For each application, the appropriate Prism module provides a complete solution. For example, the hardware/software integration solution combines state analysis, 200 MHz timing analysis, real–time performance analysis, and microprocessor control all on one acquisition module.

ALL DATA AUTOMATICALLY TIME-CORRELATED

In the Prism 3000 series, all data is synchronized right at the probe tip. Performed by custom ICs in the probes, this synchronization is the key to the Prism's tight time-correlation of events.

TEKLink, Tek's own intermodule triggering and high-speed communication bus, provides data and event communications between all application modules in the system. As a result, all data from all modules is time–stamped and time-correlated *automatically*, and can be displayed in any order you desire. This lets you view the timing relationships of data acquired from different modules in clear, meaningful displays.

QUICK TO SET UP, LEARN, AND USE

Probes are small, low-profile, and easy to connect. Microprocessor probes connect with just a single connection. At power-up, Prism recognizes what hardware is connected, autoloads the correct software, and acquires data with a single keystroke. Fast response, simplified menus, on-line context-sensitive notes, and MS-DOS compatible disks appeal to both new and experienced users.

To expand your expertise, Prism's FasTrak training package is standard with each instrument. FasTrak includes a microprocessor board full of hardware and software faults, with an accompanying workbook. As you use the Prism to find and correct the faults, you learn Prism's capabilities and build your own digital debug skills at the same time.

MULTIPLE PLATFORMS

With the Prism 3000, you can choose from portable, traditional logic analyzers or extensively reconfigurable systems. These package options ensure performance appropriate for the job and for the user as well.

Prism 3000 Platform Selection Guide

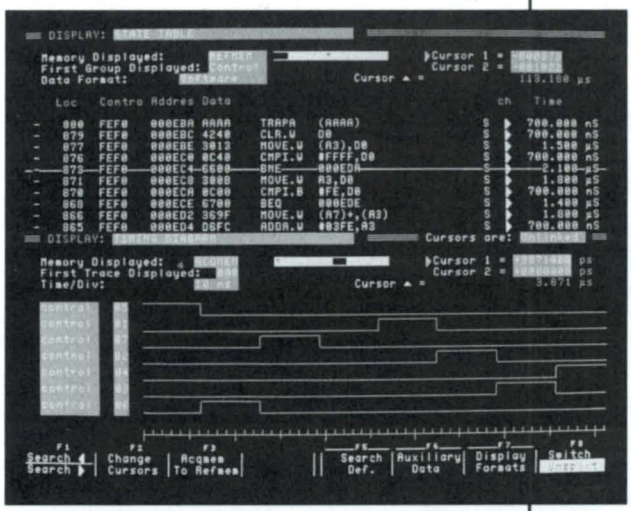
	TYPE	MAX. EXPANSION	DISPLAY	HARD DISK MBYTES	FLOPPY KBYTES
3001XXX	1-Slot portable logic analyzer	4 3002E for 9 slots total	9" Mono		720
3002C	2-slot system	4 3002E for 10 slots total	14" Color	20	720
3002P	2-slot portable system	4 3002E for 10 slots total	9" Flat Panel	20	720
3002E	2-slot expansion mainframe				

APPLICATION MODULES

Hardware/Software Integration

The MPM/MPX modules are 8/16/32-bit microprocessor integration tools. They provide 64 or 96 channels of synchronous data acquisition and 8K memory depth per channel. This wide memory window lets you capture both the cause and effect of software problems in one acquisition. Four disassembly display formats support rapid analysis of microprocessor activity.

In addition, the MPM/MPX modules provide 9 channels of 200 MHz transitional timing (or 90 MHz synchronous acquisition) with 2K memory per channel. These timing channels provide a high-resolution view of hardware activity without adding another module.



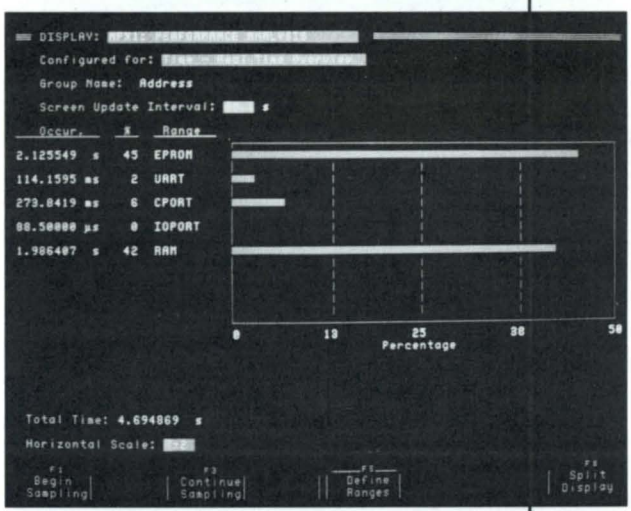
Real-Time Performance Analysis

The MPM/MPX Performance Analysis provides four modes of performance analysis:

- REAL-TIME time
- REAL-TIME count
- State overview
- Single event

Real-time performance analysis provides you with a real-time, non-statistical distribution of your program's activity by capturing 100% of its activity. This is especially vital in optimizing real-time embedded control systems.

Performance analysis is an option to the MPM/MPX modules, provided on a 3 1/2 inch floppy disk.



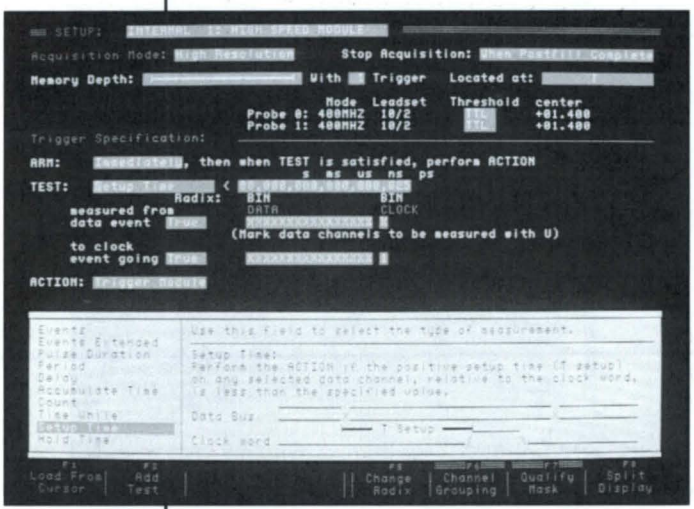
A Tek First! Microprocessor Control in a Logic Analyzer

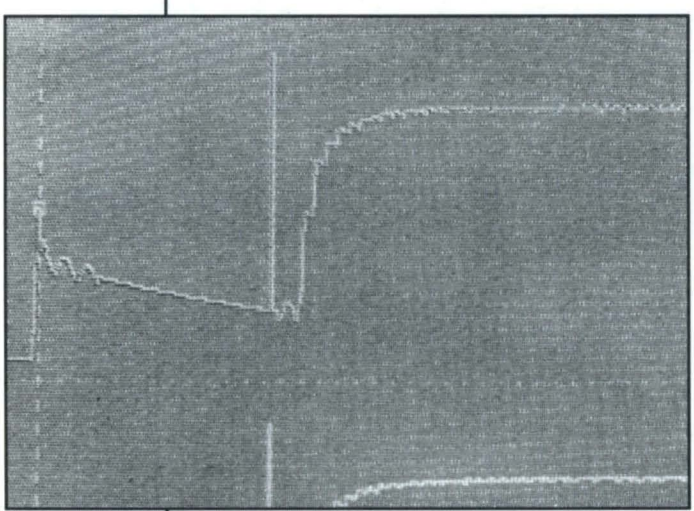
The Prism Prototype Debug Tool (PDT) provides emulator-like control of the microprocessor from the MPM/MPX module. PDT lets you:

- Download programs into memory
- Single-step code
- Set hardware and software breakpoints
- Patch and examine memory, registers, and I/O
- Reset the microprocessor

PDT is part of the MPM/MPX module and uses the module's full triggering capabilities and 8K memory depth. PDT links with all other parts of the Prism system through TEKLink. This means you can use PDT with 200 MHz timing to bring up new boards and verify signal integrity. Or, you can use multiple PDT's to control multiple microprocessors.

PRISM 3000 *LOGIC ANALYZERS*





High-Speed Hardware Analysis

The 30HSM module is a complete tool for capturing and analyzing hardware faults in digital circuitry. A range of data acquisition modes, including 2 GHz transitional timing, 300 MHz synchronous acquisition, and 400 MS/s digitizing, 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.

Applications Under Development

A digitizing oscilloscope module will provide high–resolution (500 MS/s, 8 bit, 16K deep) waveform analysis optimized for testing digital systems.

Each module will capture 1 channel at 500 MS/s or 2 channels at 250 MS/s. The waveform data will be automatically time–correlated with any timing or state data acquired by the Prism, enabling a comprehensive, accurate picture of the system under test.

GPIB–controlled remote opreration of the Prism 3000 system will be possible through a GPIB CommPack. This will support transfers of setups and data, and remote programming of specific acquisition parameters.

PRISM 3000 APPLICATION MODULE SELECTION GUIDE

	Application	Channels	Rate	Clock Type	Memory	Triggering	Other Features
30MPX 3001MPX	8/16/32-bit Hardware/Software Integration	96 9	33 MHz 200 MHz or 90 MHz	Synchronous Transitional Synchronous	8K 2K*1 2K	7 States 8 Word/range recog. 8 Counter/timers 4 TEKLink Signals	Time-Correlation Disassembly Performance Analysis Microprocessor Control
30MPM 3001MPM	8/16-bit Hardware/Software Integration	64 9	33 MHz 200 MHz or 90 MHz	Synchronous Transitional Synchronous	8K 2K*1 2K	7 States 8 Word/range recog. 8 Counter/Timers 4 TEKLink Signals	Time-Correlation Disassembly Performance Analysis Microprocessor Control
30HSM 3001HSM	High Speed Hardware Analysis	20 or 4 or 20 or 18 or 4	400 MHz 2GHz 200 MHz 300 MHz 400 MS/s	Transitional Transitional Dual Threshold Transitional Synchronous Digitized	24K*1 120K*1 12K*1 18K 24K	15 Trigger Tests 2 Levels 2 Counter/Timers 4 Word recognizers 4 TEKLink Signals	Time–Correlation Leadset Configurable

*1 *Maximum data transitions. Actual data transitions stored depends on user's data rate.*

ORDERING INFORMATION

3002C Prism Platform With Color Monitor **$6,500**
Includes: 2-slot platform with 14-inch color monitor, 20 Mbyte hard disk, 720 kbyte floppy disk, QWERTY keyboard, system software, mainframe-to-monitor cable, 3002 user's manual, five 3002 reference guides, power cords.

3002P Prism Platform With Flat-Panel Display **$7,200**
Includes: 2-slot platform with 9-inch electro-luminencent flat panel display, 20 Mbyte hard disk, 720 kbyte floppy disk, QWERTY keyboard, system software, mainframe-to-flat panel cable, 3002 user's manual, 5 3002 reference guides, power cords.

OPTIONS FOR BOTH 3002C AND 3002P

Opt. 1B – Accessory Bag **+$75**
Opt. 1C – 1200C01 RS232 COMM Pack **+$750**
Opt. 1D – Delete Hard Disk **–$750**
Opt. 2B – 3002P Carrying Case (3002P only) **+$100**
Opt. B1 – Add Service Manuals **+$300**
Opt. 8C – Hardware and/or Software Installed and Tested **+$150**
Warranty–Plus options are available.

3002E Prism Expansion **$2,000**
Includes: 2-slot platform with 9-inch TEKLink cable, 4-foot TEKLink cable, mainframe mounting plate, 3002E instruction manual, power cord.
Opt. 8C – Hardware and/or Software Installed and Tested **+$150**
Warranty–Plus options are available

3001MPM 8/16 Bit Microprocessor Analysis Instrument **$8,600**
Includes: 3001 portable platform with 30MPM application module, 720 kbyte floppy disk, system and MPM/MPX SW disk, P6480 state probe without leadset, P6486 high-speed probe with standard leadset, 3001 user's manual, MPM/MPX user's manual, five 3000MPM/MPX reference guides, FasTrak training package, power cord.
Opt. 1A – 30DA01 Performance Analysis Software **+$650**
Opt. 1F – P6480 General Purpose Probe Adapter **+$450**
Opt. 1K – Add QWERTY Keyboard **+$500**
Opt. 1L – 1 P6486 High Performance Leadset **+$500**
Opt. B1 – Add Service Manuals **+$450**
Opt. 2D – Delete FasTrak Training Package **–$400**
Opt. 2P – Sub 220 V Int'l Power for FasTrak *1
Warranty–Plus options are available.

3001MPX 8/16/32 Bit Microprocessor Analysis Instrument **$9,900**
Includes: 3001 portable platform with 30MPX application module, 720 kbyte floppy disk, system and MPM/MPX SW disk, P6480 state probe without leadset, P6486 high-speed probe with standard leadset, 3001 user's manual, MPM/MPX user's manual, five 3000MPM/MPX reference guides,. FasTrak training package, power cord.
Opt. 1A – 30DA01 Performance Analysis Software **+$650**
Opt. 1F – P6480 General Purpose Probe Adapter **+$450**
Opt. 1K – Add QWERTY Keyboard **+$500**
Opt. 1L – 1 P6486 High Performance Leadset **+$500**
Opt. B1 – Add Service Manuals **+$450**
Opt. 2D – Delete FasTrak Training Package **–$400**
Opt. 2P – Sub 220 V Int'l Power for FasTrak *1
Warranty–Plus options are available.

3001HSM High Speed Acquisition Instrument **$11,000**
Includes: 3001 portable platform with 30HSM application module, 720 kbyte floppy disk, system and HSM SW disk, 2 P6487 high-speed probes with standard leadset, 3001 user's manual, HSM user's manual, five 3000HSM reference guides, FasTrak training package, power cord.
Opt. 1K – Add QWERTY Keyboard **+$500**
Opt. 1L – 2 High Performance Leadsets **+$1,000**
Opt. 2L – 1 A/D Leadset **+$900**
Opt. 3L – 2 A/D Leadsets **+$1,800**
Opt. 4L – 1 Ultra High Resolution Leadset **+$1,200**
Opt. 5L – 2 Ultra High Resolution Leadset **+$2,400**
Opt. B1 – Add Service Manuals **+$450**
Warranty–Plus options are available.

30MPM 8/16 Bit Microprocessor Analysis Application Module **$6,100**
Includes: MPM/MPX Application SW disk, P6480 state probe without leadset, P6486 high-speed probe with standard leadset, MPM/MPX user's manual, five 3002 reference guides, FasTrak training package.
Opt. 1A – 30DA01 Performance Analysis Software **+$650**
Opt. 1F – P6480 General Purpose Probe Adapter **+$450**
Opt. 1L – 1 P6486 High Performance Leadset **+$500**
Opt. B1 – Add Service Manuals **+$150**
Opt. 2D – Delete FasTrak Training Package **–$400**
Opt. 2P – Sub 220 V Int'l Power for FasTrak *1
Opt. 8C – Hardware and/or Software Installed and Tested *1
Warranty–Plus options are available.

30MPX 8/16/32 Bit Microprocessor Analysis Application Module **$7,600**
Includes: MPM/MPX Application SW disk, P6480 state probe without leadset, P6486 high-speed probe with standard leadset, MPM/MPX user's manual, five 3002 reference guides, FasTrak training package.
Opt. 1A – 30DA01 Performance Analysis Software **+$650**
Opt. 1F – P6480 General Purpose Probe Adapter **+$450**
Opt. 1L – 1 P6486 High Performance Leadset **+$500**
Opt. B1 – Add Service Manuals **+$150**
Opt. 2D – Delete FasTrak Training Package **–$400**
Opt. 2P – Sub 220 V Int'l Power for FasTrak *1
Opt 8C – Hardware and/or Software Installed and Tested *1
Warranty–Plus options are available.

30HSM –High Speed Application Module **$6,500**
Includes: HSM Application SW disk, 2 P6487 high-speed probes with standard leadset, HSM user's manual, five 3002 reference guides.
Opt. 1L – 2 High Performance Leadsets **+$1,000**
Opt. 2L – 1 A/D Leadset **+$900**
Opt. 3L – 2 A/D Leadsets **+$1,800**
Opt. 4L – 1 Ultra High Resolution Leadset **+$1,200**
Opt. 5L – 2 Ultra High Resolution Leadsets **+$2,400**
Opt. B1 – Add Service Manuals **+$150**
Opt. 8C – Hardware and/or Software Installed and Tested *1
Warranty–Plus options are available.

RELATED PRODUCTS

30DM04 8086/88 SW and Probe Adapter, DIP Socketed **$1,150**
Opt. 1D – Delete Probe Adapte **–$300**
Opt. 1S – Substitute DIP Soldered *1

30DM06 – 80186/188 SW and Probe Adapter, PGA Socketed **$1,150**
Opt. 1D – Delete Probe Adapter **–$300**
Opt. 1S – Substitute PLCC Socketed **+$500**
Opt. 2S – Substitute LCC Socketed **+$400**

30DM08 – 80286 SW and Probe Adapter, PGA Socketed **$1,150**
Opt. 1D – Delete Probe Adapter **–$300**
Opt. 1S – Substitute PLCC Socketed **+$500**
Opt. 2S – Substitute LCC Socketed **+$400**

30DM09 – 80386 SW and Probe Adapter, PGA Socketed **$1,800**
Opt. 1D – Delete Probe Adapter **–$500**

30DM27 – 68000/10 SW and Probe Adapter, DIP Socketed **$1,150**
Opt. 1D – Delete Probe Adapter **–$300**
Opt. 1S – Substitute DIP Soldered *1
Opt. 2S – Substitute PGA Socketed *1
Opt. 3S – Substitute PLCC Socketed **+$800**
Opt. 4S – Substitute PLCC Soldered **+$200**

30DM31 – 68020 SW & Probe Adapter, PGA Socketed **$1,800**
Opt. 1D – Delete Probe Adapter **–$500**

30DM33 – 68030 SW and Probe Adapter, PGA Socketed **$1,800**
Opt. 1D – Delete Probe Adapter **–$500**

30DM41 – Z80 SW and Probe Adapter, PGA Socketed **$800**
Opt. 1D – Delete Probe Adapter **–$200**
Opt. 1S – Substitute DIP Soldered *1

30DA01 Performance Analysis Software **$650**

30RP1 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**
Opt. 8C – Hardware and/or Software Installed and Tested *1

30DD27 68000/10 PDT Disk **$1,500**

P6480 State Data Acquisition Probe without Leadset **$750**
Opt. 1F – Add General Purpose Probe Adapter **+$450**
P6486 High Speed Data Acquisition Probe with Standard Leadset, for 30MPM/MPX **$1,000**
Opt. 1L – Add High Performance Leadset **+$500**
P6487 High Speed Data Acquisition Probe with Standard headset, for 30 HSM **$1,100**
Opt. 1L – Add High Performance leadset **+$500**
FasTrak Micro Training Package **$450**
Opt. 2P – Sub 220 V International Power Adapter *1
Opt. 1W – Add Prism 3000 Workbook **+$35**
1200C01 RS-232 COMM Pack **$750**

INTERNATIONAL POWER PLUGS OPTIONS
Options A1-A5 – available for the 3002 and 3001 platforms. Please refer to page 488 for description.

*1 *Contact your local sales engineer.*

Industry-Standard Performance and Reliability

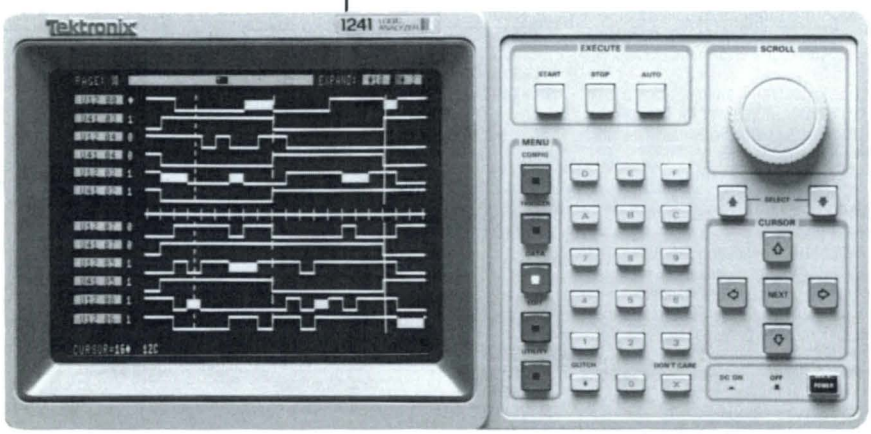
- *Modular: 9-72 Channels*
- *Support for 50 Microprocessors*
- *100 MHz Asynchronous Sampling*
- *50 MHz Synchronous Sampling*
- *Dual Timebase Triggering, Acquisition, and Display*
- *14-Level Triggering*
- *GPIB, RS-232C, Printer Support*

RAPID SETUP

The 1241 features a color display for rapid setup and operation. Setups are simple through a straightforward menu-oriented approach, combined with multi-level operation and touch-screen soft keys. Multi-level operation lets you select from one of four levels best matched to your expertise and the task at hand. Touch-screen soft keys provide high-level commands at a keystroke and keep selections simple and well labeled.

BROAD PROCESSOR SUPPORT

The 1241 supports disassembly for 50 different microprocessors and buses – more than any other logic analyzer in the industry. A full range of 8/16/32 bit processors are supported, including popular digital signal processors (DSPs). Refer to Ordering Information for a complete list.



The 1241's color display rapidly guides your eye to the most relevant information.

TIMING ANALYSIS

For timing analysis, the 1241 offers up to 36 channels at 100 MHz asynchronous and 50 MHz synchronous sampling. Glitch detection at 6 ns is also available. Superior triggering capabilities include:

- Data and glitch triggering
- Counters, timers, and duration filters for triggering on the characteristics of a signal as well as its occurrence
- Auto-run triggering to track intermittents through continuous acquisitions
- Clocked and unclocked triggering for capturing events that might not coincide with sample points

STATE ANALYSIS

State and microprocessor analysis are supported by up to 72 channels at 50 MHz synchronous/asynchronous. A flexible clocking scheme includes data demultiplexing without double-probing. Powerful triggering capabilities include:

- 14 trigger levels
- Conditional branching to track program flow through multiple branches
- Two independent word recognizers
- Data storage on/off control

SYSTEM INTEGRATION

The 1241 offers a dual timebase system that integrates all the timing and state analysis capabilities. This dual timebase system speeds integration tasks by tying together the acquisition, triggering, and display of two independent timebases. You can monitor the interaction between hardware and software, or the relationship of two interdependent systems. All data displays are time aligned and completely correlated.

SELECTABLE ACQUISITION MODULES

The 1241 has four module slots which accommodate any combination of 9-channel 1240D1 and 18-channel 1240D2 data acquisition modules.

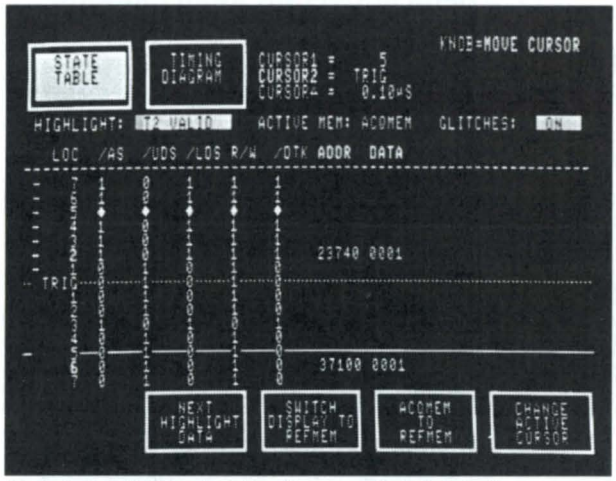
	1240D1	1240D2
Channels	9	18
Max. Async Rate	100 MHz	50 MHz
w/Glitches	50 MHz	n/a
Max. Sync Rate	50 MHz	50 MHz
Memory Depth	512	512
w/Chaining	2048	2048

Glitch capture is available on all 1240D1 channels.

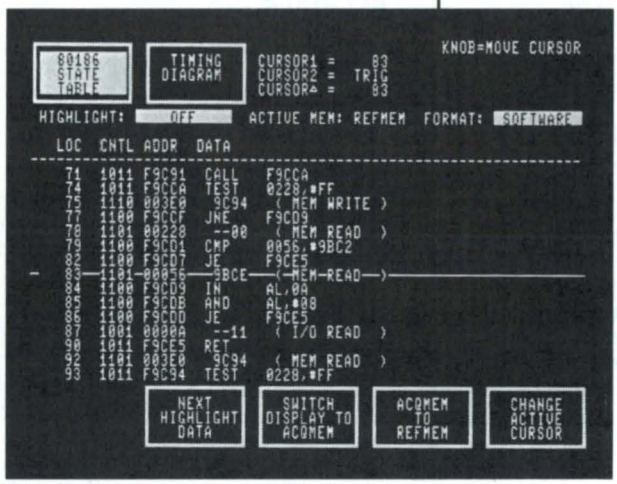
Standard memory depth can be extended to 2048 bits per channel by a special memory chaining feature. This feature lets you chain one module's memory to another of the same type, trading channel width for extended memory depth.

STATE/TIMING ON ALL CHANNELS

The 1240D1 module is optimized for timing analysis, and the 1240D2 for state analysis. However, you can make state and timing measurements on all channels with either module. Both modules also provide powerful triggering capabilities and excellent signal probing characteristics.



State table display showing time-correlated data from two separate timebases. State and timing analysis are available on every channel.



The 1241 supports disassembly for many microprocessors and buses. This example shows 80186 disassembly.

ORDERING INFORMATION

1241 Color Logic Analyzer **$6,000**
Includes: Accessory Pouch (016-0707-01), Front-Panel Cover (200-2780-00), Operator's Manual (070-4340-01), Pocket Reference Guide (070-4641-01), Workbook (062-6926-00), PowerCord
Opt. 05 – Rackmount Hardware **+$400**

1240D1 9 Channel 100 MHz Data Acquisition Module **$2,950**
Includes: one P6460 Data Acquisition Probe, Leadsets, Grabber Tips
Opt. 1D – Delete P6460 Probes **–$700**

1240D2 18 Channel 50 MHz Data Acquisition Module **$3,700**
Includes: two P6460 Data Acquisition Probes, Leadsets, Grabber Tips
Opt. 1D – Delete P6460 Probes **–$1,400**
Opt. 1S – Substitute two P6462 Probes for P6460s *1

1241NGP General-Purpose Analysis System **$12,900**
Includes: 1241 Logic Analyzer, 1240D1 Module with P6460, two 1240D2 Modules with four P6460s, 12RS02 RAM Pack

1241NBA Bus Analysis System **$17,350**
Includes: 1241 Logic Analyzer, four 1240D2 Modules with eight P6460s, 12RS02 RAM Pack

1241NHS High-Speed Analysis System **$18,300**
Includes: 1241 Logic Analyzer, four 1240D1 Modules with four P6460s, 12RS02 RAM Pack

INTERNATIONAL POWER PLUG OPTIONS
Opt. A1 – Opt. A5 Available **NC**
See page 488 for description.

Logic Analyzer accessories are described in the Accessories section of this catalog. Please refer to page 444.

1241NMP Microprocessor Analysis System **$9,950**
Includes: 1241 Logic Analyzer, 12R01 Performance Analysis ROM Pack, 12RS02 RAM Pack, 1200C11 Parallel Printer COMM Pack, plus all 1240D2 Acquisition Modules, Probing, and Disassembly Software required for microprocessor-specific support.
Opt. 01 – 8080 Support *1
Opt. 02 – 8085 Support *1
Opt. 03 – 6800 Support *1
Opt. 04 – 6801/3 Support *1
Opt. 05 – 6802 Support *1
Opt. 06 – 6805E2 Support *1
Opt. 07 – 6805E3 Support *1
Opt. 08 – 6808 Support *1
Opt. 09 – 6809 Support *1
Opt. 10 – Z80 Support *1
Opt. 11 – 6502 Support *1
Opt. 12 – NSC800 Support *1
Opt. 13 – 6301/3 Support *1
Opt. 14 – GM ECM Support **+$600**
Opt. 15 – 1802/4/5/6 Support *1
Opt. 16 – 8031/51 Support *1
Opt. 17 – 68HC11 Support *1
Opt. 21 – 8086 Support *1
Opt. 22 – 8088 Support *1
Opt. 23 – 80186 Support *1
Opt. 24 – 80188 Support *1
Opt. 25 – 80286 Support *1
Opt. 26 – 68000 Support-DIP *1
Opt. 27 – 68000 Support-PGA *1
Opt. 28 – 68008 Support *1
Opt. 29 – 68010 Support-DIP *1
Opt. 30 – 68010 Support-PGA *1
Opt. 31 – 68020 Support *1
Opt. 32 – Z8001/3 Support **+$3,700**
Opt. 33 – Z8002/4 Support **+$3,700**
Opt. 34 – 64180R0/R1 Support **+$3,700**
Opt. 35 – F9450 Support **+$3,700**
Opt. 36 – 8096 Support **+$3,700**
Opt. 37 – 68030 Support **+$1,000**
Opt. 41 – TMS32010 Support *1
Opt. 42 – TMS32020/C25 Support **+$3,700**
Opt. 43 – DSP56000/1 Support **+$3,700**
Opt. 44 – ADSP2100 Support **+$3,700**
Opt. 47 – VAXBI Support **+$4,000**
Opt. 48 – GPIB Support *1
Opt. 1B – Basic Analysis System (substitute 12RC01, two 1240D2s with P6460s for microprocessor-specific support) *1

RELATED PRODUCTS
P6460 9 Channel 100 MHz Data Acquisition Probe **$700**
P6462 9 Channel TTL-Only 25 MHz Data Acquisition Probe **$340**
A6740G Serial Acquisition Probe **$1,500**
SMG50 20 SMT Grabber Tips **$89**
K212 Portable Instrument Cart **$380**
1200C01 RS-232C COMM Pack **$750**
1200C02 GPIB COMM Pack **$850**
1200C11 Parallel Printer COMM Pack (requires 12RC01 or 12RMxx) **$500**
12R01 Performance Analysis ROM Pack **$800**
12RC01 Printer Support ROM Pack (requires 1200C01 or 1200C11) **$300**
12RC02 Master/Slave ROM Pack **$500**
Opt. 01 – Modem **+$600**
12RS02 64K RAM Pack **$500**
12RS11 32K EPROM Pack (empty) **$85**
12RS12 32K EPROM Pack **$300**
Service Maintenance Kit *1
Includes: Service Manual, 12RD01 Diagnostic ROM Pack, Extender Card, Diagnostic Leadset (067-1103-03)

*1 *Contact your local sales engineer.*

Expandable, Affordable Logic Analyzers that Grow with You

- *16 to 64 Channels*
- *100 MHz Asynchronous Sampling*
- *100 MS/s Digitizing Oscilloscope Card*
- *25 MHz Synchronous Sampling*
- *2K Memory Depth Per Channel*
- *Disassembly for 8 and 16 bit Microprocessors*
- *14–Level Triggering with Conditional Branching*
- *GPIB, RS-232C, Parallel Printer Options*

FLEXIBLE

The 1230 and 1230B Logic Analyzers are modular, general-purpose logic analyzers that support hardware, microprocessor, and system integration applications.

EXPANDABLE TO PROTECT YOUR INVESTMENT

The 1230/1230B lets you buy the performance you need now and add channels, a digitizing oscilloscope card, communication interfaces, and disassembly probes as your testing needs grow.

The basic 1230/1230B provides 16 channels. Up to three 1230E1 16-channel expander cards may be added to increase the number of channels to 64. One 1230DSM 100 MS/s digitizing scope card may be added to the 1230/1230B. Refer to the Configuration Chart.

Broad Microprocessor Support

Optional disassembly probes let you work with a long list of specific microprocessors, such as the 68000, 68010, 68332, 68HC11, Z80, 8086, 8088, 80186, 80188, 80286, 80386SX, and others. Refer to the microprocessor guide on page 206 for a complete list.

2K-deep memory can be displayed in State, Timing, or Disassembly formats. This 68000 disassembly display shows all bus cycles. Another disassembly display is also available that shows only instruction cycles and looks like an assembly listing.

Easy to Learn and Use

The 1230/1230B features a large display and fast, interactive, pop-up menus. To save you time, most menu selections are available with one or two keystrokes. Menus are never more than one level deep, so you can select parameters quickly, without bottlenecks. Prompts at the bottom of each menu describe what to do, and a NOTES key provides context-sensitive, on-screen explanation.

1230B Battery-Power

The 1230B is a model of the 1230 that operates from multiple power sources: a self-contained rechargeable battery, +12V dc, or ac. Battery and dc power let you use the 1230B in situations where ac power is unavailable, unreliable, or inconvenient.

NEW! DIGITIZING OSCILLOSCOPE

Now Tek combines multiple testing tools - a 100 MS/s digitizing scope and a logic analyzer - in the same affordable instrument. Use the scope and logic analyzer separately, or interactively as an efficient system debug/characterization tool. The 1230DSM digitizing oscilloscope card provides:

- 2 simultaneous channels
- 100 MS/s sampling rate
- 100 MHz bandwidth
- 8 bit vertical resolution
- 2048 samples per channel
- Repetitive sampling and signal averaging

POWERFUL

SYSTEM TEST APPLICATIONS

An advantage of the 1230/1230B is that each block of 16 channels can be set to sample at a different rate, independent of the other 16-channel blocks. This means that you can simultaneously collect data from different parts of your system under test to see how everything works together. For example, a 64-channel 1230/1230B can disassemble an 8-bit microprocessor plus acquire eight channels of 100 MHz timing data at the same time.

EXCELLENT TRIGGERING-A TEK STANDARD

Like all Tek logic analyzers, the 1230/1230B provides flexible, accurate triggering. Resources include 24 user-definable conditions, 14 triggering levels, two word recognizers per level, 5 ns glitch triggering, and more. All triggering resources are available for both timing and state analysis.

The 1230/1230B provides two trigger modes: Basic and Advanced. Having two modes to choose from lets you use the mode most suited to your application, without unnecessary complexity. Basic mode supports the most commonly used trigger setups. Advanced mode expands triggering capabilities with IF..THEN..ELSE instructions useful for creating two-way conditional branches and for qualifying data storage.

FOUR NONVOLATILE 2K-DEEP MEMORIES

Four different memories, each with 2K bits/channel, are available for acquisition or reference data. All four memories are nonvolatile. Nonvolatile storage means that valuable test data is not accidentally lost. The last-used setup and acquisition data are restored on power-up, letting you begin where you left off.

MEMORY COMPARISON FUNCTIONS

The 1230/1230B supports two comparison modes: Manual and Auto. Manual-compare provides a single comparison of acquisition memory to reference memory. This is useful for basic pass/fail tests.

Auto-compare makes data acquisitions and comparisons repetitively without an operator present. Auto-compare is valuable in "babysitting" applications such as isolating intermittent malfunctions, freeing you from monitoring the test until the fault is detected.

1230/1230B CONFIGURATION CHART				
	1230/1230B	With one 1230E1	With two 1230E1s	With three 1230E1s
Channels at 25 MHz sync, async	16	32	48	64
Channels at 50 MHz async	8	16	24	32
Channels at 100 MHz async	4	8	12	16
Glitch channels	8	16	24	32
Time bases	1	2	3	4
Nonvolatile memories	4	4	4	4
Nonvolatile setups	8	8	8	8
Memory depth/channel	2048	2048	2048	2048
Compatible with 1230DSM	Yes	Yes	Yes	No

In both compare modes, you can compare any two of the four memories. Differences are highlighted in the State Table.

AUTOMATION

By adding an optional RS232 or GPIB communications interface to the 1230/1230B, the analyzer can be controlled remotely from a computer keyboard or via a program written for the computer. This capability lets you turn the 1230/1230B into a low-cost automated test station.

The RS232 and GPIB interfaces also let you store unlimited memories and setups on your PC, and download them into the 1230/1230B at any time.

Included with the RS232 Interface is software package S43R101. This software runs on IBM PC, XT, ATs (or compatibles) and provides an easy, fast method for transferring 1230 setups and data over RS232. S43R101 also lets you create and run automatic, remote-controlled tests.

COMPLETE SOLUTION

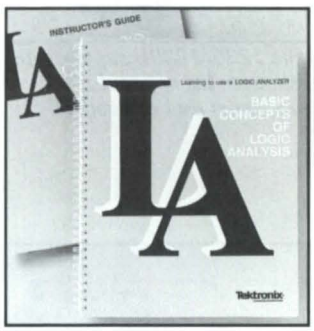
STANDARD ACCESSORIES

Everything you need to learn and use the 1230/1230B is provided standard. This includes the normal accessories you would expect: programmable-threshold acquisition probe, leadsets, grabber tips, Operator's Manual, and pocket-sized quick reference guide. In addition, the 1230/1230B also includes extensive instructional materials: training videotape, test circuit to practice on, and a workbook of application examples.

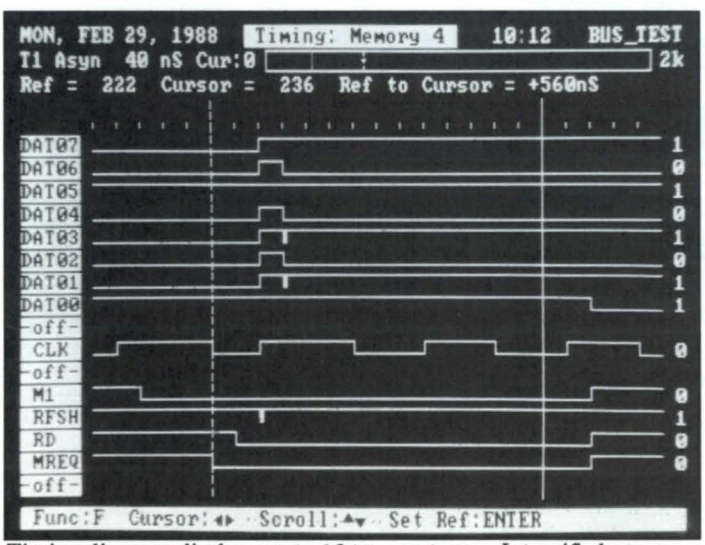
TEACHING MATERIALS

Tektronix developed the Basic Concepts of Logic Analysis self-study workbook (LABASIC) for those who need to learn or teach logic analysis theory and techniques. This optional workbook contains theory, exercises using the 1230/1230B, and student examinations.

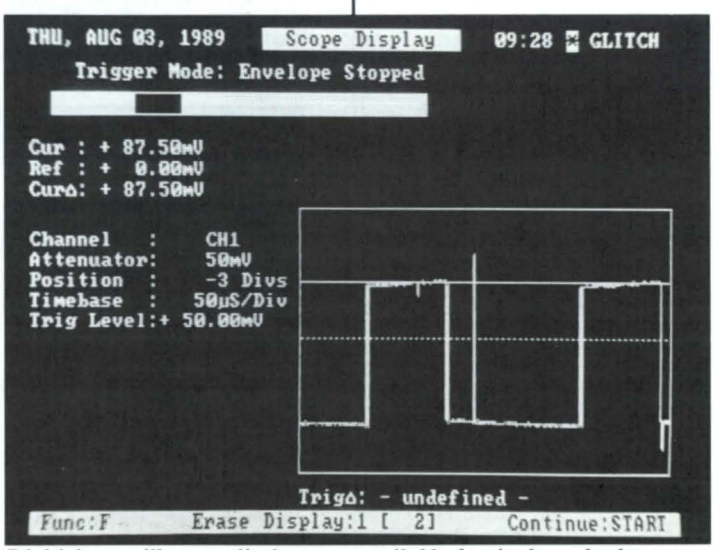
Another self-study workbook, LAMICRO, which focuses on debug techniques for microprocessor-based systems is also available. For realistic practice, a 68010-based test system, FasTrak, is available.



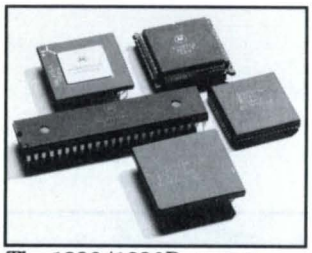
Self-paced training materials quickly build your skills. Workbooks for basic concepts and microprocessor system analysis are available.



Timing diagram displays up to 16 traces at once. Intensified areas indicate glitches.



Digitizing oscilloscope displays are available for single or dual trace, full-screen trace, and mixed scope and timing diagram traces.



The 1230/1230B supports an extensive list of popular processors and controllers.

Disassembly probes are compact and easy to connect.

MICROPROCESSOR SUPPORT

QUICK AND CONVENIENT CONNECTIONS

These compact microprocessor probes attach to the 1230/1230B in place of the standard acquisition probes. Each probe is preconfigured for fast, efficient connections to the specific microprocessor package (e.g., DIP, PGA, PLCC, or PQFP).

Disassembly probes that begin with the letters DP require the 1230DPA, a universal preprocessor.

AUTOMATIC MENU SETUP

You can completely set up all pertinent menus for the target microprocessor by uploading setups from the disassembly probe. All it takes is one keystroke at power-up. If desired, setups can then be customized for your specific application.

FLEXIBLE VIEWING OF DATA

Acquired data can be viewed in either a state table, timing diagram, or disassembly format. When using disassembly format, two additional modes of display, Hardware and Software, are available.

Hardware mode shows all bus operations by displaying all machine cycles. Software mode shows only instruction cycles, much like an assembly listing.

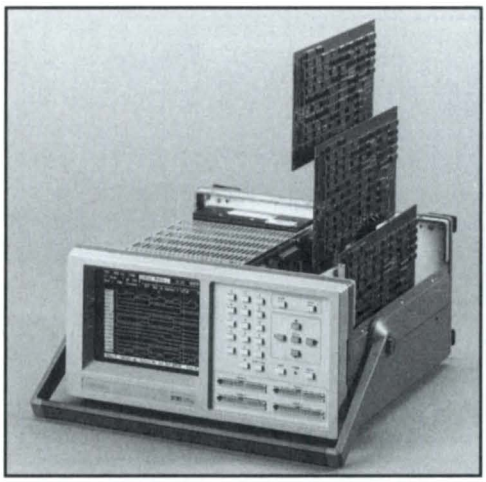
EXTRA CAPABILITIES

Data searching functions, microprocessor-specific on-screen notes, fast scrolling, and the ability to jump to any memory location are available on all disassembly probes. For processors with pre-fetch queues, instructions that are fetched, but not executed, are clearly marked.

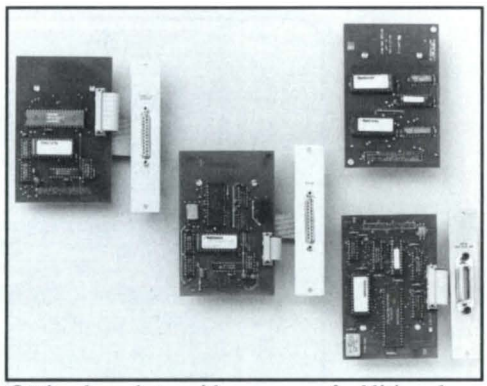
1230/1230B MICROPROCESSOR AND BUS ANALYSIS GUIDE

Processor/Bus	Package Style	Disassembly Probe	Channels Required	1230DPA Required
Intel				
8085	DIP	PM404	32	no
8031/8051	DIP	DP8031D	32	yes
8032/8052	DIP	DP8031D	32	yes
8086/8088	DIP	DP8086D	48	yes
80186/80188	PGA	DP186P	48	yes
8096/80C196	PLCC	DP96PL	48	yes
80286	PGA	DP286P	48	yes
80286	PLCC	DP286PL	48	yes
80386SX/387SX	PQFP	DP386SX	64	yes
Motorola				
6800/6802	DIP	PM407	32	no
6809/6809E	DIP	PM406	32	no
68HC11	all	DPHC11	32	yes
68000/68010	DIP	DP68KD	48	yes
68000/68010	PGA	DP68KP	48	yes
68332	PQFP	DP332	64	yes
Other				
Z80	DIP	PM402	32	no
6502/C02/C802	DIP	PM403	32	no
Buses				
GPIB	n/a	DPGPIB*1	16	yes
		1230 opt 07*2	16	no
RS232	n/a	A6740G	8	no
STD	n/a	PM405	32	no

*1 *Hardware interface and full disassembly.*
*2 *Hardware interface without disassembly.*



Both the 1230DSM and 1230E1 cards install easily so that you can reconfigure your 1230/1230B in less than five minutes.



Option boards provide a range of additional capabilities and install in minutes. Options include parallel printer port, RS232 and GPIB communication interfaces, and on-line notes in foreign languages.

ORDERING INFORMATION

1230 16–Channel Logic Analyzer ☎$2,995
Includes: P6444 programmable-threshold probe, leadsets and grabber tips, operator's manual, quick reference guide, training video tape, training workbook, training test circuit, power cord

1230B 16 ch Battery-powered Logic Analyzer $4,695
Includes: Same items as 1230 plus +12 V dc cigarette lighter adapter plug

OPTIONS FOR BOTH THE 1230 and 1230B

Opt. 01 – RS-232 interface and S43R101 PC S/W +$495
Opt. 02 – Parallel printer port +$195
Opt. 03 – GPIB interface +$695
Opt. 04 – International notes +$150
(English, German, French Canadian, French, Dutch, Spanish, and Italian)
Opt. 05 – Rackmount (1230 only) +$495
Opt. 06 – Accessory bag +$65
Opt. 07 – GPIB acquisition leadset +$195
Opt. 08 – A6740G serial acquisition probe +$1,500
Opt. 09 – International notes II +$150
(English, Danish, Finnish, Norwegian, and Swedish)
Opt. 1D – Delete P6444 probe –$600
Opt. 1S – Substitute P6443 probe for P6444 –$200
Opt. 20 – Delete video tape –$30
Opt. 21 – Service manual +$200
Opt. 22 – Service maintenance kit +$1,500
Opt. 23 – Substitute VHS-PAL videotape *2
Warranty-Plus options are available.

1230E1 16 Channel Expander Card $1,200
Includes: P6444 probe, leadsets and grabber tips
Opt. 1D – Delete P6444 probe –$600
Opt. 1S – Substitute P6443 probe for P6444 –$200

1230DSM 100 MS/s Digitizing Scope Card $2,995
Includes: Two scope probes, operator's manual

LABASIC – Concepts of Logic Analysis Workbook $15
LAGUIDE – Concepts Instructor's Guide $10
LAMICRO – Micro System Debug Workbook *2
FasTrak Micro Training Package $450

1230C32 32-ch System / Parallel Printer Port ☎$4,325
Includes: 1230 with Opt . 02, one 1230E1 expander card

1230B32 32-ch Battery-powered System/Parallel Printer Port $6,025
Includes: 1230B with Opt. 02, one 1230E1 expander card

FOR BOTH 1230C32 and 1230B32

Opt. 1D – Delete P6444 probes –$1,200
Opt. 1S – Substitute two P6443 probes for P6444s. Additional options are listed below. –$400

1230C48 48-ch System/Parallel Printer Port ☎$5,525
Includes: 1230 with Opt. 02, two 1230E1 expander cards

1230B48 48-ch Battery-powered System/Parallel Printer Port $7,225
Includes: 1230B with Opt. 02, two 1230E1 expander cards

FOR BOTH 1230C48 and 1230B48

Opt. 1D – Delete P6444 probes –$1,800
Opt. 1S – Substitute three P6443 probes for P6444s. Additional options are listed below. –$600

1230C64 64-ch System Parallel Printer Port $6,725
Includes: 1230 with Opt. 02, three 1230E1 expander cards

1230B64 64-ch Battery-powered System/Parallel Printer Port $8,425
Includes: 1230B with Opt. 02, three 1230E1 expander cards

FOR BOTH 1230C64 and 1230B64

Opt. 1D – Delete P6444 probes –$2,400
Opt. 1S – Substitute four P6443 probes for P6444s –$800

ADDITIONAL OPTIONS FOR 1230 and 1230B SYSTEMS

Opt. 01 – RS-232 interface & S43R101 PC S/W +$495
Opt. 03 – GPIB interface +$695
Opt. 04 – International notes +$150
Opt. 05 – Rackmount (1230 only) +$495
Opt. 06 – Accessory bag +$65
Opt. 07 – GPIB acquisition leadset +$195
Opt. 08 – A6740G serial acquisition probe +$1,500
Opt. 09 – International notes II +$150
Opt. 20 – Delete video tape –$30
Opt. 21 – Service manual +$200
Opt. 22 – Service maintenance kit +$1,500
Opt. 23 – Substitute VHS-PAL videotape *2
Warranty-Plus options are available.

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

MICROPROCESSOR/BUS ANALYSIS PRODUCTS

1230DPA – Disassembly probe adapter $400
DP8031D – 8031/51/8032/52 probe - DIP *1 $700
DP8086D – 8086/8088 probe - DIP *1 $1,500
DP186P – 80186/80188 probe - PGA *1 $1,600
DP96PL – 8096/80C196 probe - PLCC *1 $1,600
DP286P – 80286 probe - PGA *1 $1,600
DP286PL – 80286 probe - PLCC *1 $1,600
DP386SX – 80386SX probe - PQFP *1 $2,200
DP332 – 68332 probe - PQFP *1 $2,500
DP68KD – 68000/68010 probe - DIP *1 $1,200
DP68KP – 68000/68010 probe - PGA *1 $1,200
DPHC11 – 68HC11 probe *1 $700
DPGPIB – GPIB probe *1 $600
PM402 – Z80 probe $800
PM403 – 6502/C02/C802 probe $800
PM404 – 8085 probe $800
PM405 – STD bus probe $800
PM406 – 6809/6809E probe $800
PM407 – 6800/6802 probe $800
A6740G – Serial acquisition probe $1,500

**1 Requires 1230DPA disassembly probe adapter.*

RELATED PRODUCTS

P6443 – 16-channel TTL/CMOS probe $500
P6444 – 16-channel Programmable-threshold Probe $700
S43R101 – 1230/PC RS232 application S/W $95
1230F01 – Field-installed RS-232 Interface & S43R101 PC S/W $450
1230F02 – Field-installed parallel printer port $150
1230F03 – Field-installed GPIB interface $650
1230F04 – Field-installed international notes $125
1230F05 – Field-installed rackmount hardware (1230 only) $450
1230F09 – Field-installed international notes II $125
K217 – Instrument cart $570
Opt. 01 – Brown finish (matches 1230) NC
Securing strap – Order 346-0070-03 $40
SMG50 – 20 SMT grabber tips $89

INTERNATIONAL POWER PLUGS OPTIONS

Opt. A1-A5 – Available for the 1230/1230B NC
See page 488 for description.

Logic analyzer accessories are described in the Accessories section of this catalog.
Please refer to page 444.

**2 Contact your local sales engineer.*

SPECTRUM ANALYZER PRODUCTS
DIGITAL SIGNAL PROCESSING SYSTEMS

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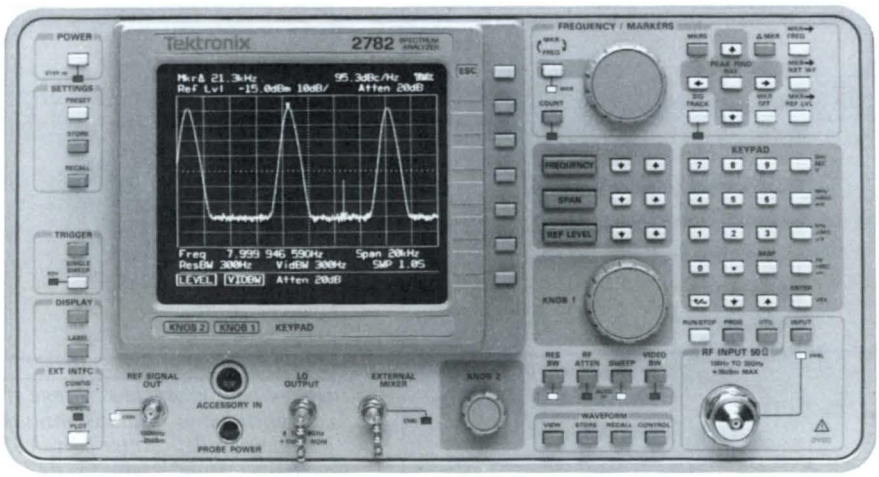
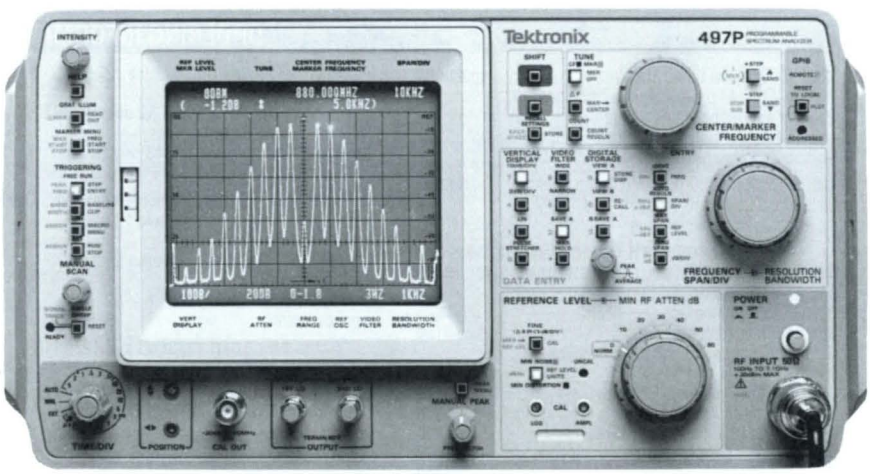
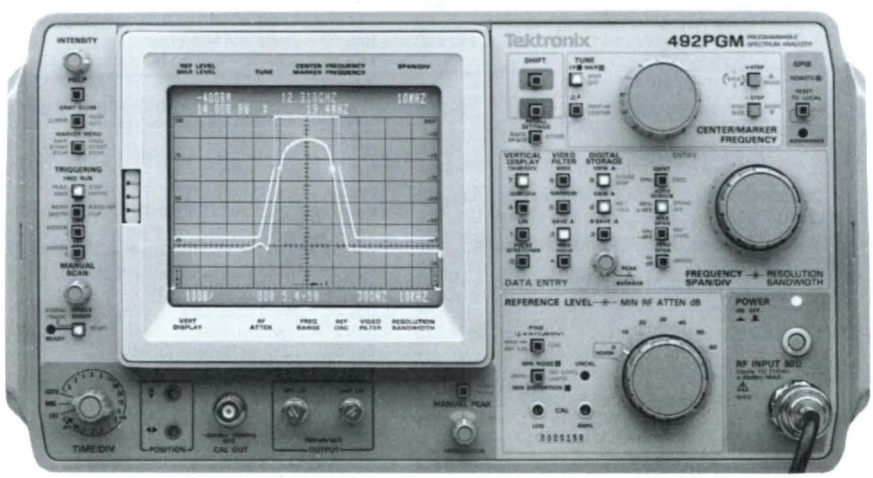


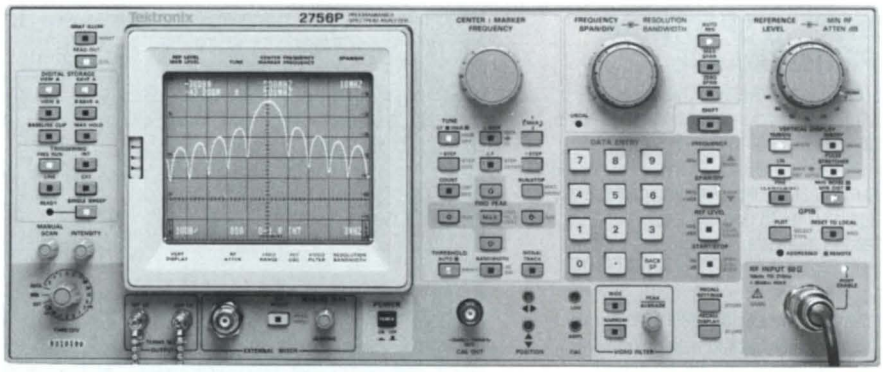
New 2782 Microwave Spectrum Analyzer



New 297P "Quasi-Microwave" Spectrum Analyzer

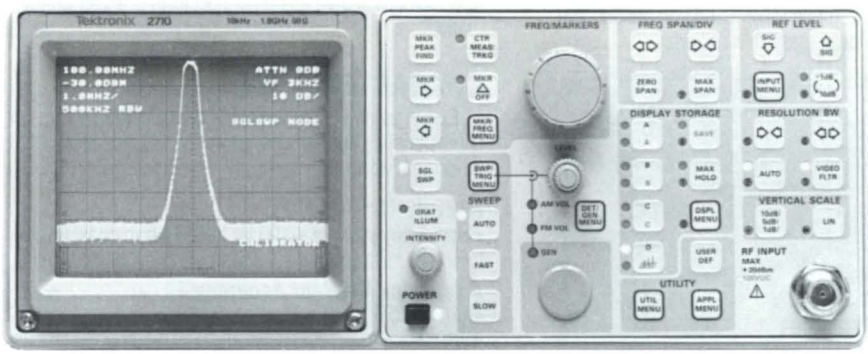


New 492PGM Microwave Spectrum Analyzer

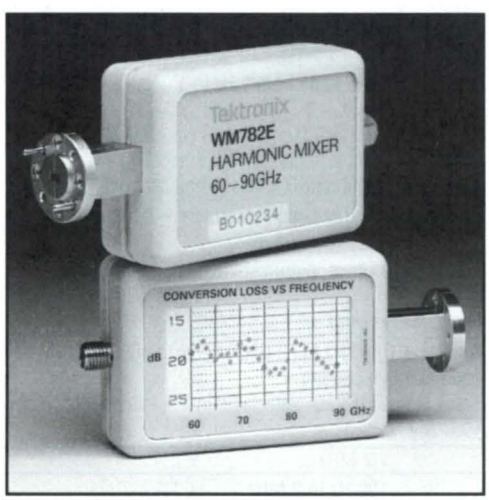


2756 Programmable Spectrum Analyzer

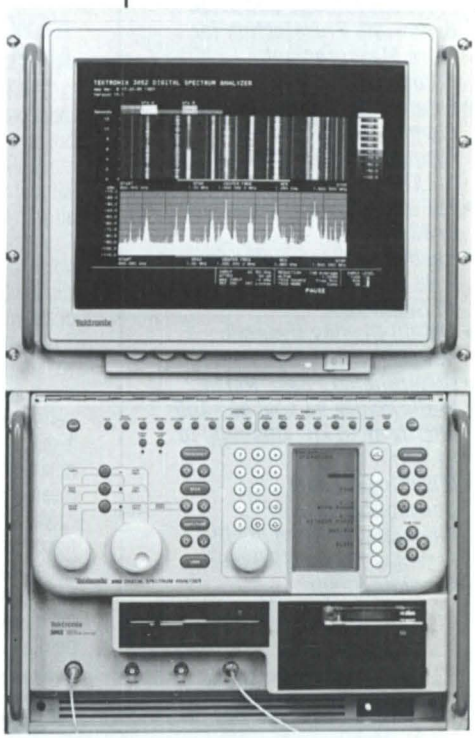
RF 160 Down Converter - Converts I.F. signals for analysis by the 3052 Digital Spectrum Analyzer System



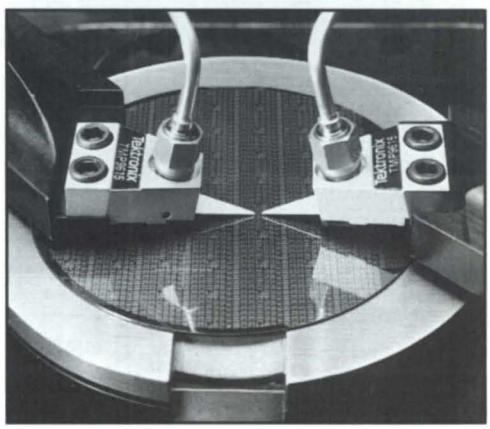
2710 Portable Spectrum Analyzer



New WM782 Waveguide Mixers



3052 DC to 10 MHz Programmable Digital Spectrum Analyzer System



New TMP9000 Microwave Probes

NEW

2782 HIGH-PERFORMANCE MICROWAVE SPECTRUM ANALYZER

FEATURES/BENEFITS

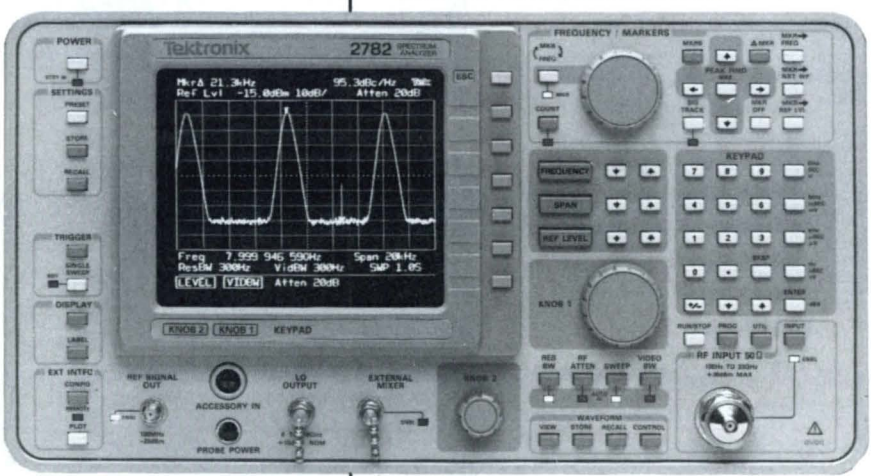
- *100 Hz to 33 GHz Coaxial Frequency Range and Wide Bandwidth Preselection for More Measurement Productivity*
- *External Waveguide Mixer Support to 325 GHz with Frequency Calibration to 1.2 THz*
- *Full-range Sweep from 0 Hz to 33 GHz*
- *Resolution Bandwidths from 3 Hz to 10 MHz in a 1, 3, 10 Sequence*
- *100 dB Display Dynamic Range*
- *Unparalleled 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 Provides Higher SNR and Dynamic Range*

NEW STANDARD IN SPECTRUM ANALYZER PERFORMANCE

The Tektronix 2782 offers you leadership measurement performance, not just through minor enhancements, but by truly extending the state of the art. For example, the 33 GHz 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 33 GHz sweep.

Whatever you need to measure, from close-in phase noise to demodulated pulsed RF, the 2782 provides the capabilities – 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 the ability to uncouple the mixer input level from the RF attenuator by up to 30 dB means higher signal-to-noise ratio measurements.

When you need to go above 33 GHz and external mixers are used, the 2782 provides 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 new WM782 Waveguide Mixers and you are set; you do not even have to peak these new mixers.

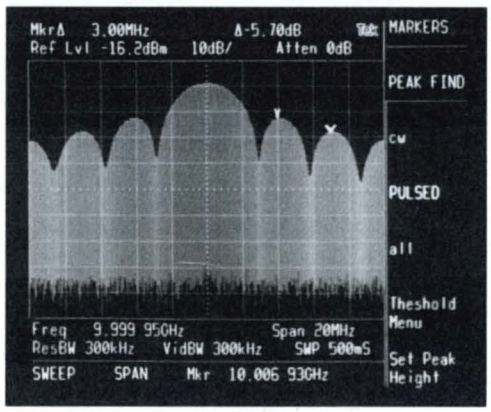


SOFT KEY, MENU, AND MACRO CONVENIENCE

The 2782 is rich in measurement features that are quickly and easily accessible through softkeys and menus that rarely go three deep. Often, your most frequently used feature can be assigned to one of two soft knobs for immediate access and control. Additionally, you can store front-panel keystroke sequences to simplify complex measurements, or even create single-key executable macros for the most complex applications.

HIGHLY EFFICIENT SYSTEMS COMPONENT

With full programmability and two GPIB ports, the 2782 offers a new level in systems convenience and



efficiency. For example, the 2782 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 with its small size, the 2782 provides 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 to the 2782 after a 30-minute warm-up.

FREQUENCY-RELATED

Frequency Range – 100 Hz to 33 GHz in coax, 8 GHz to 1.2 THz externally.

Frequency Readout Accuracy –
$\pm[F(RE+10^{-10})] + D + M$
where: 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.

Counter (S/N ≥ 20 dB) –
Range: 100 Hz to 1.2 THz
Resolution: Selectable from 1 Hz to 1 GHz
Accuracy: $\pm[F(RE + 10^{-10})]$+ 5N Hz + 1 LSD
ΔCount: $\pm[\Delta F(RE + 10^{-10})]$ + 10N Hz + 2 LSD
where: F = counter frequency; RE = reference error; N = L.O. harmonic; LSD = least significant digit.

Frequency Reference Accuracy –
Aging: < $1x10^{-6}$/year, < $7x10^{-9}$/day
Drift: < $5x10^{-7}$ over instrument temperature range of –10°C to + 40°C.

Frequency Span –

Range – 0, 10 Hz to 33 GHz in coax, to 600 GHz in external mixer bands.
Resolution: > 100 Hz, selectable in 1% increments
Accuracy:

> 2 MHz	± 2%
100 Hz to 2 MHz	± 1%
< 100 Hz	± 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%

Selectivity (60 dB/6 dB): < 10:1
Shape: Synchronously-tuned, six-pole filters

2782 Resolution Filter Bandwidths –

(Specified) 6 dB	(Typical) Random 3 dB	(Typical) 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

Video Bandwidth –
Range: 0.03 Hz to 300 kHz in 1, 3, 10 sequence, and 10 MHz.
Accuracy (nominal): ±25%

Stability –
Residual: FM: < 2 MHz span 1N Hz P-P over one second. > 2 MHz span 25N kHz P-P over 500 msec.
Drift (after one hour warm-up): < 2 MHz span 5N Hz/minute of sweep time. >2 MHz span) 5N kHz/minute of sweep time.
Notes: N = L.O. Harmonic. Errors due to drift are not cumulative from sweep to sweep.

Spectral Purity –

NOISE SIDEBANDS

dBc/Hz	Center Frequency Range			
Frequency Offset	100 Hz to 6.5 GHz	6.5 GHz to 12 GHz	12 GHz to 21 GHz	21 GHz to 33 GHz
100 Hz	–85	–80	–75	–70
1 kHz	–97	–95	–90	–86
10 kHz	–105	–105	–105	–97
100 kHz	–105	–105	–105	–97
1 MHz	–112	–112	–112	–102

AMPLITUDE-RELATED

Maximum Amplitude Range – 135 dBm to +30 dBm

Displayed Average Noise Level – (10 Hz RBW, 0 dB attenuation)

Frequency	Level
100 Hz to 50 kHz	– 85 dBm
50 kHz to 5 MHz	–105 dBm
5 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 33 GHz	–107 dBm

Using WM782 Waveguide Mixer Series (typical) – (1 kHz RBW)

Band	Frequency	Sensitivity
Q	33 GHz to 50 GHz	–115 dBm
U	40 GHz to 60 GHz	–115 dBm
V	50 GHz to 75 GHz	–115 dBm
E	60 GHz to 90 GHz	–115 dBm
W	75 GHz to 110 GHz	–105 dBm
F	90 GHz to 140 GHz	–95 dBm
D	110 GHz to 170 GHz	–90 dBm
G	140 GHz to 220 GHz	–85 dBm
J	220 GHz to 325 GHz	–75 dBm

Display Range – Log amplifier, 100 dB.

Display Law Range:	
Log	1 dB/div to 15 dB/div
Linear	5 nV/div to 50 V/div
Square Law	$1x10^{-18}$W/div to 1 kW/div
Reference Level:	
Range	–140 dBm to +30 dBm
Resolution	0.1 dB

**1 Measurements 0.5 dB/10 dB incremental.*

Frequency Response – *(for ≥ 10 dB RF attenuation and 20°C - 30°C temperature range)*
100 Hz to 6.5 GHz: ±1.0 dB
6.5 GHz to 28 GHz: ±2.5 dB
28 GHz to 33 GHz: ±3.0 dB
(Attenuator accuracy over frequency included in frequency response.)

Attenuator – Range: 0 to 70 dB, 10 dB steps
Accuracy: ±0.5 dB @ 100 MHz
IF Gain: Range: 0 - 140 dB
Resolution: 0.1 dB
Accuracy: ±0.5 dB/10 dB, ±1.0 dB/50 dB, to a maximum of 1.5 dB cumulative over a 100 dB range

RF Gain Uncertainty – ±1.5 dB

FEATURES/BENEFITS (cont.)

- ***Intelligent Markers and 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***
- ***Up to 7x10 $^{-9}$/day Center Frequency Accuracy***
- ***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.
- ***View Analog and Digitally-Stored Waveforms Simultaneously***
- ***High-Resolution Color Display***
- ***Space Saving Portable Package***

SPURIOUS RESPONSES

Spurious Responses – < -90 dBc except as noted below:

Residual Signals	< – 100 dBm, 100 Hz to 6.5 GHz < – 92 dBm, 6.5 GHz to 21 GHz < – 82 dBm, 21 GHz to 28 GHz < – 80 dBm, 28 GHz to 33 GHz

1-dB Gain Compression –
100 Hz to 21 GHz: 0 dBm.
21 GHz to 28 GHz : -3 dBm.
28 GHz to 33 GHz: -6 dBm.

Intermodulation Rejection –
Second Order Intercept: > +28 dBm, 1 MHz to 6.5 GHz.
Third Order Intercept (with signal separation < 150 MHz):
> +15 dBm, 1 MHz to 6.5 GHz.
> +10 dBm, 6.5 GHz to 28 GHz.

Second Harmonic Distortion – (at -30 dBm signal)
< – 60 dBc, 50 MHz to 6.5 GHz.
< –100 dBc, 6.5 GHz to 33 GHz.

Out of Band Responses –

	Center Frequency Ranges	
	100 Hz to 28 GHz	28 GHz to 33 GHz
Image Response	< – 65 dBc :	< – 65 dBc
Harmonic Conversions	< – 65 dBc :	< – 55 dBc
Signals at external Input with coax selected:	< – 90 dBc:	< – 90 dB GHz

DISPLAY-RELATED

Display Type – Liquid crystal color shutter, 10 x 10 div. graticule.

Digital Storage – Maximum Sweep Rate: 10 ms with 10-bit resolution, 2 ms with reduced horizontal resolution. Vertical Digitizer Uncertainty: ±0.4%.

Nonvolatile Memory – CMOS battery backed-up RAM, memory retention guaranteed to –10°C.
Battery Type: Lithium cells.
Battery Life: 1.8 years @ 20°C, 1 year @ 50°C (batteries are not used while in standby mode).
Waveforms: 20 waveforms with screen readouts and labels or date/time stamp.
Front-Panel Setups: 20 complete front-panel setups.
Front-Panel Sequences: 20 sequences.
Macros: 40k of RAM.
Instrument Calibration Data: Separate EEPROM.

Sweep Generator and Triggering –

Sweep Generator:	
Sweep Speed Range	200 s to 2 µs in 1, 2, 5 sequence
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; no more than two divisions of signal required to trigger
External	dc coupled; 0 Hz to 5 MHz or 0 Hz to 1.5 kHz; 0.3 V P-P required to trigger
Line	Copy of ac line

INPUTS AND OUTPUTS

RF Input – Frequency Range: 100 Hz to 33 GHz.
Coupling: dc.
Connector: Planar crown system connector with K compatible and N-type adapters as standard accessories.
Impedance: 50 Ω.

VSWR –

	Center Frequency Ranges		
RF Atten	100 Hz to 6.5 GHz	6.5 GHz to 28 GHz	28 GHz to 33 GHz
10 dB	< 1.4:1	< 2.0:1	< 2.0:1
0 dB	< 2.0:1	< 3.0:1	< 3.0:1

Maximum Safe Input Power –
AC Average Power: +30 dBm with ≥ 10 dB attenuation.
Pulse Power: 50 W peak, 1 µs and 0.005 duty factor with ≥ 50 dB attenuation.
DC: 0 volts.

Local Oscillator Emission – (at 0-dB RF attenuation) ≤ –75 dBm: 100 Hz to 6.5 GHz. ≤ –65 dBm: 6.5 GHz to 33 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.
LO Output Power:
≥ 13 dBm at 8 - 10 GHz
≥ 15 dBm at 10 - 16.5 GHz
≥ 13 dBm at 16.5 - 18 GHz

LO Output – Provides access to output of 1st LO at +5 dBm minimum.

Probe Power – Provides operating voltage for active probes; output voltages are:

pin 1: +5 V ± 5% @ 100 mA max
pin 2: ground
pin 3: –15 V ± 5% @ 100 mA max
pin 4: +15 V ± 5% @ 100 mA max

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 100 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; 10 MHz bandwidth.
Sweep Output: Provides copy of analog sweep.
Ext. In Video: Provides external access to instrument's video processing system; 7.5 MHz bandwidth.

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 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; jumper-selectable between Z-axis signal or sweep gate.

IF Output –
Amplitude: +10 dBm ±1 dB for a full-screen signal
Impedance: 50 Ω; VSWR ≤ 1.5:1
Frequency: 25 MHz for 3 MHz or 10 MHz resolution bandwidth filter; 4 MHz for 1 MHz or less resolution bandwidth filter.

EXTERNAL INTERFACE PORTS

GPIB – Two GPIB ports (IEEE Std. 488-1978) are standard. Interface Functions: Port 1: SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, C0.
Port 2: SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, C1, C2, C3, C4, C25, (C0 selectable).

POWER REQUIREMENTS

Input Voltage – 90 to 132 V ac, 47 to 440 Hz; 180 to 250 V ac, 47 to 63 Hz.

Power – 250 W maximum, 2.8 amperes @ 115 V ac, 60 Hz

Leakage Current – 3.5 mA maximum current.

ENVIRONMENTAL CHARACTERISTICS

MIL-T-28800C, TYPE III, CLASS 3, STYLE C

Temperature – Operating: -10°C to +55°C. Non-operating: -62°C to +85°C.

Humidity – 5 cycles per MIL STD 810D Procedure III (modified).

Altitude – Operating: 15,000 ft. Non-Operating: 40,000 ft.

Vibration – Operating: Tested to MIL STD 810D Procedure I (modified); resonant search in all axes from 5-15 Hz with displacements up to 0.060 inches, 15-25 Hz with displacements up to 0.040 inches, and 25-55 Hz with displacements up to 0.020 inches.

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.

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, full limits.
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.
RS03–14 kHz to 1 GHz; front-end responses, full limits at 1 V/m, relaxed 15 dB at 10 V/m; IF frequencies, full limits at 1 V/m, relaxed 20 dB at 10 V/m. 1 GHz to 10 GHz; front-end responses, full limits at 1 V/m, relaxed 20 dB at 10 V/m; IF frequencies, relaxed 15 dB at 1 V/m, relaxed 35 dB at 10 V/m.

VDE – Meets VDE 0871 Class B–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.

Safety – Meets the following industry safety standards:
CSA Electrical Bulletin 556B; ISO/ANSI DS82, Safety Requirements for Electronic Measuring and Controlling Instrumentation; IEC 348, 2nd Edition, Safety Requirements for Electronic Measuring Apparatus; FM–Electrical Utilization Standard Class 3810.

OPTICAL TO ELECTRICAL CONVERTER

SA-42

- Adapts Microwave Spectrum Analyzers to measure optical components and systems.
- DC to 6.5 GHz (–3dB), 15 GHz (–25dB).
- 35 mV into 50 Ω per 1 mW of optical power.
- Ultra low noise.

APPLICATIONS

- Measure RF spectral content of analog or digital

PHYSICAL CHARACTERISTICS

	Without Front Cover, Feet or Handle		With Front Cover, Feet and Handle	
Dimensions	**mm**	**in**	**mm**	**in**
Width	330	13	407*1	16*1
			407*2	16*2
Height	203	8	203*1	8*1
			203*2	8*2
Depth	473	18.6	559*1	22*1
			635*2	25*2
Weight	**kg**	**lb**	**kg**	**lb**
	–	–	20	44

*1 *Handle folded back*
*2 *Handle extended*

ORDERING INFORMATION

2782 Microwave Spectrum Analyzer **$65,000**
Includes: N-male to BNC-female adapter (103-0045-00); N to Planar Crown adapter (131-4329-00); Cable, 50-ohm SMA (012-0649-00); Line fuses: 4 A, 125 V ac (159-0319-00); 4 A, 250; V ac (159-0320-00); Power cord (161-0104-00); Operator's Manual (070-6794-00); Operator's Reference Guide (070-6795-00); Programmer's Manual (070-6796-00); Programmer's Reference Guide (070-6798-00).

OPTIONS

Opt. B1 – Two Service Manuals (Volumes 1 and 2) prepared to the component-level. **+$250**
Opt. B2 – Complete set of manuals, including two-volume, component-level Service Manual set. **+$350**
Opt. 18 – WM782 Bands A, U, E, F, and G Waveguide Mixer Set (frequency coverage from 26 to 220 GHz). **+$9,340**
Opt. 19 – WM782 Bands Q, V, W, and D (frequency coverage from 33 to 170 GHz). **+$15,040**
Opt. 20 – Utility Software for PC, includes PC GPIB card. **+$1,530**
Opt. 21 – Compaq Portable II Computer with utility software. **+$5,650**
Opt. 25 – Tektronix PEP 301 System Controller with utility software. **+$9,065**
Opt. 29 – Epson LX-850 Printer. **+$550**
Opt. 30 – Cradlemount for 19-inch rackmounting. **+$750**
Opt. 39 – Silver battery. **+$50**

WARRANTY INFORMATION

The standard one-year Tektronix warranty can be extended with the *Warranty-Plus* Service Plans listed below. For more information, contact your Tektronix Sales Engineer or local Tektronix Service Center or refer to the Service Section in this catalog.

Opt. M1 – 2 calibrations **+$3,175**
Opt. M2 – + 2 years service. **+$2,880**
Opt. M3 – + 2 years service and 4 calibrations **+$6,350**
Opt. M4 – 5 calibrations **+$5,675**
Opt. M5 – + 2 years service and 9 calibrations **+$10,480**
Opt. M7 – + 2 calibrations **+$1,835**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal European 220 V 6 A, 50 Hz. **NC**
Opt. A2 – United Kingdom 240 V/5 A, 50 Hz. **NC**
Opt. A3 – Australian 240 V/12 A, 60 Hz. **NC**
Opt. A4 – North American 240 V/12 A, 60 Hz. **NC**
Opt. A5 – Switzerland 220V/6A, 50 Hz. **NC**

OPTIONAL ACCESSORIES

Module Level Service Manual – Order 070-6799-00. *1
Service Kit – Contact your local field office.
SA-42 – Optical to Electrical Converter **$3,250**

*1 *Contact your local sales representative.*

WM782 FEATURES

- *Lowest Conversion Loss WGM Available*
- *Zero DC Bias*
- *Improved Reliability*
- *Increased Sensitivity*
- *Uniform Size*
- *Quick Reference Conversion Loss Calibration Chart*
- *Individually Calibrated*
- *Rugged LEXAN Plastic Outer Shell*
- *Anti-Parallel Diodes Reduce Vulnerability to ESD*
- *Precision Gold-Plated Brass Mixer Body*
- *Odd Harmonic Conversion Products Eliminated*

WM782 APPLICATIONS

- *Spectrum Analysis for Millimeter Wave Frequencies*
- *Swept Frequency Response Measurements*
- *Power Level Measurements for Millimeter Wave Frequencies*
- *For Independent Users, Ideally Suited for Frequency Down Conversion*
- *Harmonic Generator/ Frequency Up Conversion*

ORDERING INFORMATION

WM782 WAVEGUIDE MIXERS AND SETS

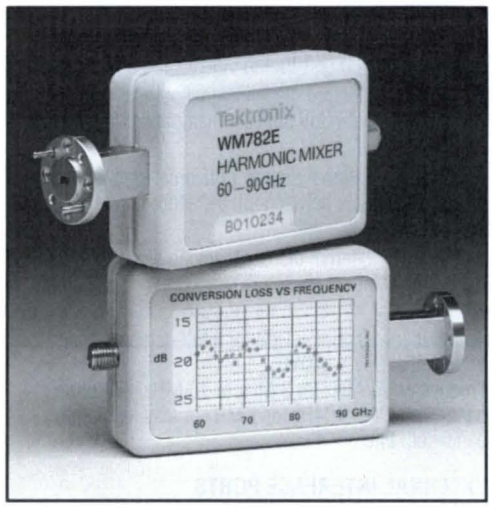
26-40 GHz – Order WM782A	**$1,835**
33-50 GHz – Order WM782Q	**$2,130**
40-60 GHz – Order WM782U	**$2,530**
50-75 GHz – Order WM782V	**$2,870**
60-90 GHz – Order WM782E	**$3,115**
75-110 GHz – Order WM782W	**$3,195**
90-140 GHz – Order WM782F	**$3,425**
110-170 GHz – Order WM782D	**$4,775**
140-220 GHz – Order WM782G	**$4,890**
220-325 GHz – Order WM782G Opt. 01 (adds tapered waveguide transition)	**+$1,765**
26 to 60 GHz Set – Includes WM782A and WM780U. Order WM7826	**$4,365**
26 to 90 GHz Set – Includes WM7826 plus WM782E. Order WM7827	**$7,480**
26 to 140 GHz Set – Includes WM7827 plus WM782F. Order WM7828	**$10,905**
26 to 220 GHz Set – Includes WM7828 plus WM782G. Order WM7829	**$15,795**
33 to 75 GHz Set – Includes WM782Q and WM782V. Order WM78210	**$5,000**
33 to 110 GHz Set – Includes WM78210 plus WM782W. Order WM78211	**$8,195**
33 to 170 GHz Set – Includes WM78211 plus WM782D. Order WM78212	**$12,970**

NEW WM782 SERIES

WAVEGUIDE MIXERS

The Tektronix WM782 Series of Waveguide Mixers are a new high-performance, broadband, zero dc bias, anti-parallel dual-diode type mixers for use with the new Tektronix 2782 Spectrum Analyzer. 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 new 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.



Typical Electrical Characteristics

Tektronix Model No.	Band Desig.	Freq. Range (GHz)	Sensitivity *1 (dBm)	Freq. Response *2 (dB)	Conv. Loss (dB)	Low-Pass Cut-Off Freq. *5
WM782A	A	26 to 40	–120	-	20	16 GHz
WM782Q	Q	33 to 50	–115	±3	20	20 GHz
WM782U	U	40 to 60	–115	±3	20	20 GHz
WM782V	V	50 to 75	–115	±3	20	28 GHz
WM782E	E	60 to 90	–115	±3	20	28 GHz
WM782W	W	75 to 110	–105	±3	30	28 GHz
WM782F	F	90 to 140	–95	±3 *3	35	32 GHz
WM782D	D	110 to 170	–90	±3 *3	40	40 GHz
WM782G	G	140 to 220	–85	±3 *3	45	40 GHz
WM782G Opt. 01	J	220 to 325	–75	±3 *3	50	–
Opt. 01 *4						

*1 *Equivalent average noise level using a 2782 Spectrum Analyzer in 1 kHz resolution bandwidth.*
*2 *Maximum amplitude variation across each waveguide mixer band using a 2782 Spectrum Analyzer.*
*3 *Over any 5 GHz bandwidth for millimeter wave mixers above 60 GHz.*
*4 *Tapered waveguide transition allows WM782G to cover this range.*
*5 *Low-pass filters in LO/IF path.*

Tektronix Product	Waveguide (EIA)	(JAN)	Dimensions Flange LxWxH (in)	Weight LxWxH (cm) (oz)
WM782A 26 to 40 GHz	WR-28	UG-599/U	9.525x2.54x4.32 3.75x1.00x1.70	113.4 4.0
WM782Q 33 to 50 GHz	WR-22	UG-383/U-M	8.89x2.54x4.32 3.50x1.00x1.70	113.4 4.0
WM782U 40 to 60 GHz	WR-19	UG-383/U-M	8.89x2.54x4.32 3.50x1.00x1.70	113.4 4.0
WM782V 50 to 75 GHz	WR-15	UG-385/U	8.89x2.54x4.32 3.50x1.00x1.70	113.4 4.0
WM782E 60 to 90 GHz	WR-12	UG-387/U	8.89x2.54x4.32 3.50x1.00x1.70	113.4 4.0
WM782W 75 to 110 GHz	WR-10	UG-387/U-M	8.89x2.54x4.32 3.50x1.00x1.70	113.4 4.0
WM782F *1 90 to 140 GHz	WR-08	UG-387/U-M	8.89x2.54x4.32 3.50x1.00x1.70	113.4 4.0
WM782D *1 110 to 170 GHz	WR-06	UG-387/U-M	8.89x2.54x4.32 3.50x1.00x1.70	113.4 4.0
WM782G *1 140 to 220 GHz	WR-05	UG-387/U-M	8.89x2.54x4.32 3.50x1.00x1.70	113.4 4.0
WM782G/ Option 01 220 to 325 GHz	G-J Band tapered transition and flange adapter: WR-05 WR-03	74-003 74-005		

*1 *All mixers are equipped with Standard UG-xxx/U-type flanges. MIL-F-3022-type flanges are available in F, D, and G bands.*

2750 SERIES SPECTRUM ANALYZERS

Tektronix 2750 Series Spectrum Analyzers offer a broad selection of features and benefits to meet wide-ranging needs for laboratory-level frequency domain spectrum analysis. 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 range of the instruments is as follows:

10 kHz to 325 GHz: 2756P and 2755AP
10 kHz to 21 GHz: 2754P
100 Hz to 1.8 GHz: 2753P

2750 Series Spectrum Analyzers combine affordability with laboratory performance, wide frequency coverage range, and a comprehensive set of powerful features. They are designed for benchtop use or rackmounting, in the lab, on an engineering workbench, or on the manufacturing floor.

A wide array of price/performance alternatives are available. If you need 10 Hz resolution for an exacting close-in spectral purity measurement, the 2756P will fill your need. For more routine uses, such as a microwave transmitter occupied-bandwidth measurement, the 2754P 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 ten complete front-panel measurement parameter setups in nonvolatile memory to save you measurement time. You can also save up to nine 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 2756P. For added confidence in measurements, a built-in microwave signal counter in the 2756P with 144 dB dynamic range means you can determine the exact frequency of marked signals only 10 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.

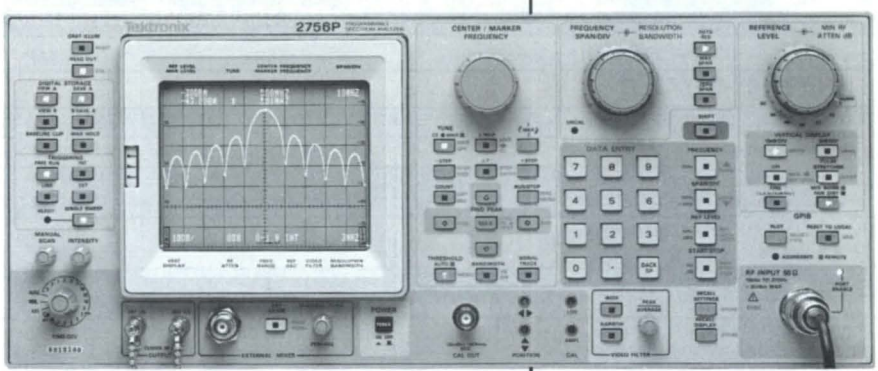
Menu-selected dynamic markers automatically update frequency and amplitude data with every sweep. Unprecedented signal processing power results when you use these markers in conjunction with the built-in intelligence. With *PULSE* Mode, you can mark the peak of a main lobe and peaks of side lobes at 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.

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. Screen messages prompt you for proper keypad inputs--all "valid" keys to push are illuminated to steer you to the proper selections. The unique marker keypad allows *Peak Find, Right & Left Next, Next Higher & Lower, Left & Right X dB,* and *Peak Find & Center* operations to be executed directly from the front panel. This makes signal searches much easier.

Optional switch-selectable 50-ohm and 75-ohm impedances add versatility. For applications such as baseband and CATV, 75-ohm/dBmV greatly simplifies spectrum analysis.

The performance leader is the 2756P, which offers frequency coverage from 10 kHz to 21 GHz with its internal mixer, and to 325 GHz with external mixers such as Tek's WM490 Series, or the new WM780 Series (each WM780 Series mixer is indivually calibrated). Signal sensitivity is an impressive -134 dBm. The 2756P 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 2755AP covers the same frequency range as the 2756P, 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 2754P'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 2753P features the same functionality and high level of performance as the 2756P, but over a frequency range of 100 Hz to 1.8 GHz. It is optimized for standalone or automated operation in baseband through UHF measurements, where the ability to identify and process weak signals is critical.

Laboratory Performance with Affordable Prices

FEATURES/BENEFITS

- ***100 Hz to 325 GHz Frequency Coverage***
- ***Continuous-Resolution Frequency Tuning Combines "Synthesized" Settability and Accuracy with Analog Feel***
- ***Wide Viewable Dynamic Range; as much as 90 dB with 10 Hz to 3 MHz Resolution Bandwidth***
- ***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 Occupied-Bandwidth and Noise-Normalization Functions***
- ***Macro Capability with Nonvolatile Memory to Simplify and Speed Up Commonly-Used Routines***
- ***75-ohm Option Allows Switch-Selectable Impedances***
- ***Nonvolatile Memory for up to 9 Waveforms and 10 Front Panel Settings***
- ***GPIB Programmability with Tek Codes and Formats for Standardized Bus Operation***
- ***Optional MATE/CIIL Compatibility for Military Applications***
- ***Ergonomically-Designed Front Panel Controls***
- ***Direct Screen Data Plots without a Controller***
- ***Many Application-Specific Options***

SPECTRUM ANALYZERS

TYPICAL MEASUREMENTS

- *Baseband Measurements*
- *Carrier Level Monitoring*
- *Carrier ON/OFF Ratios*
- *Carrier/Noise Measurements*
- *EMI/RFI Compliance*
- *EW Gathering and Analysis*
- *Frequency Counting*
- *Harmonic Distortion*
- *IF Amplifier Adjustments*
- *Modulation Adjustments*
- *Pulse Analysis*
- *Spectral Monitoring*
- *Spur Searches*

TYPICAL APPLICATIONS

- *Manufacturing ATE*
- *Avionics*
- *Broadcasting*
- *CATV*
- *Cellular Radio*
- *Design and Engineering*
- *Nuclear Physics*
- *Radio Astronomy*
- *Satellite Communications*
- *Terrestrial Microwave*
- *Two-Way Radio*

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. Tek's Standard Codes and Formats keeps commands clear, consistent, and universally understood.

You can increase programming flexibility and power with the optional MATE/CIIL language extension. It provides direct memory access (DMA) for high-speed data transmission, a requirement for MATE/CIIL compliance.

TekSPANS software lets you use the 2750 Series Spectrum Analyzers as system components, controlling them with popular instrument controllers such as the Tektronix PEP-Series, Compaq models, and other 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.

Available Tektronix automated spectrum analyzer packages provide ordering convenience. They are configured around a DOS-based PC, one of the 2750 Series of programmable Spectrum Analyzers, and Tek's General RF Applications Software Package (GRASP). The GRASP software 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.

2750 Series Spectrum Analyzer characteristics are provided in the following tables.

2750 SERIES CHARACTERISTICS

	2756P	2755AP	2754P	2753P
FREQUENCY-RELATED				
Frequency Range with Internal Mixers	10 kHz to 21 GHz	10 kHz to 21 Ghz	10 kHz to 21 GHz	100 Hz to 1.8 GHz
Frequency Range with External Mixers	10 kHz to 325 GHz	10 kHz to 325 GHz	N/A	N/A
Frequency Readout Accuracy (center or marker), ± [2% span + (CF x Ref) + (2N + 25) Hz]	± 20 kHz @ 1 GHz with 100 kHz/div span	± 21 kHz @ 1 GHz with 100 kHz/div span	± 30 kHz @ 1 GHz with 100 kHz/div span	± 20 kHz @ 1 GHz with 100 kHz/div span
Frequency Counter Accuracy, ± [(CF x Ref) + (5 + N) Hz + 1 LSD]	± 100 Hz @ 1 GHz	± 1 kHz @ 1 GHz	N/A	± 100 Hz @ 1 GHz
Delta Count Accuracy, ± [(D-F x Ref) + (10 + 2N) + 1 LSD]	± 13 Hz for 1 MHz D-F	± 14 Hz for 1 MHz D-F	N/A	± 13 Hz for 1 MHz D-F
Frequency Reference Accuracy	≤ $1x10^{-7}$ per year (aging)	≤ $1x10^{-6}$ per year (aging)	≤ $1x10^{-5}$ per year (aging)	≤ $1x10^{-7}$ per year (aging)
Frequency Stability (residual FM)	≤ 5 Hz @ 1 GHz	≤ 12 Hz @ 1 GHz	≤ 12 Hz @ 1 GHz	≤ 5 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	−105 dBc/Hz @ 1 GHz	−103 dBc/Hz @ 1 GHz	−105 dBc/Hz @ 1 GHz
Frequency Span Range (per div)	0 Hz, 10 Hz to 10 GHz	0 Hz, 100 Hz to 10 GHz	0 Hz, 200 Hz to 1 GHz	0 Hz, 10 Hz to 100 MHz
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 Range (6 dB)	10 Hz to 3 MHz	100 Hz to 3 MHz	1 kHz 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	≤ 7.5:1 except 15:1 @ 10 Hz
Video Bandwidth Range	0.3 Hz to 30 kHz	0.3 Hz to 30 kHz	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

2750 SERIES CHARACTERISTICS (cont.)				
	2756P	**2755AP**	**2754P**	**2753P**
AMPLITUDE-RELATED (cont.)				
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
Viewable Dynamic Range	90 dB (12 dB/div)	90 dB (12 dB/div)	80 dB (10 dB/div)	90 dB (12 dB/div)
Residual Response (no signal and zero RF attenuation)	–100 dBm (input terminated)	–100 dBm (input terminated)	–95 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 –40 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)	N/A
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)	–13 dBm	–13 dBm	–13 dBm	–13 dBm
Frequency Response (10 dB RF attenuation referred to cal signal)				
Band 1 (10 kHz to 1.8 MHz)	±2.5 dB	±2.5 dB	±3.0 dB	±1.5 dB (100 Hz to 1.8 GHz)
Band 2 (1.7 GHz to 5.5 GHz)	±3.5 dB	±3.5 dB	±4.0 dB	N/A
Band 3 (3.0 GHz to 7.1 GHz)	±3.5 dB	±3.5 dB	±4.0 dB	N/A
Band 4 (5.4 GHz to 18 GHz)	±4.5 dB	±4.5 dB	±5.0 dB	N/A
Band 5 (15 GHz to 21 GHz)	±6.5 dB	±6.5 dB	±7.0 dB	N/A
In-band Flatness (with 10 dB RF attenuation)				
Band 1 (10 kHz to 1.8 MHz)	±1.5 dB	±1.5 dB	±2.0 dB	±1.0 dB (100 Hz to 1.8 GHz)
Band 2 (1.7 GHz to 5.5 GHz)	±2.5 dB	±2.5 dB	±3.0 dB	N/A
Band 3 (3.0 GHz to 7.1 GHz)	±2.5 dB	±2.5 dB	±3.0 dB	N/
Band 4 (5.4 GHz to 18 GHz)	±3.5 dB	±3.5 dB	±4.0 dB	N/A
Band 5 (15 GHz to 21 GHz)	±5.0 dB	±5.0 dB	±6.0 dB	N/A
Displayed Average Noise Level (input terminated, narrowest resolution bandwidth & video filter)				
Band 1 (100 Hz)	–100 dBm (typical)	–40 dBm (typical)	N/A	–100 dBm (typical)
Band 1 (1 kHz to 10 kHz)	–110 dBm (typical)	–90 dBm (typical)	–40 dBm (typical)	–110 dBm
Band 1 (10 kHz to 100 kHz)	–110 dBm	–100 dBm	–90 dBm	–110 dBm
Band 1 (100 kHz to 1 MHz)	–120 dBm	–115 dBm	–105 dBm	–120 dBm
Band 1 (1 MHz to 1.8 GHz)	–134 dBm	–120 dBm	–110 dBm	–131 dBm
Band 2 (1.7 GHz to 5.5 GHz)	–125 dBm	–120 dBm	–108 dBm	N/A
Band 3 (3.0 GHz to 7.1 GHz)	–125 dBm	–119 dBm	–108 dBm	N/A
Band 4 (5.4 Ghz to 12/12 to 18 GHz)	–111/–107 dBm	–105/–100 dBm	–94/–89 dBm	N/A
Band 5 (15 GHz to 21 GHz)	–105 dBm	–99 dBm	–88 dBm	N/A
IF Gain Uncertainty	±2 dB max over 107 dB range	±2 dB max over 107 dB range	±2 dB max over 97 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/ ±4 dB max	±2 dB	±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	N/A
18 to 21 GHz	±3.0 dB/10 dB; ±6.0 dB max	±3.0 dB/10 dB; ±6.0 dB max	±3.0 dB/10 dB; ±6.0 dB max	N/A
Resolution Bandwidth Switching Uncertainty (ref BW=3 MHz)	±0.4 dB	±0.4 dB	±0.4 dB	±0.4 dB

2750 SERIES CHARACTERISTICS (cont.)				
	2756P	**2755AP**	**2754P**	**2753P**
TIME-RELATED				
Sweep Time Range, Digitized Display	10 msec/div to 10 sec/div	10 msec/div to 10 sec/div	10 msec/div to 10 sec/div	10 msec/div to 10 sec/div
Sweep Time Range, Real-Time Display	20 µsec/div to 10 sec/div	20 µsec/div to 10 sec/div	20 µsec/div to 10 sec/div	20 µsec/div to 10 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, and External	Free Run, Line, Video, Single, and External	Free Run, Line, Video, Single, and External	Free Run, Line, Video, Single, and External
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 2.5 GHz to 6.0 GHz 6.0 GHz to 18 GHz 18 GHz to 21 GHz	 1.3:1 max 1.7:1 max 2.3:1 max 3.5:1 max	 1.3:1 max 1.7:1 max 2.3:1 max 3.5:1 max	 1.3:1 max 1.7:1 max 2.3:1 max 3.5:1 max	 1.3:1 max N/A N/A N/A
Local Oscillator Emission Level (10 dB input attenuation)	≤ −80 dBm	≤ −80 dBm	≤ −80 dBm	≤ −80 dBm
External Mixer Input	Approx 2 GHz IF	Approx 2 GHz IF	N/A	N/A
External Reference Input	1, 2, 5, or 10 MHz	1, 2, 5, or 10 MHz	N/A	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 ± 100 Hz, −20 dBm ± 0.3 dB	100 MHz ± 1 kHz, −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	−7 to −17 dBm	−7 to −17 dBm	−7 to −17 dBm	−7 to −17 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
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 Voltage Frequency Power	 90-132/180-250 Vac 48-440 Hz 210 W max @ 115 Vac, 60 Hz	 90-132/180-250 Vac 48-440 Hz 210 W max @ 115 Vac, 60 Hz	 90-132/180-250 Vac 48-440 Hz 210 W max @ 115 Vac, 60 Hz	 90-132/180-250 Vac 48-440 Hz 210 W max @ 115 Vac, 60 Hz
Weight (carrying), Nominal	27 kg (60 lbs)	27 kg (60 lbs)	27 kg (60 lbs)	27 kg (60 lbs)
Dimensions (mm/inches)	177.8 x 431.8 x609.6mm 7 x 17 x 24 in.	177.8 x 431.8 x609.6mm 7 x 17 x 24 in.	177.8 x 431.8 x609.6mm 7 x 17 x 24 in.	177.8 x 431.8 x609.6mm 7 x 17 x 24 in.
Digital Storage	1000 pts horiz, 250 pts vertical	1000 pts horiz, 250 pts vertical	1000 pts horiz, 250 pts vertical	1000 pts horiz, 250 pts vertical
Digitizing Rate	9 µS	9 µS	9 µS	9 µS
Macro Programming	8K	8K	N/A	8K
Nonvolatile Memory	9 waveforms, 10 control settings	9 waveforms, 10 control settings	9 waveforms, 10 control settings	9 waveforms, 10 control settings

2750 SERIES CHARACTERISTICS (cont.)

	2756P	2755AP	2754P	2753P
ENVIRONMENTAL (PER MIL-T-28800C, TYPE III, CLASS 5, STYLE E)				
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 STD. 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 C0
Direct Plotter Output	Supports Tek HC100, HP 7470A	Supports Tek HC100, HP 7470A	Supports Tek HC100, HP 7470A	Supports Tek HC100, HP 7470A
Waveform Transfer Speed	165 msec/1000 pts	165 msec/1000 pts	165 msec/1000 pts	165 msec/1000 pts

ORDERING INFORMATION

2750 Series Spectrum Analyzers are warranted to be free from defects in material and workmanship for 1 year from date of shipment.

2756P Programmable Spectrum Analyzer **$43,225**
Includes: Operator's Manual; Programmer's Manual; 6-ft, 50-ohm coaxial cable, N-N (012-0114-00); 18-inch, 50-ohm 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; CRT filter set consisting of amber and gray light filters plus mesh filter, gray CRT light filter.

2755AP Programmable Spectrum Analyzer **$30,895**
Includes: same as 2756P.

2754P Programmable Spectrum Analyzer **$19,900**
Includes: same as2756P, except gray CRT light filter (no filterset).

2753P Programmable Spectrum Analyzer **$21,900**
Includes: same as 2756P.

OPTIONS

Opt. 07 – 75 Ω dBmV input and calibration in addition to the normal 50 Ω dBm input and calibration. (Not combinable with Options 21 and 22; no external mixer capability) **+$750**
Includes: 42-inch, 75 Ω BNC-BNC coax cable (012-0074-00) and BNC male to "F" female adapter (013-0126-00)

Opt. 21 (2756P, 2755AP) – High-performance 18 to 40 GHz WM490 Series Waveguide Mixer Set **+$2,785**
Includes: WM490 (18-26.5 GHz and WM490A (26.5-40 GHZ) Waveguide Mixers, Diplexer Assembly (015-0385-00), and interconnecting cable (012-0649-00).

Opt. 22 (2756P, 2755AP) – High-performance 18 to 60 GHz Waveguide Mixer Set **+$4,685**
Includes: same as Option 21 plus WM490U (40-60 GHz) Waveguide Mixer

Opt. 23 – GRASP software (S26RF00), GPIB cable. **$1,530**
The PC2A is a National Instruments GPIB interface card.

NOTE: *Options 24 through 29 and 32 through 34 are available only in the U.S. and Canada. For more information on any of these bundled software and computer packages, please contact your local Tek sales representative.*

Opt. 24 – COMPAQ Portable II (with 80286 processor, built-in monitor, 640 KB RAM, 20 MB hard drive, 360 KB diskette drive, serial/parallel interface, DOS 3.3), GRASP software, PC2A interface, and GPIB cable. **+$5,150**

Opt. 25 – COMPAQ Deskpro 286E, Model 1 (with 8026 processor, VGA color monitor, 1 MB RAM, 1.2 MB and 360 KB diskette drives, serial/parallel interface, DOS 3.3), GRASP software, PC2A interface, and GPIB cable. **+$4,825**

Opt. 26 – COMPAQ Deskpro 286E, Model 20 (with 80286 processor, VGA color monitor, 1 MB RAM, 20 MB hard drive, 1.2 MB and 360 KB diskette drives, serial/parallel interface, DOS 3.3) GRASP software, PC2A interface, and GPIB cable. **+$5,325**

Opt. 27 – Compaq SLT/286, Model 20 (with 80C286 processor, VGA backlit display, 640 KB RAM, 20 MB hard drive, 1.44 MB 3.5" diskette drive, serial/parallel interface, enhanced NiCad battery pack, desktop expansion base, DOS 3.3), GRASP software, PC2A interface, and GPIB cable **+$7,550**

Opt. 28 – COMPAQ Deskpro 386S, Model 20 (with 80386SX processor, VGA color monitor, 1 MB RAM 20 MB hard drive, 1.2 MB and 360 KB diskette drives, serial/parallel interface, DOS 3.3), GRASP software, PC2A interface, and GPIB cable. **+$5,925**

Opt. 29 – Epson FX-850 printer with parallel interface cable. **+$550**

Opt. 30 – Rackmount 19" rack width **+$250**

Opt. 31 – Rackmount 19" rack width with rear panel input/output capability **+$450**

Opt. 32 –Tektronix PEP 301 system controller with additional 360K floppy disk drive. **+$8,190**

NOTE: *The PEP 301 is an MS-DOS instrument/ system controller based on the Intel 80386 with 80387 Coprocessor. It includes an EGA display, 40M hard disk, 1.2M floppy disk drive, and complete GPIB interface with cable.*

Opt. 33 – Tektronix PEP 301 system controller with additional 360K floppy disk drive plus GRASP software. **+$8,550**

Opt. 34 – Tektronix PEP 301 system controller with additional 360K floppy disk drive plus EMI software **+$9,150**

Opt. 39 – Non-lithium (Silver) batteries for battery-backed memory. **+$50**

Opt. 41 (all except 2753P) – 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 3 dB signal bandwidth ≥ 4.5 MHz. **+$1,500**

Opt. 45 (except 2754P) – MATE/CIIL language interface. **+$4,975**

Opt. B1 – Service manual(s). **+$250**

Opt. B2 – Operator's Manual, Programmer's Manual, and Service Manual(s) set. **+$300**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 - A5 – Available. See page 488.

OPTIONAL ACCESSORIES

1405 – TV Sideband Analyzer Adapter (525/60 markers) **$5,780**

TR503 – Tracking Generator, 100 Hz to 1800 MHz **$7,080**

Microwave Comb Generator – TM500-Series compatible. Order 067-0885-00 **$2,055**

Tek HC100 – Color Plotter **$895**

CRT Visor – Order 016-0653-00 **$35**

75 Ω to 50 Ω minimum loss adapter – Order 011-0112-00 **$65**

DC blocking capacitor – N connector Order 015-0509-00 **$310**

2-meter GPIB cable – Order 012-0630-01 **$105**

GPIB cable – Order 012-0991-00 **$160**

Programmer's Reference Guide – Order 070-5567-00 **$11.50**

Service Kit – Order 006-3286-01 **$810**

WARRANTY-PLUS SERVICE OPTIONS

For more information see page 490.

Opt. M1 – 2 years service and 2 calibrations
2756P **+$2540**
2755AP **+$2,346**
2754P **+$2,366**
2753P **+$1,984**

Opt. M2 – 4 years service
2756P **+$3,769**
2755AP **+$3,510**
2754P **+$3,654**
2753P **+$3,016**

Opt. M3 – 4 years service and 4 calibrations
2756P **+$5,081**
2755AP **+$4,693**
2754P **+$4,733**
2753P **+$3,969**

Opt. M4 – 2 years service and 5 calibrations
2756P **+$3,425**
2755AP **+$3,143**
2754P **+$3,153**
2753P **+$2,624**

Opt. M5 – 4 years service and 7 calibrations
2756P **+$6,521**
2755AP **+$5,992**
2754P **+$6,015**
2753P **+$5,012**

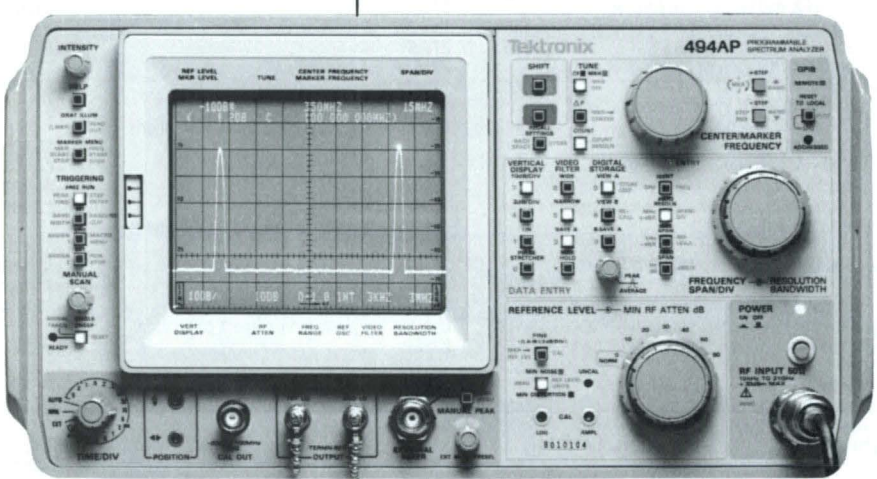
Opt. M7 – 2 calibrations
2756P **+$656**
2755AP **+$592**
2754P **+$585**
2753P **+$476**

Opt. M8 – 4 calibrations **$xxx**
2756P **+$1,312**
2755AP **+$1,183**
2754P **+$1,170**
2753P **+$952**

Opt. M9 – 2 years service
2756P **+$1,884**
2755AP **+$1,755**
2754P **+$1,782**
2753P **+$1,508**

FEATURES/BENEFITS

- ***100 Hz to 325 GHz Frequency Coverage***
- ***Continuous-Resolution Frequency Tuning Combines "Synthesized" Settability and Accuracy with Analog Feel***
- ***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 Occupied-Bandwidth and Noise-Normalization Functions***
- ***Macro Capability with Nonvolatile Memory to Simplify and Speed Up Commonly-Used Routines***
- ***Optional Switch-Selectable 50/75-ohm Impedances***
- ***Nonvolatile Memory for up to Nine Waveforms and Ten Front Panel Settings***
- ***GPIB Programmability with Tek Codes and Formats for Standardized Bus Operation***



- ***Optional MATE/CIIL Compatibility for Military Applications***
- ***Ergonomically-Designed Front Panel Controls***
- ***Direct Screen Data Plots without a Controller***
- ***Many Application-Specific Options***
- ***Ruggedized for Harsh Field Environments***

PORTABLE LABORATORY PERFORMANCE WITH AFFORDABLE PRICES

Tektronix 490 Series Spectrum Analyzers offer a broad selection of features and benefits to meet wide-ranging needs for laboratory-level frequency domain spectrum analysis. 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 range of the instruments is as follows:

10 kHz to 325 GHz: 494AP and 492BP
10 kHz to 21 GHz: 492PGM
100 Hz to 7.1 GHz: 497P
100 Hz to 1.8 GHz: 495P

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 494AP. For more routine uses, such as a microwave transmitter occupied-bandwidth measurement, the 492PGM 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 you 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 494AP. For added confidence in measurements, a built-in microwave signal counter in the 494AP with 144 dB dynamic range means you can determine the exact frequency of marked signals only 10 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.

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. Screen messages prompt you for proper keypad inputs — all "valid" keys to push are illuminated to steer you to the proper selections. The unique marker keypad allows Peak Find, Right and Left Next, Next Higher and Lower, Left and Right X dB, and Peak Find and Center operations to be executed directly from the front panel. This makes signal searches much easier.

Optional switch-selectable 50-ohm and 75-ohm impedances add versatility. For applications such as baseband and CATV, 75-ohm/dBmV greatly simplifies spectrum analysis.

The performance leader is the 494AP, which offers frequency coverage from 10 kHz to 21 GHz with its internal mixer, and to 325 GHz with external mixers such as Tek's WM490 Series, or the new WM780 Series (each WM780 Series mixer is individually calibrated). Signal sensitivity is an impressive -134 dBm. The 494AP 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 492BP covers the same frequency range as the 494AP, 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.

NEW

The 497P provides the same cost-effective performance as the 492BP, but over a frequency range of 100 Hz to 7.1 GHz.

The 492PGM'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 495P features the same functionality and high level of performance as the 494AP, but over a frequency range of 100 Hz to 1.8 GHz. It is optimized for standalone or automated operation in baseband through UHF measurements, where the ability to identify and process weak signals is critical.

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. Tek's Standard Codes and Formats keeps commands clear, consistent, and universally understood.

You can increase programming flexibility and power with the optional MATE/CIIL language extension. It provides direct memory access (DMA) for high-speed data transmission, a requirement for MATE/CIIL compliance.

TekSPANS software lets you use the 490 Series Spectrum Analyzers as system components, controlling them with popular instrument controllers such as the Tektronix PEP-Series, Compaq models, and other 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.

Available Tektronix automated spectrum analyzer packages provide ordering convenience. They are configured around a DOS-based PC, one of the 490 Series of programmable Spectrum Analyzers, and Tek's General RF Applications Software Package (GRASP). The GRASP software 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.

490 Series Spectrum Analyzer characteristics are given in the following tables.

TYPICAL MEASUREMENTS

- *Baseband Measurements*
- *Carrier Level Monitoring*
- *Carrier ON/OFF Ratios*
- *Carrier/Noise Measurements*
- *EMI/RFI Compliance*
- *EW Gathering and Analysis*
- *Frequency Counting*
- *Harmonic Distortion*
- *IF Amplifier Adjustments*
- *Modulation Adjustments*
- *Pulse Analysis*
- *Spectral Monitoring*
- *Typical Spur Searches*

TYPICAL APPLICATIONS

- *Manufacturing ATE*
- *Avionics*
- *Broadcasting*
- *CATV*
- *Cellular Radio*
- *Design and Engineering*
- *Nuclear Physics*
- *Radio Astronomy*
- *Satellite Communications*
- *Terrestrial Microwave*
- *Two-Way Radio*

490 SERIES CHARACTERISTICS

	494AP	492BP	*NEW* 492PGM	*NEW* 497P	495P
FREQUENCY-RELATED					
Frequency Range with Internal Mixers	10 kHz to 21 GHz	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	10 kHz to 325 GHz	N/A	N/A	N/A
Frequency Readout Accuracy (center or marker), ±[2% span + (CF x Ref) + (2N + 25) Hz]	±20 kHz @ 1 GHz with 100 kHz/div span	±21 kHz @ 1 GHz with 100 kHz/div span	±30 kHz @ 1 GHz with 100 kHz/div span	±21 kHz @ 1 GHz with 100 kHz/div span	±20 kHz @ 1 GHz with 100 kHz/div span
Frequency Counter Accuracy, ± [(CF x Ref) + (5 + N) Hz + 1 LSD]	±100 Hz @ 1 GHz	±1 kHz @ 1 GHz	N/A	±1 kHz @ 1 GHz	±100 Hz @ 1 GHz
Delta Count Accuracy, ± [(D-F x Ref) + (10 + 2N) + 1 LSD]	±13 Hz for 1 MHz D-F	±14 Hz for 1 MHz D-F	N/A	±14 Hz for 1 MHz D-F	±13 Hz for 1 MHz D-F
Frequency Reference Accuracy	≤ $1x10^{-7}$/yr (aging)	≤ $1x10^{-6}$/yr (aging)	≤ $1x10^{-5}$/yr (aging)	≤ $1x10^{-6}$/yr (aging)	≤ $1x10^{-7}$/yr (aging)
Frequency Stability (residual FM)	≤5 Hz @ 1 GHz	≤ 12 Hz @ 1 GHz	≤ 12 Hz @ 1 GHz	≤ 12 Hz @ 1 GHz	≤5 Hz @ 1 GHz
Frequency Stability (drift)	< 50 Hz/minute	< 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	–105 dBc/Hz @ 1 GHz	–103 dBc/Hz @ 1 GHz	–105 dBc/Hz @ 1 GHz	–105 dBc/Hz @ 1 GHz
Frequency Span Range (per div)	0 Hz, 10 Hz-10 GHz	0 Hz, 100 Hz-10 GHz	0 Hz, 200 Hz-1 GHz	0 Hz, 100 Hz-500 MHz	0 Hz, 10 Hz-100 MHz
Frequency Span Accuracy	±5%	±5%	±5%	±5%	±5%
Delta Frequency Accuracy Marker Mode	1% of span	1% of span	1% of span	1% of span	1% of span
Resolution Bandwidth (6 dB) Range	10 Hz to 3 MHz	100 Hz to 3 MHz	1 kHz to 3 MHz	100 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	≤7.5:1	≤7.5:1 except 15:1 @ 10 Hz
Video Bandwidth Range	0.3 Hz to 30 kHz	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	–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)	1 Watt (+30 dBm)
Maximum Safe Input Power, 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)	75 W Pk (1 µS pulse, 0.1% duty factor)	75 W Pk (1 µS pulse)
CRT Display Range, Log	1 to 15 dB/div	1 to 15 dB/div	1 to 15 dB/div	1 to 15 dB/div	1 to 15 dB/div

490 SERIES CHARACTERISTICS (cont.)					
	494AP	**492BP**	***NEW* 492PGM**	***NEW* 497P**	**495P**
AMPLITUDE-RELATED (cont.)					
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	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	0 to 60 dB in 10 dB steps
Viewable Dynamic Range	90 dB (12 dB/div)	90 dB (12 dB/div)	80 dB (10 dB/div)	90 dB (12 dB/div)	90 dB (12 dB/div)
Residual Response (no signal and zero RF attenuation)	–100 dBm (input terminated)	–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 –40 dBm)	–60 dBc (mixer level -40 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)	–100 dBc (mixer level –20 dBm)	N/A
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)	–70 dBc (mixer level –27 dBm)
Calibrator Accuracy	±0.3 dB	±0.3 dB	±0.3 dB	±0.3 dB	±0.3 dB
Gain Compression (1 dB)	–13 dBm	–13 dBm	–13 dBm	–13 dBm	–13 dBm
Frequency Response (10 dB RF attenuation referred to cal signal) Band 1 (10 kHz to 1.8 MHz) Band 2 (1.7 GHz to 5.5 GHz) Band 3 (3.0 GHz to 7.1 GHz) Band 4 (5.4 GHz to 18 GHz) Band 5 (15 GHz to 21 GHz)	 ±2.5 dB ±3.5 dB ±3.5 dB ±4.5 dB ±6.5 dB	 ±2.5 dB ±3.5 dB ±3.5 dB ±4.5 dB ±6.5 dB	 ±3.0 dB ±4.0 dB ±4.0 dB ±5.0 dB ±7.0 dB	 ±2.5 dB ±3.5 dB ±3.5 dB N/A N/A	 ±1.5 dB (100 Hz to 1.8 GHz) N/A N/A N/A N/A
In-band Flatness (with 10 dB RF attenuation) Band 1 (10 kHz to 1.8 MHz)	±1.5 dB	±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) Band 3 (3.0 GHz to 7.1 GHz)	±2.5 dB ±2.5 dB	±2.5 dB ±2.5 dB	±3.0 dB ±3.0 dB	±2.5 dB ±2.5 dB (5.4 GHz to 7.1 GHz)	N/A N/A
Band 4 (5.4 GHz to 18 GHz) Band 5 (15 GHz to 21 GHz)	±3.5 dB ±5.0 dB	±3.5 dB ±5.0 dB	±4.0 dB ±6.0 dB	N/A N/A	N/A N/A
Displayed Average Noise Level (input terminated, narrowest resolution bandwidth and video filter) Band 1 (100 Hz) Band 1 (1 kHz to 10 kHz) Band 1 (10 kHz to 100 kHz) Band 1 (100 kHz to 1 MHz) Band 1 (1 MHz to 1.8 GHz) Band 2 (1.7 GHz to 5.5 GHz) Band 3 (3.0 GHz to 7.1 GHz) Band 4 (5.4 to 12 GHz/12 to 18 GHz) Band 5 (15 GHz to 21 GHz)	 –100 dBm (typical) –110 dBm (typical) –110 dBm –120 dBm –134 dBm –125 dBm –125 dBm –111 –107 dBm –105 dBm	 –40 dBm (typical) –90 dBm (typical) –100 dBm –115 dBm –120 dBm –120 dBm –119 dBm –105 / –100 dBm –99 dBm	 N/A –40 dBm (typical) –90 dBm –105 dBm –110 dBm –108 dBm –108 dBm –94 / –89 dBm –88 dBm	 –40 dBm (typical) –90 dBm –100 dBm –115 dBm –120 dBm –120 dBm –119 dBm N/A N/A	 –100 dBm (typical) –110 dBm –110 dBm –120 dBm –131 dBm N/A N/A N/A N/A
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	±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/ ±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	±5% of full scale
Input Attenuator Switching Accuracy (20 dB to 60 dB settings) 0 to 1.8 GHz 1.8 to 18 GHz 18 to 21 GHz	±0.5 dB/10 dB; ±1.0 dB max ±1.5 dB/10 dB; ±3.0 dB max ±3.0 dB/10 dB; ±6.0 dB max	±0.5 dB/10 dB; ±1.0 dB max ±1.5 dB/10 dB; ±3.0 dB max ±3.0 dB/10 dB; ±6.0 dB max	±0.5 dB/10 dB; ±1.0 dB max ±1.5 dB/10 dB; ±3.0 dB max ±3.0 dB/10 dB; ±6.0 dB max	±0.5 dB/10 dB; ±1.0 dB max ±1.5 dB/10 dB; ±3.0 dB max (1.8 to 7.1 GHz) N/A	±0.5 dB/10 dB; ±1.0 dB max N/A N/A
Resolution Bandwidth Switching Uncertainty (reference BW = 3 MHz)	±0.4 dB	±0.4 dB	±0.4 dB	±0.4 dB	±0.4 dB

490 SERIES CHARACTERISTICS (cont.)					
	494AP	**492BP**	***NEW* 492PGM**	***NEW* 497P**	**495P**
TIME-RELATED					
Sweep Time Range, Digitized Display	10 msec/div to 10 sec/div	10 msce/div to 10 sec/div	10 msec/div to 10 sec/div	10 msec/div to 10 sec/div	10 msec/div to 10 sec/div
Sweep Time Range, Real-Time Display	20 µsec/div to 10 sec/div	20 µsec/div to 10 sec/div	20 µsec/div to 10 sec/div	20 µsec/div to 10 sec/div	20 µsec/div to 10 sec/div
Sweep Time Accuracy	± 5%	± 5%	± 5%	± 5%	± 5%
Marker Time Measurement Accuracy	± 10%	± 10%	± 10%	± 10%	± 10%
Delta Marker Time Measurement Accuracy	± 5%	± 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	Free Run, Line, Video, Single, Ext
EXTERNAL INPUT					
RF Input Impedance	50 ohms nominal	50 ohms nominal	50 ohms nominal	50 ohms nominal	50 ohms nominal
VSWR (10 dB input attenuation) < 2.5 GHz 2.5 GHz to 6.0 GHz 6.0 GHz to 18 GHz 18 GHz to 21 GHz	 1.3:1 max 1.7:1 max 2.3:1 max 3.5:1 max	 1.3:1 max 1.7:1 max 2.3:1 max 3.5:1 max	 1.3:1 max 1.7:1 max 2.3:1 max 3.5:1 max	 1.3:1 max 1.7:1 max N/A N/A	 1.3:1 max N/A N/A N/A
Local Oscillator Emission Level (10 dB input attenuation)	≤ – 80 dBm	≤ – 80 dBm	≤ – 80 dBm	≤ – 80 dBm	≤ – 80 dBm
External Mixer Input	Approx 2 GHz IF	Approx 2 GHz IF	N/A	N/A	N/A
External Reference Input	1, 2, 5, or 10 MHz	1, 2, 5, or 10 MHz	N/A	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	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	0 to +4 V/0 to -10 V
EXTERNAL OUTPUT					
Calibrator	100 MHz ± 10 Hz, –20 dBm ± 0.3 dB	100 MHz ± 100 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 6 GHz, +6 to +20 dBm	2 to 4 GHz, +6 to +20 dBm
2nd Local Oscillator	–7 to –17 dBm	–7 to –17 dBm	–7 to –17 dBm	–7 to–17 dBm	–7 to –17 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	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	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	+5 V nominal; TTL-compatible
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	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	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	+5 V, –15 V, +15 V; 100 mA max each
GENERAL SPECIFICATIONS					
Power Requirements Voltage Frequency Power	 90-132/180-250 Vac 48-440 Hz 210 W max @ 115 Vac, 60 Hz	 90-132/180-250 Vac 48-440 Hz 210 W max @ 115 Vac, 60 Hz	 90-132/180-250 Vac 48-440 Hz 210 W max @ 115 Vac, 60 Hz	 90-132/180-250 Vac 48-440 Hz 210 W max @ 115 Vac, 60 Hz	 90-132/180-250 Vac 48-440 Hz 210 W max @ 115 Vac, 60 Hz
Weight (carrying), Nominal	22.2 kg (48 lbs)	21.76 kg (47 lbs)	21.3 kg (46 lbs)	20.83 kg (45 lbs)	19.44 kg (42 lbs)
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	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	1000 pts horizontal, 250 pts vertical
Digitizing Rate	9 µS	9 µS	9 µS	9 µS	9 µS
Macro Programming	8K	8K	N/A	8K	8K
Nonvolatile Memory	9 waveforms, 10 control settings	9 waveforms, 10 control settings	9 waveforms, 10 control settings	9 waveforms, 10 control settings	9 waveforms, 10 control settings
HELP Mode	Yes	Yes	Yes	Yes	Yes

490 SERIES CHARACTERISTICS (cont.)

	494AP	492BP	*NEW* 492PGM	*NEW* 497P	495P
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	MIL-STD-461B
Calibration Interval	1 Year	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 C0	SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, and C0
Direct Plotter Output	Supports Tek HC100, HP 7470A	Supports Tek HC100, HP 7470A	Supports Tek HC100, HP 7470A	Supports Tek HC100, HP 7470A	Supports Tek HC100, HP 7470A
Waveform Transfer Speed	165 msec/1000 pts	165 msec/1000 pts	165 msec/1000 pts	165 msec/1000 pts	165 msec/1000 pts

ORDERING INFORMATION

WARRANTY

Tektronix 490 Series Spectrum Analyzers are warranted to be free from defects in material and workmanship for a period of one year from the date of shipment.

494AP Programmable Spectrum Analyzer **$43,255**
Includes: Operator's Manual; Programmer's Manual; 6-ft, 50-Ω coaxial cable, N-N (012-0114-00); 18-inch, 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; CRT filter set consisting of amber and gray light filters plus mesh filter (all except 492PGM); gray crt light filter (492PGM).

492BP Programmable Spectrum Analyzer **$30,895**
Includes: same as 494AP

492PGM Programmable Spectrum Analyzer **$19,900**
Includes: same as 494AP, except gray CRT filter (no filter set)

497P Programmable Spectrum Analyzer **$25,000**
Includes: same as 494AP

495P Programmable Spectrum Analyzer **$21,900**
Includes: same as 494AP

OPTION ORDERING INFORMATION

Opt. 07 – 75-Ω dBmV input and calibration in addition to the normal 50-Ω dBm input and calibration. (Not combinable with Options 21 and 22; no external mixer capability.) Includes 42-inch, 75-Ω BNC-BNC coax cable (012-0074-00) and BNC male to "F" female adapter (013-0126-00) **+$750**

Opt. 21 (494AP, 492BP) – High-performance 18 to 40 GHz WM490 Series Waveguide Mixer Set Includes WM490K (18-26.5 GHz) and WM490A (26.5-40 GHz) Waveguide Mixers, Diplexer assembly (015-0385-00), and interconnecting cable (012-0649-00) **+$2,785**

Opt. 22 (494AP, 492BP): High-performance 18 to 60 GHz WM490 Series Waveguide Mixer Set Includes: same as option 21 plus WM490U (40-60 GHz) Waveguide Mixer **+$4,685**

Opt. 23 – GRASP software (S26RF00), PC2A interface, GPIB cable. **+$1,530**

NOTE: *The PC2A is a National Instruments GPIB Interface Card.*

NOTE: *Options 24 through 29 and 32 through 34 are available only in the U.S. and Canada. For more information on any of these bundled software and computer packages, please contact your local Tek sales representative.*

Opt. 24 – Compaq Portable II (with 80286 processor, built-in monitor, 640 kb RAM, 20 Mb hard drive, 360 kb diskette drive, serial/parallel interface, DOS 3.3), GRASP software, PC2A interface, and GPIB cable. **+$5,150**

Opt. 25 – Compaq Deskpro 286E, Model 1 (with 80286 processor, VGA color monitor, 1 Mb RAM, 1.2 Mb and 360 kb diskette drives, serial/parallel interface, DOS 3.3), GRASP software, PC2A interface, and GPIB cable. **+$4,825**

Opt. 26 – Compaq Deskpro 286E, Model 201 (with 80286 processor, VGA color monitor, 1 Mb RAM, 20 Mb hard drive, 1.2 Mb and 360 kb diskette drives, serial/parallel interface, DOS 3.3), GRASP software, PC2A interface, and GPIB cable. **+$5,325**

Opt. 27 – Compaq SLT/286, Model 20 (with 80C286 processor, VGA backlit display, 640 kb RAM, 20 Mb hard drive, 1.44 Mb 3 1/2" diskette drive, serieal/parallel interface, enhanced NiCad battery pack, desktop expansion base, DOS 3.3), GRASP software, PC2A interface, and GPIB cable. **+$7,750**

Opt. 28 – Compaq Deskpro 386S, Model 20 (with 80386SX processor, VGA color monitor, 1 Mb RAM, 20 Mb hard drive, 1.2 Mb and 360 kb diskette drives, serial/parallel interface, DOS 3.3), GRASP software, PC2A interface, and GPIB cable. **+$5,925**

Opt. 29 – Epson FX-850 printer with parallel interface cable **+$550**

Opt. 32 – Tektronix PEP 301 system controller with additional 360K floppy disk drive **+$8,190**

NOTE: *The PEP 301 is an MS-DOS instrument/system controller based on the Intel 80386 with 80387 Coprocessor. It includes an EGA display, 40M hard disk, 1.2M floppy disk drive, and complete GPIB interface with cable.*

Opt. 33 – Tektronix PEP 301 system controller with additional 360K floppy disk drive plus GRASP software **+$8,550**

Opt. 34 – Tektronix PEP 301 system controller with additional 360K floppy disk drive plus EMI software **+$9,150**

Opt. 39 – Non-lithium (Silver) batteries for battery-backed memory **+$50**

Opt. 41 (all except 495P) – 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 3 dB signal bandwidth ≥ 4.5 MHz **+$1,500**

Opt. 45 (all except 492PGM): MATE/CIIL language interface **+$4,975**

Opt. B1 – Service manual(s) **+$250**

Opt. B2 – Operator's manual, Programmer's manual, and Service manual(s) set **+$300**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 - Opt. A5 – Available. See page 488. **NC**

OPTIONAL ACCESSORIES/ANCILLARIES (for all units unless otherwise noted)

1405 TV Sideband Analyzer Adapter (525/60 markers); TR503 Tracking Generator, 100 Hz to 1800 MHz; Microwave Comb Generator, TM500-Series compatible (067-0885-00, all except 495P); Tek HC100 Color Plotter; CRT Visor (016-0653-00); 75-Ω to 50-Ω minimum loss adapter (011-0112-00); DC blocking capacitor, N conn. (015-0509-00); 2-meter GPIB cable (012-0630-00); GPIB cable (012-0991-00); Programmer's Reference Guide (070-5567-00); Service Kit (006-3286-01).

WARRANTY-PLUS SERVICE PLANS

For more informationsee page 490.

Opt. M1 – 2 years service and 2 calibrations

494AP	+$2,540
492BP	+$2,346
492PGM	+$2,366
497P	+$1,995
495P	+$1,984

Opt. M2 – 4 years service

494AP	+$3,769
492BP	+$3,510
492PGM	+$3,654
497P	+$2,985
495P	+$3,016

Opt. M3 – 4 years service and 4 calibrations

494AP	+$5,081
492BP	+$4,693
492PGM	+$4,733
497P	+$3,990
495P	+$3,969

Opt. M4 – 2 years service and 5 calibrations

494AP	+$3,425
492BP	+$3,143
492PGM	+$3,153
497P	+$2,670
495P	+$2,624

Opt. M5 – 4 years service and 7 calibrations

494AP	+$6,521
492BP	+$5,992
492PGM	+$6,015
497P	+$5,095
495P	+$5,012

Opt. M7 – 2 calibrations

494AP	+$656
492BP	+$592
492PGM	+$585
497P	+$595
495P	+$476

Opt. M8 – 4 calibrations

494AP	+$1,312
492BP	+$1,183
492PGM	+$1,170
497P	+$1,005
495P	+$952

Opt. M9 – 2 years service

494AP	+$1,884
492BP	+$1,755
492PGM	+$1,782
497P	+$1,490
495P	+$1,508

WM780 AND WM490 SERIES

WAVEGUIDE MIXERS

The Tektronix WM780 Series and WM490 Series Waveguide Mixers cover a frequency range of 18 to 325 GHz with optimum flatness. Although designed specifically for use with the Tektronix 2750 and 490 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. Custom characterization for system use is also available upon request.

For the WM490 Series WGMs two microwave mixers with field-replaceable diodes cover the 18-26.5 GHz and 26.5-40 GHz ranges. When used with 2750 and 490 Series, the frequency response of both the WM490 and WM780 Series WGMs is ±2 dB. Eight millimeter-wave mixers cover the 33-220 GHz range in the standard Mil-Spec band ranges. A special tapered flange transition converts the G-band mixers to cover the 220-325 GHz J band.

All mixers are gold-plated brass, conforming to MIL-G-45204 Class I, Type 1 specifications, and will withstand harsh environments. Mixer sets come complete with a 28-inch cable, an instruction manual, and a wood storage box with foam cutout storage locations for five mixers.

NOTE:

A diplexer assembly and diplexer interconnecting cable, such as Tektronix part numbers 015-0385-00 and 012-0649-00, respectively, are required for waveguide mixers used with the 2750 and 490 Series Spectrum Analyzers. The 015-0385-00 Diplexer Assembly includes a TNC-to-SMA adaptor and an SMA semi-rigid coax.

CHARACTERISTICS

Maximum CW RF Input Level – +20 dBm (100 mW)

Maximum PULSED RF Input Level – 1 W peak with 0.001 maximum duty factor and 1 µS maximum pulse width.

LO Requirement – +7 dBm minimum, +15 dBm maximum, +10 dBm typical.

Bias Requirement – –2.0 V to +0.5 V with respect to the mixer body through a current-limiting resistor, to provide 0 mA to 20 mA of bias current.

1 dB Compression Point – +13 dBm typical (at system level). –10 dBm typical when used with the 2750 Series and 490 Series Spectrum Analyzers.

ELECTRICAL CHARACTERISTICS

(Shown for WM780 Series; characteristics and model number suffixes (K, A, Q, U, V, E, W, F, D, G, and G Opt. 1) are the same for WM490 Series.)

Frequency Range (GHz)	Tektronix Model No.	Band Desig.	Sensitivity*1 (dBm)	Frequency*2 Response (dB)	Conversion*3 Loss, Typical (dB)	Low-Pass*7 Cutoff Frequency
18-26.5	WM780K	K	–100	±2	–30	12 GHz
26.5-40	WM780A	A	–95	±2	–30	16 GHz
33-50	WM780Q	Q	–95	±2	–30	21 GHz
40-60	WM780U	U	–95	±2.5	–30	16 GHz
50-75	WM780V	V	–95 @ 50 GHz –90 @ 75 GHz typ	±3*4 typical	–30 @ 50 GHz –35 @ 75 GHz	28 GHz
60-90	WM780E	E	–95 @ 60 GHz –85 @ 90 GHz typ	±3*4 typical	–30 @ 60 GHz –40 @ 90 GHz	28 GHz
75-110	WM780W	W	–90 @ 75 GHz –80 @ 110 GHz typ	±3*4 typical	–35 @ 75 GHz –45 @ 110 GHz	30 GHz
90-140	WM780F	F	–85 @ 90 GHz –75 @ 140 GHz typ	±3*4 typical	–40 @ 90 GHz –50 @ 140 GHz	32 GHz
110-170	WM780D	D	–80 @ 110 GHz –70 @ 170 GHz typ	±3*4 typical	–45 @ 110 GHz –55 @ 170 GHz	40 GHz
140-220	WM780G	G	–75 @ 140 GHz –65 @ 220 GHz typ	±3*4 typical	–50 @ 140 GHz –60 @ 220 GHz	40 GHz
220-325	WM780G w/Opt. 1*6	J	–65 @ 220 GHz,*5 –50 @ 325 GHz typ	±3*4 typical	–60 @ 220 GHz –70 @ 325 GHz	-

*1 *Equivalent average noise level (using a 2750 Series or 490 Series Spectrum Analyzer in 1 kHz resolution bandwidth).*

*2 *Maximum amplitude variation across each waveguide mixer band (using a 2750 Series or 490 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 *Option 1 adds a tapered waveguide transition allowing WM780G/WM490G to cover this range.*

*7 *These low-pass filters are in LO/IF connector.*

ORDERING INFORMATION

WM780 WAVEGUIDE MIXERS & SETS

18-26.5 GHz – Order WM780K **$1,575**
26.5-40 GHz – Order WM780A **$1,575**
33-50 GHz – Order WM780Q **$1,825**
40-60 GHz – Order WM780U **$2,170**
50-75 GHz – Order WM780V **$2,455**
60-90 GHz – Order WM780E **$2,670**
75-110 GHz – Order WM780W **$2,740**
90-140 GHz – Order WM780F **$2,935**
110-170 GHz – Order WM780D **$4,095**
140-220 GHz – Order WM780G **$4,190**
220-325 GHz – Order WM780G Opt. 01 (adds tapered transition) **+$1,275**
18 to 40 GHz Set – Includes WM780K, WM780A. Order WM7802 *1
18 to 60 GHz Set – Includes WM780K, WM780A, WM780U. Order WM7803 *1
26.5 to 60 GHz Set – Includes WM780A, WM780U. Order WM7806. **$3,745**
26.5 to 90 GHz Set – Includes WM780A, WM780U, WM780E. Order WM7807. **$6,415**
26.5 to 140 GHz Set – Includes WM780A, WM780U, WM780E, WM780F. Order WM7808. **$9,350**
26.5 to 220 GHz Set – Includes WM780A, WM780U, WM780E, WM780F, WM780G. Order WM7809. **$13,540**
33 TO 50 GHz Set – Includes WM780Q, WM780V. Order WM78010. **$4,280**
33 to 110 GHz Set – Includes WM780Q, WM780V, WM780W. Order WM78011. **$7,020**
33 to 170 GHz Set – Includes WM780Q, WM780V, WM780W, WM780D. Order WM78012. **$11,115**

WM490 WAVEGUIDE MIXERS & SETS

18-26.5 GHz – Order WM490K **$1,375**
26.5-40 GHz – Order WM490A **$1,375**
33-50 GHz – Order WM490Q **$1,595**
40-60 GHz – Order WM490U **$1,895**
50-75 GHz – Order WM490V **$2,150**
60-90 GHz – Order WM490E **$2,335**
75-110 GHz – Order WM490W **$2,395**
90-140 GHz – Order WM490F **$2,570**
110-170 GHz – Order WM490D **$3,580**
140-220 GHz – Order WM490G **$3,665**
220-325 GHz – Order WM490G, **Opt. 01** – (adds tapered transition) **+$1,325**
18 to 40 GHz Set – Includes WM490K, WM490A. Order WM4902 **$2,810**
18 to 60 GHz Set – Includes WM4902 plus WM490U. Order WM4903 **$4,740**
18 to 90 GHz Set – Includes WM4903 plus WM490E. Order WM4904 **$7,075**
18 to 140 GHz Set – Includes WM4904 plus WM490. Order WM4905 **$9,650**

WM780 & WM490 ACCESSORIES

Diplexer Assembly – (required for 2750/490 Series). Order015-0385-00 **$290**
Diplexer to Waveguide Mixer Interconnecting Cable Assembly – (required for 2750/490 Series) 50-ohm, SMA-to-SMA. Order 012-0649-00 **$37**
Tapered Transition – Extends WM780G/WM490G frequency coverage to 220-325 GHz. Order 119-1728-00 **$1,865**
Case – Order 016-0465-01 **$30**

*1 *Contact your local sales representative*

SA-42 OPTICAL CONVERTER WM780E HARMONIC MIXER

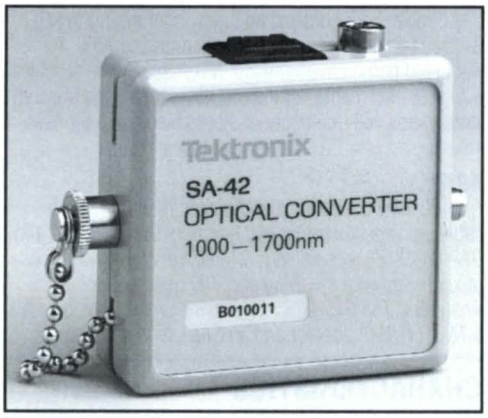
FEATURES/BENEFITS

- *Adapts Microwave Spectrum Analyzers to Measure Optical Components and Systems*
- *D.C. to 6.5 GHz (– 3dB), 15 GHz (– 25dB)*
- *35 mV into 50 Ω per 1 mW of Optical Power*
- *Ultra Low Noise*

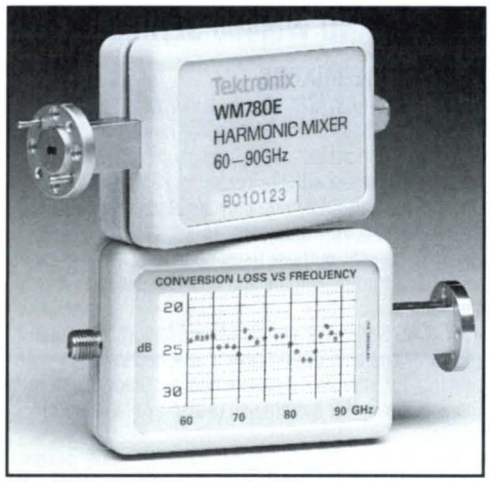
APPLICATIONS

- *Measure R.F. Spectral Content of Analog or Digital Optical Communications Systems*
- *Analyze Laser Intensity Noise*

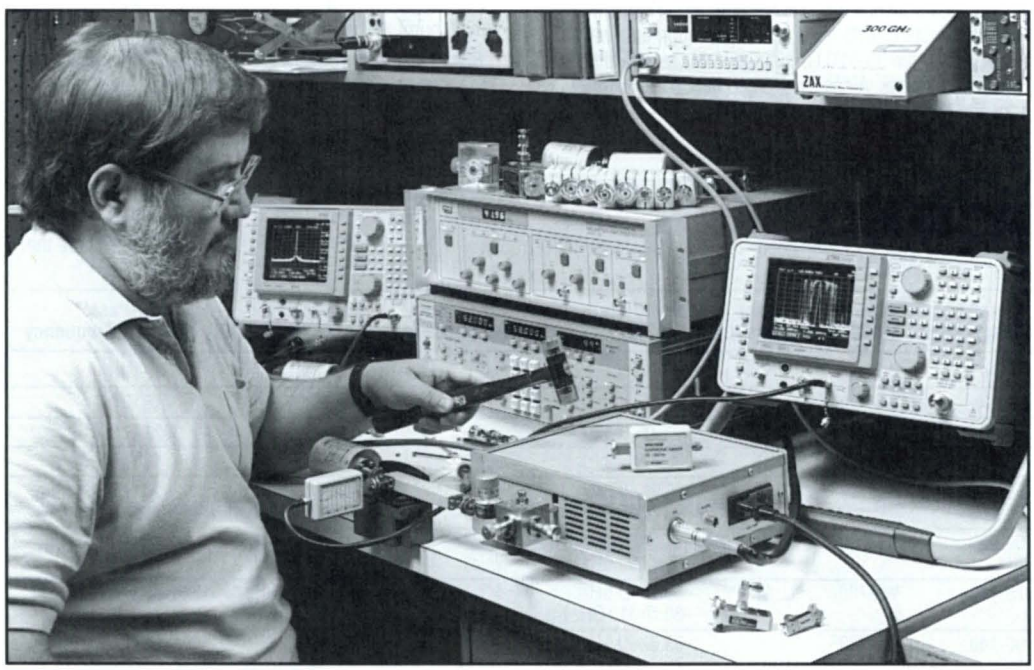
See page 372 for more information



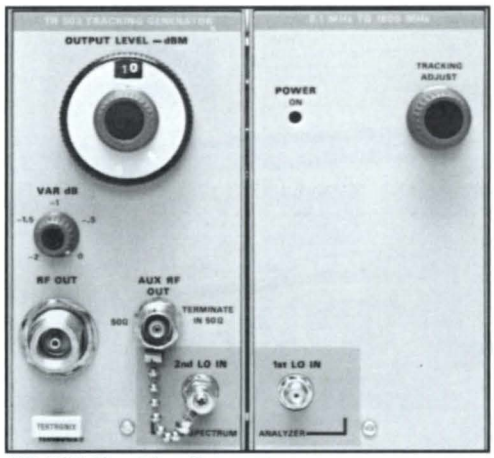
The SA-42 Optical Converter



The WM 780E Harmonic Mixer



2782 Millimeter Wave Test System



TR 503 Tracking Generator

TR 503
Tracking Generator

The TR 503 works with all 2750 and 490 Series spectrum analyzers to provide con stant level, calibrated RF sources for swept frequency tests to 1.8 GHz. The tracking generator is a two-wide unit compatible with the TM 500 and TM 5000 Modular Instrument Series.

The low residual FM of these systems enhances narrow bandwidth frequency response measurements.

When used as a CW signal source with the analyzer in a manual mode, these systems have excellent frequency stability.

The tracking generator sweep rates are controlled with the spectrum analyzer, and the output level is controlled from the tracking generator. The output frequency of the tracking generator is the same as the frequency of the analyzer at any instant of the sweep.

The TR 503 Aux RF Output may be used to drive a frequency counter package, such as the recommended DP 501, DC 509 Option 01. Frequencies up to 1.8 GHz may be measured accurately in the presence of high level adjacent signals to the sensitivity limits of the analyzer.

CHARACTERISTICS

TR 503/All 490 and 2750 Series

Frequency Range – 100 kHz 1.8 GHz

Output Level – (Max) 0 dBm ±0.5 dB

Range – 0 to 59 dB in 10 dB and 1 dB steps

Flatness – Within ±2.25 dB Max from 100 kHz to 1.8 GHz (Typically ±1.5 dB)

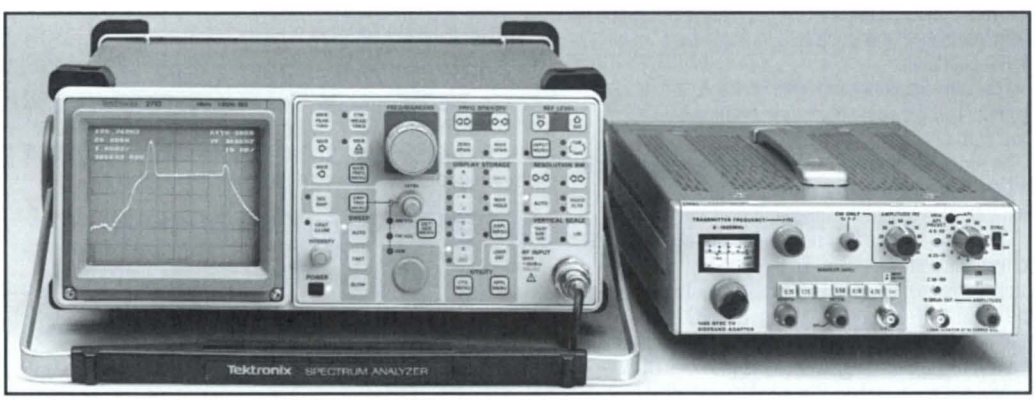
Dynamic Range – ≥ 110 dB

Residual FM – 50 Hz p-p

Output Impedance – 50 Ω Nominal, VSWR 2:1 or less to 1.8 GHz

Auxiliary Output – 0.1 V RMS into 50 Ω load 7 dBm minimum

Spurious Output – Harmonic 20 dBc Nonharmonic 40 dBc



2710 Spectrum Analyzer and the 1405 TV Sideband Adapter

1405
TV Sideband Adapter

To analyze the sideband response of a television transmitter, the 1405 Sideband Adapter is recommended for use in tandem with the Tektronix 2710, 2750 Series and 490 Series spectrum analyzers. It generates a composite video signal, which is applied as modulation to a television transmitter. The output is displayed on the spectrum analyzer and appears as a response curve, to within ±0.2 dB, of the transmitter being tested.

The 1405/Spectrum Analyzer combination will display frequency response characteristics of RF and IF circuits for transmitters with frequencies to 1 GHz. Video circuits can also be analyzed.

Correct frequencies at the TV Channel marks on the dial readout for 2750 and 490 Series spectrum analyzers are provided with Option 02, and for the 2710 Spectrum Analyzer with Option 03.

Request Tek Brochure 26W-4787-1 for complete specifications or call your local sales engineer for additional information.

TR 503
Tracking Generator

- *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 Frequecny Counter Measurement Even of Signals at the Noise Floor*

ORDERING INFORMATION

TR 503 Tracking Generator **$7,080**
Includes: Two 50 Ω coax cables (012-0649-00); N male to BNC female adapter (103-0045-00); retainer plug-in (343-0604-00); 3 mm male to BNC female adapter (015-1018-00); instruction manual (070-3526-00).

OPTIONAL ACCESSORIES

TM 503A Power Module **$395**
TM 504 Power Module **$495**
Blank Panel – Order 016-0195-03 **$35**

1405
TV Sideband Adapter

- *Facilities In-Service Testing of Transmitter*
- *Measure Transmitter Frequency Response to ± 0.2 dB*
- *Video Circuits Can be Swept*
- *For In-Service Testing, Use of External Blanking Allows Either Full Field or Single Line Operation*
- *Check Aural FM Deviation with Built-In Bessel Null Technique*
- *Flexible Marker System Will Accept Standard Crystals*

ORDERING INFORMATION

1405 TV Sideband Adapter **$5,780**
525/60 Markers
Includes: Instruction manual (070-2078-00)

OPTIONS

Opt. 01 – TV Sideband Adapter (625/50 Markers) **+$200**
Opt. 02 – Dial Readout for 490/2750 Series Spectrum Analyzers **NC**
Opt. 03 – Dial Readout for use with 2710 Spectrum Analyzer **NC**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1-A5 – Available **NC**
See page 488 for description.

RACKMOUNT CONVERSION KIT

Standard 19-inch Rack –
Order 016-0489-00 **$590**

490P/2750P SPECTRUM ANALYZER

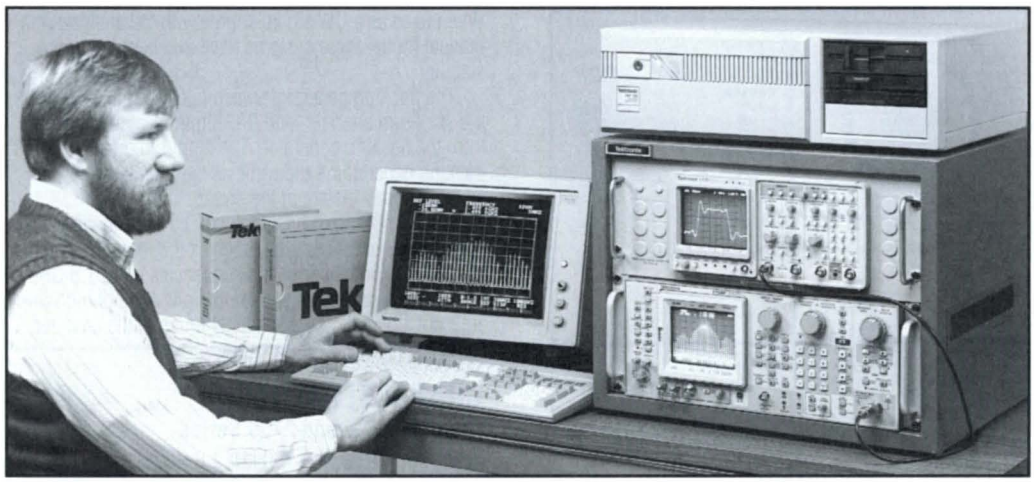
- *10 kHz to 21 GHz Frequency Coverage in Coax, to 325 GHz Using Tektronix Waveguide Mixers*
- *Built-in Frequency Counter with High Accuracy and Resolution*
- *"Smart" Markers for Faster, More Accurate Measurements*
- *Nonvolatile Memory to Save Front Panel Settings and CRT Displays*
- *Fully Programmable Over the IEEE-488 Bus*

SOFTWARE

- *Menu-Driven Operation for Easy Access to Test Routines*
- *Exclusive Swept Frequency Response Measurements*
- *A Wide Variety of Measurement and Utility Routines*
- *Color-Annotated Displays*
- *Store/Recall Waveforms and Test Results to Disk*

PEP 301 CONTROLLER

- *16 MHz Intel 80386 32-bit Microprocessor*
- *Intel 80387 Math Coprocessor*
- *2 Mbyte Zero-Wait-State RAM on Board, Expandable to 16 Mbyte*
- *40 Mbyte Hard Disk Drive (28 ms access time)*
- *Real-Time Clock/Calendar*
- *5 1/4 inch HD (1.2 Mb) Floppy Disk Drive*
- *5 1/4 inch 360 kb Floppy Disk Drive*
- *MS-DOS, GW-BASIC and GURU II Software*
- *GURU II Hardware Package (GPIB Interface and Cable)*
- *High-Resolution Graphics Card: CGA, EGA, 640x480, 800x600 modes*
- *14-inch High-Resolution, Multi-Sync Color Display Monitor*
- *101-Key, Detachable Keyboard with 10-ft Coil Cable*
- *2 Asynchronous RS-232 Serial Ports*
- *1 Centronics-Compatible Parallel Port*



The Tektronix 2756P Option 33 system is designed for benchtop ATE applications.

AUTOMATE YOUR MEASUREMENTS WITH TEK SPECTRUM ANALYZER SYSTEMS

Tektronix Spectrum Analyzer Packages are configured around the Tek PEP 301 Controllers or Compaq personal computers and Tektronix' laboratory-quality programmable spectrum analyzers. Coupling the PC to the analyzer via the IEEE-488 bus lets you take advantage of the PC's capability, as well as the power and versatility of Tektronix Spectrum Analyzers. Tektronix Spectrum Analysis Software (TekSPANS) provides applications and utility routines that are selected through easy, menu-driven operation.

Tektronix Spectrum Analyzer Packages are turnkey systems that get your application running with a minimum of effort.

To order one of these systems, use the model number and desired options of the programmable spectrum analyzer, plus one of the following package options.

Opt. 23 is intended for users who already have a PC-compatible computer. Opt. 24 through Opt. 28 are turnkey systems designed for R&D, manufacturing test, and general RF automated testing. Opt. 29 adds a graphics-compatible printer to each of these systems.

Each of the Compaq PC systems includes DOS, GRASP software, and a GPIB interface installed in it. A GPIB cable is also included.

Each of these computer options is configured and checked out prior to shipment. Thus, the customer receives a turnkey system and will encounter minimal effort in configuring and running the system.

490P/2750P/COMPAQ PC SPECTRUM ANALYZER SYSTEMS

A choice of portable or desktop Compaq PCs is available:

COMPAQ PORTABLE II, MODEL 4 (OPT. 24)

The Compaq Portable II, Model 4 with the powerful 80286 processor and designed-in flexibility is the standard in portable personal computing. It includes 640 kb of RAM, a 20 Mb hard disk drive, a 360 kb floppy disk drive, an internal display monitor, and both serial and parallel interfaces.

DESKPRO 286E, MODEL 1 (OPT. 25)

The Deskpro 286E, Model 1 has an 80286 processor running at 12 MHz. It contains both 1.2 Mb and 360 kb floppy disk drives. It also includes 1 Mb of RAM, a VGA color display, plus serial and parallel interfaces.

DESKPRO 286E, MODEL 20 (OPT.26)

The Deskpro 286E, Model 20, is configured the same as the Deskpro 286E, Model 1, but adds a 20 Mb hard disk drive.

SLT/286, MODEL 20 (OPT. 27)

This Compaq Laptop Computer features an 80C286 processor running at 12 MHz. It has a built-in VGA backlit display, a 20 Mb hard drive, a 3.5" 1.44Mb diskette drive, 640 kb of RAM, plus serial and parallel interfaces. The Compaq Desktop Expansion Base is also included.

DESKPRO 386S (OPT. 28)

The Deskpro 386S, Model 20, features the speed and processing power of Intel's 80386SX processor running at 16 MHz. It also includes 1.2 Mb and 360 kb floppy disk drives, a 20 Mb hard disk drive, 1 Mb RAM, a VGA color display, and both serial and parallel interfaces.

490P/2750P/PEP 301 SPECTRUM ANALYZER SYSTEMS

Tektronix Programmable Spectrum Analyzers are now available with the Tektronix PEP 301 Systems Controller and TekSPANS software. The PEP 301 is a high-performance, MS-DOS compatible computer based on the Intel 80386/80387.

The PEP 301 provided with these systems is configured the same as a standard PEP 301, except that a second floppy disk drive (360 Kb) has been added. Also, in lieu of the normal on-site installation provided by Tektronix, each of the computer options is configured and checked out prior to shipment.

The PEP 301 is compatible with the IBM PC/AT, but typically runs programs three to four times faster.

2782 SPECTRUM ANALYZER SYSTEMS

Tektronix offers turnkey spectrum analysis systems based on the *NEW* 2782 Spectrum Analyzer, a Compaq or Tektronix computer/controller, and 2782 Utility Software. These options have been set up as a convenience for users who want to automate their spectrum analysis measurements at a resonable cost.

In addition to the computer-based options, there is an option for adding a GPIB interface with the 2782 Utility Software, plus an option to add a printer. (The printer option is intended only as a peripheral to the computer options; the 2782 does not currently support direct output to a printer.)

The Tektronix 494AP Option 24 system is ideal for portable data logging applications.

In addition to the systems described on these pages, Tektronix can configure custom systems to meet your particular needs (e.g., systems built around other controllers such as the Tek 2402). Tektronix can also provide Technical Assistance Services for users requiring custom programming or applications assistance. Contact your Tektronix sales engineer for details.

2782
SPECTRUM ANALYZER

- *100 Hz to 33 GHz Coaxial Frequency Range; to 325 GHz with External Mixers*
- *Full-range Sweep from 0 Hz to 33 GHz*
- *100 dB Display Dynamic Range*
- *Intelligent Markers and Signal Processing*
- *Built-in Automation*
- *High–Resolution Color Display*

ORDERING INFORMATION

490P/2750P SYSTEMS

When ordering, use the model number and desired options of the 490P or 2750P Series programmable spectrum analyzer plus one of the following package options. Refer to the text for descriptions of the various Compaq models.

OPTIONS

Opt. 23 – GRASP Software (S26RF00), PC2A*1, GPIB cable **+$1,530**

Opt. 24 – GRASP, PC2A*1, GPIB cable, Compaq Portable II, Model 4 **+$5,150**

Opt. 25 – GRASP, PC2A*1, GPIB cable, Compaq Deskpro, 286E, Model 1 **+$4,825**

Opt. 26 – GRASP, PC2A*1, GPIB cable, Compaq Deskpro 286E, Model 20 **+$5,325**

Opt. 27 – GRASP, PC2A*1, GPIB cable, Compaq SLT/286, Model 20, Desktop Expansion Base **+$7,550**

Opt. 28 – GRASP, PC2A*1, GPIB cable, Compaq Deskpro 386S, Model 20 **+$5,925**

Opt. 29 – Epson FX-850 printer and parallel interface cable **+$550**

*1 *National Instruments PC2A (GPIB) interface Card.*

Opt. 32 – PEP 301 Controller **+$8,190**

Opt. 33 – PEP 301 Controller with GRASP software (S26RF00 Opt. 1A) **+$8,550**

Opt. 34 – PEP 301 Controller with EMI software (S26EM00) *2

Note: Options 24-29 and 32-34 may have limited distribution due to export controls. Contact your local Tektronix sales representative for more information.

2782 SYSTEMS

When ordering, specify the 2782 Spectrum Analyzer plus one of the following package options:

Opt. 20 – 2782 Utility Software (S26UT00), S3FG120 GPIB Interface Package (includes National PC2A Interface Card), GPIB cable **+$1,530**

Opt. 21 – Compaq Portable II, Model 4 Computer, 2782 Utility PG 228, PG 229 Software, S3FG120 GPIB Interface Package, GPIB cable **+$5,650**

Opt. 25 – PEP 301 Systems Controller, 2782 Utility Software **+$9,065**

Opt. 29 – Epson FX-850 Printer **+$550**

*2 *Contact your local sales representative*

General RF Applications – (GRASP)

- *Performs Automated Spectrum Analysis on Choice of Popular Controllers*
- *Applications Routines Are Selected Through Easy, Menu-Driven Operation*
- *Supports Tek PEP 301 and PC-Compatible Computers*
- *Supports HP Series 200 Controllers*
- *Supports Tek 4041 Controller and Multiple-Site/Remote-Site Monitoring of RF Equipment*

2782/PC UTILITY SOFTWARE

- *Performs Automated Spectrum Analysis on PC-Compatible Controllers*
- *Applications Routines are Selected Through Pop-up Menus*
- *Provides Data Logging to Color Copier, Printer, or Magnetic Media.*

Remote Site Monitoring (RSM)

- *Control Tektronix Instrumentation from Anywhere in the World*
- *Monitor RF Signals at One or More Remote Installations*
- *Immediate Call-back Warning of Failure Conditions*
- *Applications Routines Are Selected Through Pop-up Menu Structure*

EMI SOFTWARE

- *Cost-Effective Approach to Automated EMI Testing*
- *Runs on IBM or Compatible PC*
- *Easy, Menu-Driven Operation*
- *Prequalification Testing for FCC/VDE, MIL-STD-461B/462 CE03 and RE02. Test Categories Include: FCC/VDE Electric Field Radiated, VDE Magnetic Field Radiated, FCC/VDE Conducted, VDE Absorbing Clamp, RE02 Radiated (MIL-STD-461B/462), CE03 Conducted (MIL-STD-461B/462)*

MEASUREMENTS
Harmonic Distortion
Amplitude Modulation
Signal-to-Noise
Frequency Response
Cursors

WAVEFORM OPERATIONS
Acquire AView Waveform
Acquire BView Waveform
Send to instrument
Store on Disk
Load from Disk
Graph Waveform
Overlay Waveform
Redraw Waveform
Normalize Waveform

FILTER TESTS
Band-pass Filter
Low-pass Filter
High-pass Filter

SIGNAL SEARCH
Fast Search
Precise Search
Spur Search
Automatic Identify

UTILITIES
Talk/listen (Command)
Sensitivity Test
Resolution Filters Test
Calibration Assistance
Select Instrument
Select Disk

The GRASP main menu lists all submenus and their routines.

GENERAL RF APPLICATIONS SOFTWARE PACKAGE

GRASP

Tek's GRASP (General RF Applications Software Package) is the first in a family of spectrum analyzer software packages called TekSPANS. GRASP is designed to capitalize on the power of Tek's 490P and 2750P Series Spectrum Analyzers and a choice of controllers such as Tek's PEP 301/303.

This highly versatile software package offers many applications/utility routines that are selected through easy, menu-driven operation. Even a non-technical operator has immediate access to operations such as swept-frequency measurements, waveform storage and recall, and performing signal analysis, including measurements of harmonic distortion and signal-to-noise ratio.

From GRASP's main menu, a user selects among any of the submenus for Measurements, Filter Tests, Signal Search routines, Waveform Operations, and Utilities. Selections are made by pressing the appropriate function key shown on-screen.

Prompts guide the user through each measurement task. For example, users can utilize a Cursors routine which displays the instrument crt on their terminal screen. It calculates and displays both the absolute amplitude and frequency of one or two marked signals, plus the relative (delta) amplitude and frequency difference between the two markers.

Complete source code is provided, thereby simplifying the task of integrating user-written routines into GRASP.

2782/PC UTILITY SOFTWARE

Tek's 2782/PC Utility Software is designed to capitalize on the power of the Tektronix 2782 Spectrum Analyzer and PC-compatible controllers such as the Tektronix PEP 301/303.

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, 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.

All 2782 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 Adaptor) and EGA (Enhanced Graphics Adaptor) displays. Graph colors are user-selectable.

REMOTE SITE MONITORING PC SOFTWARE

RSM

RSM (Remote Site Monitoring) software, part of the TekSPANS family of spectrum analysis software, simplifies the control and data analysis of instruments at remote sites or in hostile environments. RSM merges the power and precision of Tek's 490P and 2750P 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 Tek 490P or 2750P Series Spectrum Analyzer, and perhaps to other Tek programmable instruments, via the IEEE 488 interface. This remote PC includes either the Tek GURU interface or the National Instruments PC2 or PC2A card.

MONITOR
Enter Parameters
Take a Measurement
Report Errors
Hang-Up/Monitor
Immediate Call Back
Show Parameters

WAVEFORM OPERATIONS
Acquire AView Waveform
Acquire BView Waveform
Send to instrument
Store on Disk
Load from Disk
Graph Waveform
Acquire Mode: Norm

UTILITIES
Talk/listen (Command)
Sensitivity Test
Resolution Filters Test
Calibration Assistance
Select Instrument
Select Disk
User Program

MEASUREMENTS
Harmonic Distortion
Amplitude Modulation
Signal-to-Noise

SIGNAL SEARCH
Fast Search
Precise Search
Spur Search

RSM provides a variety of routines for signal monitoring and interactive testing.

The host-site PC is located at a convenient location such as an office or lab. At the host site, the user has complete control over the operations of the remote-site PC, and all screen displays seen are identical to those currently appearing at the remote site, including full color.

From RSM's main menu, a user selects any of the submenus for Monitor, Waveform Operations, Utilities, Measurements, and Signal Search. Each of these submenus and the included routines are accessed through a pop-up menu structure.

The Monitor menu contains several routines that control the operation of the Independent Automated Signal Monitoring mode. RSM continually checks the RF input signals to the remote spectrum analyzer and compares them to a user-defined frequency/amplitude tolerance window. The user can define all monitoring parameters, verify pass/fail conditions of the current setup, initiate monitoring, and report all current and logged errors.

The Monitor menu includes a Hang-Up/Monitor routine which terminates any existing phone connection between the host and remote sites and initiates the signal monitoring routine as specified. If the signal drops out of the previously defined amplitude/frequency window, an automatic telephone call is placed to the host site to 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 Tek instruments at the remote site. This menu also allows inclusion of a user-written program to perform tasks such as automated signal surveillance of a set of communication channels.

The Measurements and Signal Search menus provide a variety of routines for performing tasks such as measuring harmonic distortion and amplitude modulation, as well as performing a precise signal search over a specified frequency range.

For maximum flexibility, the RSM system is offered in two packages: a host-site module and a remote-site module. At least one of each module is required to comprise a working remote monitoring system. Both modules are provided with source code.

EMI SOFTWARE

Tek's EMI Prequalification Software provides a low-cost, time-saving approach to EMI conducted and radiated emissions testing using Tek's 490P and 2750P Series Spectrum Analyzers. It is particularly useful to design engineers who require a compact system for measuring and documenting EMI levels during the various design stages.

When used with a Tek 490P or 2750P programmable spectrum analyzer and an IBM or compatible PC (equipped with a National Instruments PC2A IEEE-488 interface card), this software enables a cost-effective approach for integrated EMI testing. This highly versatile software package includes test routines for FCC Part 15J (A & B), VDE 0871 (A & B), and MIL-STD- 461B/462 RE02 and CE03. Routines are accessed through easy, menu-driven operation. For each class of test, routines are provided for acquiring data, graphing results (semilog plot with selected limits superimposed) and creating printouts of frequencies approaching or exceeding limits. Capability is also included for updating and displaying antenna factors.

ORDERING INFORMATION

When ordering the GRASP package, specify the choice of media from the Options list below:

S26RF00 GRASP Software Package **$875**
Includes: Software (see choice of media under Options), license agreement, and users manual.

S26UT00 2782 Utility Software *1
Includes: Software on DS/DD diskettes, license agreement, and user's manual.

S26RM00 RSM Host-Site module **$300**

S26RM01 RSM Remote-Site module **$750**
Includes: Software on DS/DD diskettes, license agreement, and user's manual.

S26EM00 EMI Prequalification Software **$1,475**
Includes: Software on DS/DD diskettes, license agreement, and user's manual.

OPTIONS

S26RF00 Software
Opt. 01 – TEK PEP 301/IBM AT high-density disk **NC**
Opt. 1A – IBM PC double-density disk **NC**
Opt. 02 – HP 200 Series 5 1/4" double-density disk **NC**
Opt. 2A – HP 200 Series 3 1/2" microdisk **NC**
Opt. 03 – Tek 4041 DC-100 Tape **NC**
Opt. 10 – GPIB interface for PC **+$495**

S26UT00 Software
Opt. 9 – Source Code *1
Opt. 10 – GPIB interface for PC *1

S26RM01 Software
Opt. 10 – GPIB interface for PC **+$495**

S26EM00 Software
Opt. 09 – Source Code **+$1,000**
Opt. 10 – GPIB Interface for PC **+$495**

*1 *Contact your local sales representative.*

2710 *ECONOMY PORTABLE SPECTRUM ANALYZER*

BENEFITS

- *High Confidence in Frequency Measurements*
- *Easily See Weak Signals*
- *Ease of Use Enhanced by Automated Calibration (Normalization), Dedicated Function Keys, Microprocessor Control, Pushbutton Measurements*
- *Short Waiting Time Before Making Measurements*
- *High Portability*
- *Enhanced Measurement Comparisons*
- *Measurement Convenience with Full Marker/Delta Marker Capability*
- *See Modulation-Related Phenomena and Low Level Beats*

FEATURES

- *10 kHz to 1800 MHz Frequency Range*
- *1 x 10^{-5} or Optional 5 x 10^{-7} Frequency Accuracy*
- *1 Hz Frequency Resolution at Wide Span/Div Using Optional Internal Frequency Counter*
- *Up to –127 dBm Sensitivity, or –139 dBm Sensitivity Using Built-in Preamp*
- *9.5 Kg (21 lb.) Weight, Compact Size*
- *Fast Warmup, High Stability*
- *Full Display Area Usable With 80 dB Display Dynamic Range*
- *Four-Trace Digital Storage*
- *Direct-Reading 50 ohm and 75 ohm Operation Modes*
- *True Analog Display*
- *Signal Identification and Qualitative Analysis with Aural and Optional Video Demod*

CHARACTERISTICS

The following specifications and features apply after a 15-minute warmup period unless otherwise noted.

FREQUENCY RELATED

Frequency Range – 10 kHz to 1800 MHz.

Center Frequency Accuracy – $1x10^{-5} \pm 5$ kHz; Option 01: $5x10^{-7} \pm 700$ Hz.

Frequency Counter Accuracy (Opt. 02) – $1x10^{-5} \pm 10$ Hz, 0°C to 50°C; 3 (10^{-6}) ±10 Hz/year; Opt. 01: $5x10^{-7} \pm 10$ Hz, 0°C to 50°C, at $2x10^{-6}$ ±10 Hz/year.

Dot Marker Frequency Accuracy – CF Accuracy plus 3% of span.

Frequency Counter Readout Resolution (Opt. 02) – 1 Hz.

Typical Long-Term Drift – 10 ppm/yr; Opt. 01: 2 ppm/yr.

Short-Term Drift – 20 kHz maximum drift between correction cycles. Typical short-term drift between correction cycles is within 5 kHz. Opt. 01: ≤ 400 Hz maximum drift between correction cycles.

Residual FM – ±2 kHz p-p/20 µsec; Opt. 01: ±100 Hz p-p/20 µsec at span/div ≤ 20 kHz/div; ±2 kHz p-p/20 µsec at span/div > 20 kHz/div.

Resolution Bandwidth – (–6 dB) 5 MHz, 300 kHz, 30 kHz, 3 kHz; Option 01: add 300 Hz.

Resolution Bandwidth Shape Factor – ≤ 7:1

Noise Sidebands – >–70 dBc at 30xRBW (Resolution Bandwidth).

Video Filter – Approx. 1/100 (Auto) of RBW. Manual Selection: 3 Hz to 300 kHz in 1–3 sequence.

Freq. Span/Div Range – 180 MHz to 10 kHz; Opt. 01: add 1,2,5 kHz/div. Selected in 1,2,5 sequence or 2 significant digits via menu. Max span, zero span keys.

Span Accuracy – ±3% measured over the center eight divisions.

AMPLITUDE RELATED

Flatness – ±1.5 dB measured with 10 dB RF attenuation (preamp off).

Vertical Display Modes – 10, 5, 1 dB/div, Linear.

Measurement Range – –129 (preamp on) to +20 dBm; Option 01: –139 (preamp on) to +20 dBm.

Display Dynamic Range – 80 dB max.

Reference Level Range – LOG Mode: –70 to + 20 dBm (–23 to + 67 dBmV). LINEAR Mode: 8.8 µV/div to 280 mV/div.

Reference Level Steps – LOG Mode: 1 dB or 10 dB. LINEAR Mode: 1,2,5 sequence: 10 µV/div to 280 mV/div.

Mixer Input Level – Automatically controlled by instrument for on-screen signals. Level selectable between –20 to –50 dBm.

Display Amplitude Accuracy – 10 dB/div: ±1.0 dB/ 10 dB to max. cum. error of ±2 dB over 80 dB range. 5 dB/div: ±1.0 dB/ 5 dB to max. cum. error of ±2.0 dB over 40 dB range. 1 dB/div: 1 dB max. error over 8 dB range. LINEAR Mode: ±5% of full scale.

RF Attenuation Range – 0 - 50 dB, 2 dB steps.

Maximum Sensitivity – –117 dBm at 3 kHz RBW. –129 dBm at 3 kHz RBW w/preamp. Opt. 01: –127 dBm at 300 Hz RBW, –139 at 300 Hz RBW w/preamp.

SPURIOUS RESPONSE(WITH PREAMP OFF)

Residual Spurious Response – ≤–100 dBm referenced to input of 1st mixer.

3rd Order IM Distortion – ≤–70 dBc, from any two on-screen signals within any frequency span at –20 dBm input level, 10 dB attenuation.

2nd Harmonic Distortion – ≥ – 66 dBc with – 30 dBm input and 0 dB attenuation.

INPUT RELATED

LO Emission – ≤–70 dBm with 0 dB RF attenuation.

RF Input – Type N connector, 50Ω

VSWR with 10 dB or more RF attenuation – 1.5:1 max.

Maximum Safe Input – +20 dBm (0.1 W) continuous peak with 0 dB RF attenuation; 100 V dc (initially applied with full attenuation).

1 dB Compression Point – ≥ –15 dBm with 0 dB RF attenuation.

SWEEP RELATED

Sweep Times – 1 µsec to 2 sec/div in 1,2,5 seq. (7 decade range); AUTO SWEEP mode; MANUAL SWEEP select.

Sweep Time Accuracy – ±10% over the center 8 divisions.

Trigger – Free run, internal, external, line, TV field, TV line, single sweep, manual scan.

Trigger Amplitude – Internal: One division or more of signal. External: 1.0 V peak, minimum; DC coupled (15 Hz to 1 MHz).

OTHER INPUTS/OUTPUTS

External Trigger – BNC connector, 10 kΩ impedance, DC coupled 0.1 µs minimum pulse width. 35 V max.

External Video Input – DC coupled, 0-100 kHz, 0-1.6 V (200 mV/div) signal input for vertical deflection of CRT beam.

Sweep Gate Out – TTL level signal that is HI while CRT beam sweeps.

Sweep Output – +1.3 to –1.3 V, negative going ramp, proportional to the horizontal sweep. Source impedance ≤50 Ω, load impedance ≥10 Ω.

Video Output – 0 to +1.6 V of video signal, proportional to vertical display amplitude. 0 V is top of screen. 1 k Ω impedance.

ENVIRONMENTAL

Temperature – Operating: 0°C to +50° C (MIL-T 28800C). Nonoperating: –55°C to +75° C.

Humidity – Nonoperating: Five cycles (120 hours) per MIL-T-28800C, class 5.

Vibration – Meets MIL-T-28800C Method 514 Procedure X (modified).

Shock – Operating and Nonoperating: Three guillotine-type shocks of 30 g, one-half sine, 11 ms duration each direction along each major axis; total of 18 shocks.

Radiated and Conducted Emissions – Meets FCC Part 15, sub-part J, class A and VDE 0871, class B.

Radiated and Conducted Susceptibility – Meets Part 7 MIL-STD 461B.

GENERAL CHARACTERISTICS

Power Requirements – 90 W MAX (1.2 A) at 115 V, 60 Hz. Operates 48 Hz to 440 Hz, 90 to 250 V ac. Battery power option available.

Weight – 9.5 kg (<21 lb.) nominal for basic configuration.

Dimensions (H, W, D) with feet, handle and front panel cover – 137x361x445 mm (5.4x14.2x17.5 inches).

OTHER CAPABILITIES

Markers – Single marker/delta markers; next right, next left peaks; next lower, next higher peaks; (highest) peak find; marker to CF; select start/stop frequencies; transpose Δ markers.

Nonvolatile memory – Up to 18 displays and/or 8 front panel setups may be saved. Lithium battery backup.

Digital Storage Display – Selectable acquisition modes of positive peak only, positive/negative peak. SAVE A, B, C and active D trace; up to four traces on screen; MAX HOLD A, B; MIN HOLD A, B or C; B, C minus A; WATERFALL display mode; ensemble averaging; (min., max., mean, min/max); digital storage off provides analog display.

Ensemble Averaging – Provides weighted averaging of display resulting in reduction of random noise and impulse signals without sweep speed changes.

Direct Entry of Control Parameters – Frequency, span/div, reference level, RBW, video filter, vert. scale, sweep rate.

Measurement Modes – Noise, Carrier-to-Noise, Bandwidth (user definable "dB down" points).

Internal Freq. Counter (signal counter) – Opt. 02.

Internal Preamplifier – Preamp may be switched in/out of circuit (degrades flatness below 10 MHz and above 600 MHz, provides approx. 12 dB sensitivity improvement) with zero RF attenuation.

Alternate Reference Level Units – dBm, dBmV, dBV, dBm, dBμW, dBμV/m.

User-definable Power-on Status – Instrument powers up to user-definable state or supplied default settings.

Constant Rate Tuning – Same on-screen tuning sensitivity regardless of span/div selection.

Center Measure – Signal nearest CF (from any screen location) is centered with frequency and peak amplitude automatically read out (not a marker mode). The centered signal will be counted if the Opt. 02 Frequency Counter is installed.

Signal Track – Drifting signal is kept at display center with correct frequency and peak amplitude displayed.

Graticule Illumination – Contrast enhancement for CRT photography.

Centronics Interface – Opt. 09. Will support Epson FX Series Printers and compatibles and Tek HC100 Printer/Plotter.

Rackmount Option – Opt. 30. Converts unit to a rack mounted installation. Five-inch rack height, 19-inch rack width.

Portable-to-Rack Adapter – Opt. 34. Provides rackmounting of instrument in standard enclosure with handle. Offers immediate instrument portability when needed. Seven-inch rack height, 19-inch rack width.

AM/FM Detectors – Built-in amplifier, speaker and headphone jack for aural demodulation.

Video Monitor Mode – Opt. 10. Allows direct viewing of television picture on analyzer screen. Functions in NTSC, PAL and SECAM systems. Includes selectable horizontal line trigger.

2704 INVERTER/2705 BATTERY PACK

The 2704 Inverter and 2705 Battery Pack can provide a minimum of one hour continuous operation for the 2710 in locations where ac power is not available. These units mount directly on the 2710 to form a portable package.

They can also be used for other remote applications requiring 115V, 60 Hz power. Maximum continuous output power is 125 watts.

Several 2705s can be used to provide an uninterruptible power source for the 2710 or other equipment. The 2704 includes a battery charger, and provides an auxiliary 18 volt output. The 2704 also accepts 12 volt input from other sources, such as car batteries. These units are described in more detail in Tektronix Specification/Ordering Information Sheet 26W-7061.

TYPICAL APPLICATIONS

- *Cable Television*
- *VTR/VCR Maintenance*
- *Television and Audio Broadcasting*
- *Broadband Local Area Networks*
- *Education*
- *Manufacturing Test*
- *EMI/RFI*
- *Land Mobile/Two-Way Communication*
- *Avionics*
- *Cellular Radio*

ORDERING INFORMATION

2710 Spectrum Analyzer. **$8,250**
Includes: Power cord (U.S. 115 V/60 Hz) (161-0104-00); Operator's manual (070-6022-02); Front cover (200-2520-00); and 75/50Ω min-loss pad (131-4199-00).

OPTIONS

Opt. 01 – 300 Hz resolution bandwidth/phaselock stabilization/5 x 10^{-7} ±700 Hz frequency accuracy **+$1,200**
Opt. 02 – Internal frequency counter with selectable 1 kHz/1 Hz readout resolution **+$600**
Opt. 06 – 1106 Battery Pack, 1107 Inverter, Battery operation, nicad **+$2,720**
Opt. 07 – 2704 Inverter and 2705 Battery Pack, gell cell lead acid **+$1,290**
Includes: Power cord (U.S. 115 V, 60 Hz), Operator's Manual, 2710 Mounting Plate.
Opt. 09 – Centronics interface **+$450**
Opt. 10 – Video monitor mode **+$620**
Opt. 14 – Adds 1 kHz, 10 kHz, 100 kHz and 1 MHz RBW filters **+$570**
Opt. 15 – Tek 1405 TV Sideband Analyzer Interface **+$250**
Opt. 30 – Rackmount for 19-inch rack width, 5- inch height **+$150**
Opt. 33 – Travel Line Package **+$95**
Includes: Accessory pouch; carrying strap; smoke-gray CRT filter; vinyl rain cover
Opt. 34 – Portable to Rack mount adaptor for 19-inch rack width, 7 inch height **+$425**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 - A5 – Available **NC**
See page 488 for description.

WARRANTY-PLUS **SERVICE PLANS**

Opt. M1 – Available **+$710**
Opt. M2 – Available **+$1,190**
Opt. M3 – Available **+$1,430**

OPTIONAL ACCESSORIES

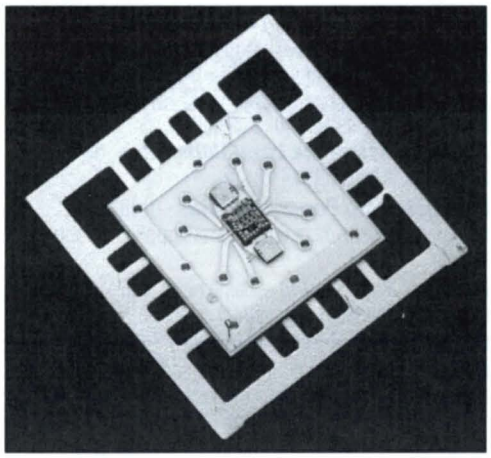
2704 – Inverter **$995**
Includes: Power cord (U.S. 115 V, 60 Hz), Operator's Manual, 2710 Mounting Plate.
2705 – Battery Pack **$295**
Front Panel Cover – 200-2520-00 **$6.00**
Accessory Pouch – Mounts on top. Order 016-0677-02 **$45**
Viewing Hoods –
(Collapsible) Order 016-0592-00 **$15**
(Binocular) Order 016-0566-00 **$21**
(Polarized) Order 016-0180-00 **$60**
Carrying Strap – 346-0199-00 **$19.25**
Shipping Case – 016-0792-02 **$375**

TPAK SERIES

- *Low Cost MMIC Packaging*
- *Optimum Performance to 18 GHz*
- *Thin Film Ceramic Processing Technology*
- *Precision Brazing Achieves Hermeticity*
- *Multiple RF Signal Lines From Motherboard to Chip*
- *$3x10^{-8}$arm/cc-sec Hermeticity*
- *Direct-Contact Heatsinking*

ORDERING INFORMATION

To contact the TEKPAC™ product line:
Microwave Technology Organization
Tektronix, Inc.
P.O. Box 500, 58-MTO
Beaverton, OR 97077
(503) 627-1299



Typical Application used in Micro-S product line, TriQuint Semiconductor, Inc.

The TPAK Series MMIC packages represent the leading edge of hermetic surface-mount MMIC packaging technology, with optional performance to 18 GHz. The TPAK Series MMIC packages not only offer a MMIC package but a total integrated packaging solution.

The signal path transition is the unique design feature that characterizes the package's electrical perfromance. This transition design has been awarded a U.S. patent.

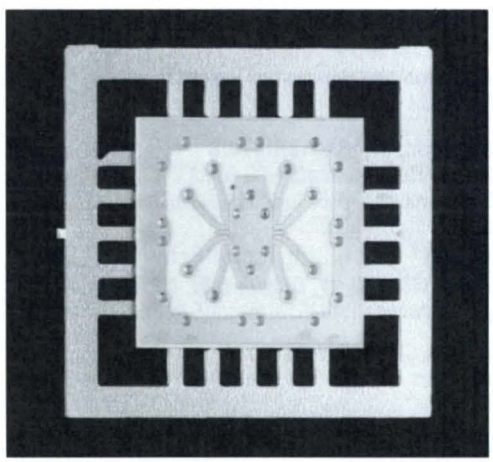
CHARACTERISTICS

	0 – 12 GHz	12 – 18 GHz
VSWR*1	1.2:1 max	2.0:1 max
Insertion loss*1	0.5 dB max	1 dB max
Isolation*2	40 dB min	30 dB min

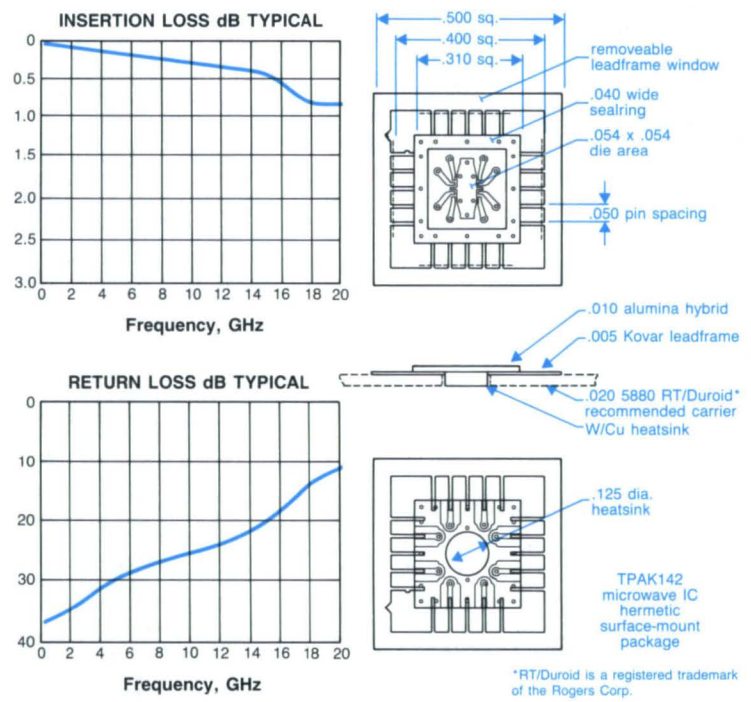
**1 Measured for one signal line from leadframe to die attach pad.*

**2 Measured for two opposite signal lines with all unconnected lines grounded.*

Environmentally Tested – per MIL-STD-883.



Front View (TPAK142)



ORDERING INFORMATION

Product	Frequency Performance	Case Size (inches)	Motherboard Recommended	Diepad Area (inches)	Prices
TPAK142	DC-18 GHz	0.31 x 0.31	0.020 5880 RT/Duroid	0.054 x 0.054	**$41**
TPAK145	DC-18 GHz	0.31 x 0.31	0.020 5880 RT/Duroid	0.096 x 0.096	**$41**

Options	Prices
Opt. 01 – Lid and preform included	**+$4**
Opt. 05 – Leadframe window removed	**NC**
Opt. 40 – Heatsink removed	**–$5**

TKIT14E – Evaluation Kit for the TPAK Series **$499**

Includes production test fixtures, test pattern calibration standards, connectors, lids, preforms, Duroid boards, TPAX 142 packages, de-embedding board and fixture.

TEKPAC ™: HERMETIC MMIC PACKAGE PRODUCTS

TPAX SERIES

TPAX142

- *Optimum Performance to 12 GHZ*
- *Multi-layer Ceramic Processing Technology*
- *Filled Metal VIAS Achieve Hermeticity*
- *Low Cost MMIC Package*
- *Multiple RF Signal Lines From Motherboard to Chip*
- *1 x 10^{-8} atm/cc-sec Hermeticity*
- *Direct Contact Heartsinking*

The TPAX Series MMIC package represents a new benchmark for low cost surface-mountable and hermetically sealable microelectronic packages designed for Monolithic Microwave Integrated Circuits (MMICs).

The TPAX Series is a first in a series of low cost, 12 GHz performance MMIC packages. Multi-layer ceramic technology and well established fabrication techniques provide a cost-effective solution without sacrificing performance.

CHARACTERISTICS

	0 – 6 GHz	6 – 12 GHz
VSWR*1	1.2:1 max	1.5:1 max
Insertion loss*1	0.5 dB max	1 dB max
Isolation*2	40 dB min	30 dB min

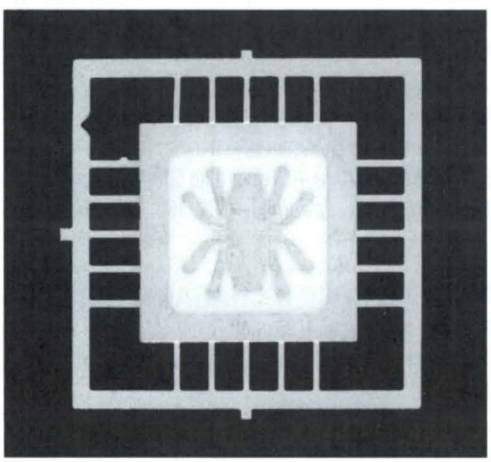
*1 *Measured for one signal line from leadframe to die attach pad.*

*2 *Measured for two opposite signal lines with all unconnected lines grounded.*

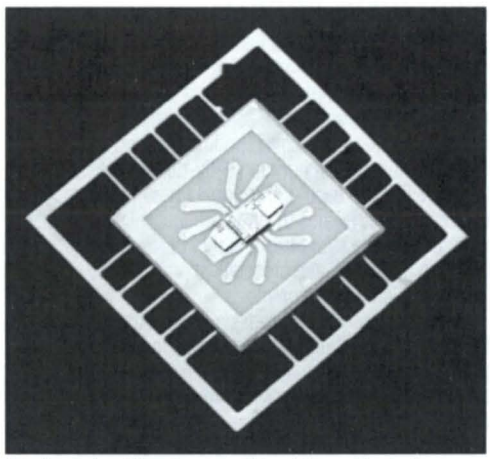
Environmentally Tested – per MIL-STD-883.

OTHER SERVICES AVAILABLE

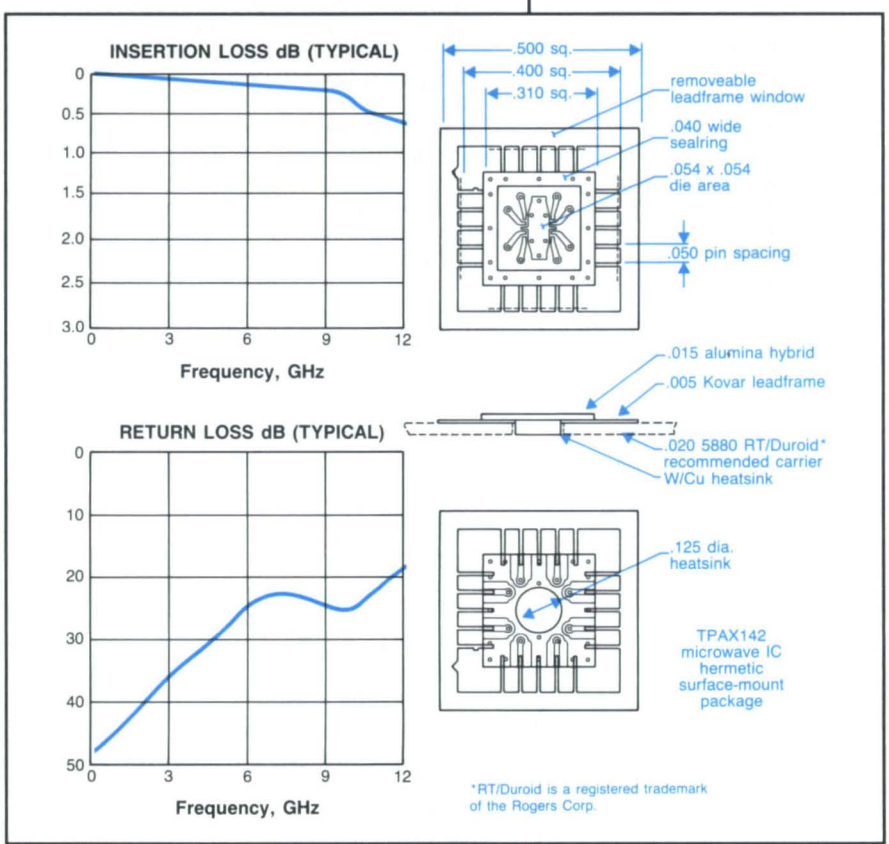
- Product Technology/Licensing
- Custom Design/Applications



Front View (TPAX142)



Typical Application used in Micro-S product line, TriQuint Semiconductor, Inc.



ORDERING INFORMATION

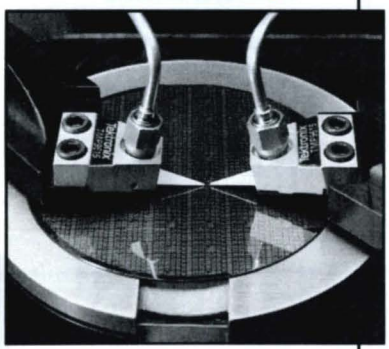
Tektronix Product	Frequency Performance	Case Size (inches)	Motherboard Recommended	Diepad Area (inches)	Prices	TEKPAC Options	Prices
TPAX142	DC-12 GHz	0.31 x 0.31	0.020 5880 RT/Duroid	0.054 x 0.054	**$23**	**Opt. 01** – Lid and preform set **Opt. 05** – Leadframe window removed	**+$4** **NC**
TKIT14E – Evaluation Kit for the TPAX 142 Series					**$499**		

Includes production test fixtures, test pattern MMIC package calibration standards, connectors, lids, preforms, Duroid boards, TPAX 142 packages, de-embedding board and fixture.

NEW

TMP9000 *MICROWAVE PROBES*

TYPICAL APPLICATIONS
- *S-Parameter Measurements*
- *Noise Measurements*
- *TDR Measurements*
- *Characterization of Packages*



BENEFITS
- *Superior Performance from DC to 26.5 and 40 GHz*
- *Low Insertion Loss*
- *A Low-Cost Microwave Testing Tool*
- *Compatible with Industry Standard Microwave Probe Stations*
- *High Confidence in Making Accurate and Repeatable Measurements*
- *Rugged Design Ideal for Production Environments*
- *Improved Reliability*
- *Versatility in Configuring Test System*

FEATURES
- *Capability to Probe Hybrid Microwave Circuits, MMICs or Microwave Packages*
- *Ground-Signal-Ground, Signal-Ground, and Ground-Signal Footprints*
- *Available Pitch Increments of 100, 125, 150, 175, 200, 250, and 300 Microns*
- *Input to Probe through Female K Connector*
- *Optional OS-50 Female Connector Available*

MICROWAVE PROBES

The Tektronix TMP9000 Family of Microwave Probes are a key element in the microwave probing system. There are no needles for contacting the DUT pads as before with traditional probes and probe cards. Instead, each probe provides a 50-ohm transmission line between coaxial connector and photolithographically-defined contacts at the probe tips, for each of the signal lines. The replacement of contact needles by photolithographically-defined transmission line structures greatly improves the reflection, radiation, and crosstalk characteristics of probes at microwave frequencies.

TMP9000 Microwave Probes are precision adapters that convert coaxial input into ground-signal-ground, ground-signal, and signal-ground co-planar waveguide footprints that interface to hybrid microwave circuits, MMICs, or microwave packages. The superior performance of the Tektronix microwave probe is achieved by using photolithography techniques to define the tapered co-planar waveguide and contact bumps.

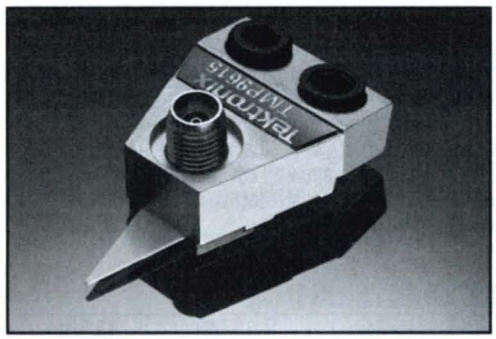
Tektronix TMP9000 Family of Microwave Probes are distributed into three Performance Series groups:
- The *TMP9200 Series* is a DC to 26.5 GHz probe with a Signal-Ground footprint
- The *TMP9300 Series* is a DC to 26.5 GHz probe with a Ground-Signal footprint
- The *TMP9600 Series* is a DC to 40 GHz probe with a Ground-Signal-Ground footprint.

Tektronix microwave probes are compatible with industry-standard microwave probe stations, including those manufactured by Alessi, Cascade Microtech, Design Techniques, Electroglass, Karl Suss, Micromanipulator, Rucker & Kolls, Signatone, and Wentworth Laboratories.

Probes are available in discrete pitch increments of 100, 125, 150, 175, 200, 250, and 300 microns. Probe input is through a female K connector. A female OS-50 connector is available as an option.

TMP9200 SERIES CHARACTERISTICS

Frequency Range – DC to 26.5 GHz
Footprint – Signal-Ground
Insertion Loss –
< 0.7 dB to 18 GHz (typical)
< 1.5 dB to 26 GHz (typical)
Maximum 2.0 dB at 26.5 GHz
Return Loss –
> 20 dB to 4 GHz
> 10 dB to 26.5 GHz
Crosstalk (measured with two probes 4 mils apart contacting a bare alumina substrate) – < 30 dB at 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 – 3 to 5 mils
Estimated Lifetime – Greater than 500,000 cycles
Available Pitch (spacing) – 100, 150, 200, 250, and 300 microns



TMP9300 SERIES CHARACTERISTICS

Frequency Range – DC to 26.5 GHz
Footprint – Ground-Signal
Insertion Loss –
< 0.7 dB to 18 GHz (typical)
< 1.5 dB to 26 GHz (typical)
Maximum 2.0 dB at 26.5 GHz
Return Loss –
> 20 dB to 4 GHz
> 10 dB to 26.5 GHz
Crosstalk (measured with two probes 4 mils apart contacting a bare alumina substrate) – < 30 dB at 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 – 3 to 5 mils
Estimated Lifetime – Greater than 500,000 cycles
Available Pitch (spacing) – 100, 150, 200, 250, and 300 microns

TMP9600 SERIES CHARACTERISTICS

Frequency Range – DC to 40 GHz
Footprint – Ground-Signal-Ground
Insertion Loss –
< 0.7 dB to 18 GHz (typical)
< 1.5 dB to 26 GHz (typical)
< 2.0 dB to 40 GHz (typical)
Maximum 2.5 dB at 40 GHz
Return Loss –
> 20 dB to 4 GHz
> 10 dB to 40 GHz
Crosstalk – < 30 dB at 40 GHz (measured with two probes 4 mils apart contacting a bare alumina substrate)
Planarity – 1:100
Temperature Range – –20°C to +125°C
Nominal Impedance – 50 Ω
Maximum Overtravel – 15 mils (0.38 mm)
Recommended Overtravel – 3 to 5 mils
Estimated Lifetime – Greater than 500,000 cycles
Available Pitch (spacing) – 100, 125, 150, 175, 200, and 250 microns

CALIBRATION SUBSTRATES

The ability to calibrate microwave measurements at the probe tip opens a new level of accuracy in microwave device characterization. Tektronix' Calibration Substrates bring precision measurements to your test system. *CAL93* for the TMP9200 Series and TMP9300 Series probes, and *CAL96* for the TMP9600 Series probes facilitate precise one-port and two-port measurements with a network analyzer calibrated at the probe tip.

CAL96 CHARACTERISTICS

Footprint – Ground-Signal-Ground

Sapphire Substrate –

All elements labeled and easy to locate

Hard-plated gold pads

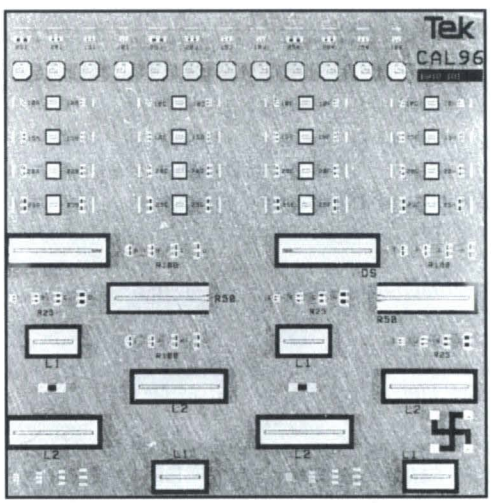
Traditional Open-Short-Load-Thru –

Short, Load, and Thru located for easy 2-port calibration, Standard and orthogonal elements, 8 durable loads in standard orientation for each pitch, 3 orthogonal loads for each pitch, 25 dB return loss (typical) for lumped loads, Open-short characteristics, 1 psec thru.

Line-Reflection-Line – 10 GHz to 40 GHz.

Verification Elements –

Open stub, 25-Ω resistor, and 100-Ω resistor; dc values for each load and verification resistor.



CAL93 CHARACTERISTICS

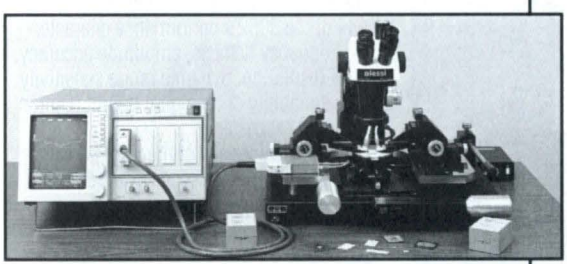
Footprints – Ground-Signal and Signal-Ground

All other CAL 93 characteristics resemble those of the CAL 96 Characteristics, except for the frequency range of the CAL 93 Calibration Substrate being DC - 26.5 GHz.

MICROWAVE PROBE STATION AND TEST SYSTEMS

With the introduction of the TMP9000 Microwave probes and 11800 high frequency oscilloscope, Tektronix initiates a new era of cost effective high frequency TDR and device characterization test systems.

The MTS1190 Test Systems consist of either the 11801 or 11802 high frequency oscilloscope complete with a 20 GHz SD24 sampling head, an REL-4300 microwave probe station complete with two planarizable micropositioners, two planarizable probe arms, and a set of four TMP9000 microwave probes.



ORDERING INFORMATION

MICROWAVE PROBES

TMP9200 SERIES
(DC-26.5 GHz Frequency Range, Signal-Ground Footprint)

TMP9210 – 100 micron pitch	**$979**
TMP9215 – 150 micron pitch	**$979**
TMP9220 – 200 micron pitch	**$979**
TMP9225 – 250 micron pitch	**$979**
TMP9230 – 300 micron pitch	**$979**

TMP9300 SERIES
(DC-26.5 GHz Frequency Range, Ground-Signal Footprint)

TMP9310 – 100 micron pitch	**$979**
TMP9315 – 150 micron pitch	**$979**
TMP9320 – 200 micron pitch	**$979**
TMP9325 – 250 micron pitch	**$979**
TMP9330 – 300 micron pitch	**$979**

TMP9600 SERIES
(DC-40 GHz Frequency Range, Ground-Signal-Ground Footprint)

TMP9610 – 100 micron pitch	**$979**
TMP9612 – 125 micron pitch	**$979**
TMP9615 – 150 micron pitch	**$979**
TMP9617 – 175 micron pitch	**$979**
TMP9620 – 200 micron pitch	**$979**
TMP9625 – 250 micron pitch	**$979**

OPTIONAL ACCESSORIES FOR TMP9000 FAMILY PROBES

Opt. 01 – Female OS-50 Connector	**+$175**
Opt. 43 – Microwave Probe Station Includes: an REL-4300 Microwave Probe Station, two planarizable micropositioners and two planarizable probe arms.	*1

CALIBRATION SUBSTRATES

CAL93 – For TMP9200 and TMP9300 Series Probes	**$1,100**
CAL96 – For TMP9600 Series Probes	**$1,100**

MICROWAVE PROBING TEST SYSTEMS FOR TDR & DEVICE CHARACTERIZATION

MTS4390 Microwave Probe Station *1
Includes: an REL Microwave Probe Station, two planarizable micropositioners, two planarizable probe arms and a set of 4 TMP9000 microwave probes (see Probe Options below)

MTS1191 Microwave ProbingTest System *1
Includes: Tek 11801 HighFrequency Sampling Oscilloscope complete with a 20 GHz SD24 Sampling Head, Alessi REL-4300 Microwave Probe Station, and set of four (4) Tek TMP9000 Microwave Probes (see Probe Options below)

MTS1192 Microwave Probing Test System *1
Includes: Tek 11802 HighFrequency Sampling Oscilloscope complete with a 20 GHz SD24 Sampling Head, Alessi REL-4300 Microwave Probe Station, and set of four (4) Tek TMP9000 Microwave Probes (see Probe Options below)

PROBE OPTIONS
(One option is required for a complete system configuration. Please specify required option.)

Opt. 9 – Includes four TMP9210 probes	*1
Opt. 10 – Includes four TMP9215 probes	*1
Opt. 11 – Includes four TMP9220 probes	*1
Opt. 12 – Includes four TMP9225 probes	*1
Opt. 13 – Includes four TMP9230 probes	*1
Opt. 14 – Includes four TMP9310 probes	*1
Opt. 15 – Includes four TMP9315 probes	*1
Opt. 16 – Includes four TMP9320 probes	*1
Opt. 17 – Includes four TMP9325 probes	*1
Opt. 18 – Includes four TMP9330 probes	*1
Opt. 19 – Includes four TMP9610 probes	*1
Opt. 20 – Includes four TMP9612 probes	*1
Opt. 21 – Includes four TMP9615 probes	*1
Opt. 22 – Includes four TMP9617 probes	*1
Opt. 23 – Includes four TMP9620 probes	*1
Opt. 24 – Includes four TMP9625 probes	*1

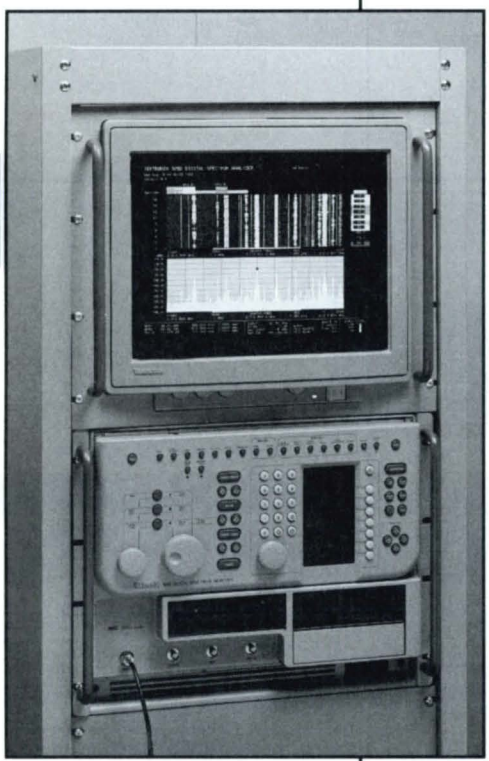
*1 *Contact your local sales representative.*

3052 DIGITAL SPECTRUM ANALYZER SYSTEM

FASTEST REAL TIME BANDWIDTH – 2 MHz

TYPICAL APPLICATIONS

- *Communications*
- *Signal Analysis*
- *Radar Signal Processing*
- *Telephony*



BENEFITS

- *Wide Real Time Bandwidth Captures Elusive Transients*
- *Digital Interface Transfers Data Quickly (Option 10)*
- *System Flexibility Using Industry Standards*

FEATURES

- *Real Time Output in Spans to 2 MHz*
- *Sophisticated Triggering Capabilities, Including Optional Spectral Event Triggering*
- *Spans from 1 kHz to 10 MHz with Center Frequency Tunable Across the DC to 10 MHz Range*
- *Trigger and Capture 500 Sequential Spectrums at Real Time Rates and Scroll the Captured Block*

The Tektronix 3052 Digital Spectrum Analyzer introduces a nearly hundred-fold improvement in real time spectrum analysis–at much wider frequency spans. With a maximum real time span of 2 MHz, the 3052 updates its spectral output every 200 µs. The 3052 offers solutions to difficult analysis and measurement problems.

Spectral frames are the output of a digitally implemented bank of 1024 parallel band-pass filters. The output of each filter consists of both real and imaginary data components.

FILTER BANK

The shape of each filter is the key to several of the 3052's performance characteristics: frequency flatness, amplitude accuracy, spectral resolution, dynamic range sensitivity, and the suitability of its digital output (Option 10) for post processing.

The center frequency of the filter bank is tunable, enabling any frequency within the instrument's 10 MHz operating range to be viewed at narrow spans.

DISPLAY

The 3052 features a high resolution, 16-inch color monitor that displays 800 frequency bins.*1 Display formats include power versus frequency, phase versus frequency, Spectrogram, and Waterfall. One display can occupy the full screen or two can be presented on a split screen.

FRONT PANEL

Knobs provide quick operation and basic spectrum analyzer control. In addition, a liquid crystal display presents menus of more extensive functions and prompts the entry of parameters. The front panel is detachable for flexibility in positioning and handling.

BLOCK CAPTURE MODE

Blocks of 500 sequential spectral frames are captured in memory and transferred to the monitor for Spectrogram display. With this mode, a user may trigger on a spectral event, capture a block of 500 sequential frames, then scroll back to examine the contents of the block frame-by-frame.

SYSTEM ARCHITECTURE AND SOFTWARE

The system architecture is based on the VMEbus. Cards comprising the main part of the instrument are "pipelined" to a stage that interfaces with the standard VMEbus. The instrument software 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 for the development of application programs via RS-232 port.

REAL TIME INTERFACE (OPTION 10)

An optional interface provides access to real time spectral data output; 32 bit spectral data is divided into two parts, available at two separate RS-422 connectors. Option 10 also provides a Spectral Event Detection Output; two spectral limit masks may be implemented; a maximum and a minimum. When the spectral output falls outside one of these limits, a TTL Low accompanies the data to identify the spectral frame and bin. Analog outputs to drive an oscillographic recorder, an x-y monitor, or an oscilloscope are provided as part of Option 10.

CHARACTERISTICS

FREQUENCY RELATED

Range – DC to 10 MHz.

Span – 1 kHz to 10 MHz in a 1,2,5 sequence

Shape Factor – Ratio of FIR Filter 3 dB to 60 dB andwidth: 1.7

Displayed Bins – 801 for all spans

Center Frequency Accuracy – $\pm$CF x 10^{-7}

Signal Resolution With FIR Filter – 3 bin widths (also, one signal at Reference Level and the other at 70 dBc)

10 MHz Standard Drift – 1 x 10^{-9}/day and 1 x 10^{-7}/year

AMPLITUDE RELATED

Reference Level Range – $\pm$33 to –140 dBm

Accuracy – $\pm$0.2 at 12.5 kHz, 0.5 dB at all other frequencies with error correction

Flatness Across Span – $\pm$0.85 dB normalized to 12.5 kHz, $\pm$0.33 dB with error correction

Display Dynamic Range – 84 dB

A/D Converter – 25.6 megasamples/per seconds, 10 bits

Maximum Input Range – + 33 to –57 dBm (signals above the Maximum Input Level are clipped by the A/D Converter).

Harmonic Distortion (with signal 6 dB below maximum input) – DC to 1MHz: 65dBc. 1 to 10 MHz: 58 dBc

IM Distortion (2nd and 3rd Order with two signals 6 dB Below maximum input) – DC to 1 MHz: 65 dBc. 1 to 10 MHz: 60 dBc

Residual Responses – 80 dB below maximum input.

*1 *A bin is a hardware storage location for the complex data output of each filter in the bank. Each spectral frame is comprised of the parallel outputs from the 1,024 bins. The central 800 bins are displayed, covering the selected span of the 3052. A bin width is considered to be 1/800th of the displayed span. All 1024 bins are accessible with Option 10.*

SYSTEM V168 ™ is a trademark of Motorola, Inc.
UNIX ™ is a trademark of AT&T.

DISPLAY RELATED

Display Operation – Full and split screen depiction.

Display Modes – Amplitude vs Frequency, Phase vs Frequency, Spectrogram, and Waterfall.

Display Formats – Average, Min/Max, Peak, R th, Block Capture.

Vertical Display – 1, 2, 5, or 10 dB/div, 1-15 dB/div keyboard definable, and Linear.

Display Range – 10 divisions.

DISPLAY MONITOR

Pixel Resolution – 1024 by 768.

Refresh Rate – 60 Hz noninterlaced.

Displayable Colors – 256 concurrent.

Size – 16 inch diagonal.

POWER REQUIREMENTS

Line Frequency – 47 Hz to 63 Hz.

Line Voltage – 100 Vac to 132 Vac; 200 Vac to 250 Vac.

Input Power – Instrument chassis with Front Panel and Monitor: 1150 watts maximum, 950 watts typical.

ENVIRONMENTAL

Altitude – Operating: 10,000 ft. Nonoperating: 15,000 ft.

Temperature – Operating: 10°C to 40°C. Nonoperating: –20°C to + 60°C.

Relative Humidity – Noncondensing, Operating and Nonoperating: 5 to 95% over a temperature range of 10°C to 30°C.

Shock – Operating: 10 G (except disks: 5 G). Nonoperating: 10 G.

Vibration – Operating and Nonoperating (5 Hz to 55 Hz): 2 G (except disks). Display Monitor (5 Hz to 500 Hz): 0.75 G.

EMI – complies with FCC 20780, Part 15, Sub Part J, Class A.

SPAN RELATED CHARACTERISTICS

Span	Resolution Passband	Spectral Frame Output Inverval	Sensitivity @ 100 kHz dBm	dBv
10 MHz	12.5 kHz	200 µs	–107	–120
5 MHz	6.25 kHz	200 µs	–110	–123
2 MHz	2.50 kHz	200 µs	–114	–127
1 MHz	1.25 kHz	200 µs	–117	–130
500 kHz	625 Hz	200 Ms	–120	–133
200 kHz	250 Hz	1 ms	–124	–137
100 kHz	125 Hz	1 ms	–127	–140
50 kHz	62.5 Hz	1 ms	–130	–143
20 kHz	25.0 Hz	5 ms	–134	–147
10 kHz	12.5 Hz	5 ms	–137	–150
5 kHz	6.25 Hz	5 ms	–140	–153
2 kHz	2.50 Hz	25 ms	–144	–157
1 kHz	1.25 Hz	25 ms	–147	–160

SIGNAL INPUT

Signal Input – AC and DC: –3 dB at 10 Hz.

Impedance – 5 Ω, 1 MΩ.

Maximum Rated Input – 5 Ω: 5 Vrms (+ 27 dBm), 1 MΩ: 500 Vdc, 17 Vrms (+ 25 dBv).

INPUT TRIGGERING AND ACQUISITION START/STOP

Sources – Internal, External, Line, Free Run.

INPUT/OUTPUT

Contact a Tektronix Field Representative for detailed information.

CLOCK

Internal Reference – 10 MHz Frequency Drift: 1 part/billion/day, 100 parts/billion/year.

External Reference – 1 MHz: ±200 Hz. 5 MHz: ±1 kHz. 10 MHz: ±2 kHz.

MILITARY SPECIFICATION

Specified to MIL T-28800D, Type III, Style E (or F), with exceptions.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	483	18.75
Height	756	29.75
Depth	629	24.75
Weight	**kg**	**lb**
Net	`95	210

ORDERING INFORMATION

3052 Digital Spectrum Analyzer System **$79,500**
Includes: Operators and Maintenance Manuals, and Operator's Guide.

OPTIONS

Opt. 01 – GPIB (IEEE-488.2) Interface. Functions as a "listener/talker" **+$1,995**
Includes: VME board and driver software.

Opt. 10 – Real Time Interface **+$9,500**
Includes: Two RS422 compatible digital data outputs; spectral event detection output; analog outputs for Tek 608 monitor, oscilloscope and oscillographic recorder.

Opt. 11 – Compatibility with Tektronix 4693RGB Color Screen Printer **+$1,495**
Includes: parallel printer port, cable, and driver software.

Opt. 12 – Removable Hard Disk **+$4,900**

Opt. 14 – Streaming Tape Drive **+$2,495**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220V/16A, 50 Hz **NC**

Opt. A2 – United Kingdom 240V/13A, 50 Hz **NC**

Opt. A3 – Australian 240V/10A, 50 Hz **NC**

OPTIONAL ACCESSORIES

P6134 –10X, 10 MΩ passive probe **$170**

Rack – Order 437-0398-00 **$1,500**

WARRANTY

On-site, 90 days parts and labor.

MAINTENANCE

Calibration Period – 1 year.

Service Support – On-site assembly level board exchange, and at Tektronix designated service centers.

NEW

RF160 *RF160 DOWN CONVERTER*

TYPICAL APPLICATIONS

- *Wide-Band Spur Searches on Radar Systems*
- *RF Signal Monitoring and Analysis*
- *Manufacturing ATE*

FEATURES

- *Works with Tektronix 49X, 275X, and 2782 Series Spectrum Analyzers*
- *Accepts 160, 110, or 25 MHz Wide-Band IF Signals from Tektronix RF Spectrum Analyzers and Popular Receivers*
- *Down Converts IF Signals for Rigourous 3D Modulation Analysis on the Tektronix 3052 Digital Spectrum Analyzer*
- *Effective Component in Complex Processing Systems*

The RF160 Down Converter is an effective means of combining the three dimensional signal analysis capability of the 3052 Digital Spectrum Analyzer with common receivers and Tektronix spectrum analyzers. Housed in a rugged rackmountable module, the Down Converter is designed to be mounted in a rack below the 3052.

The RF160 works by taking the Intermediate Frequency (IF) output from a receiver or Tektronix spectrum analyzer, and mixing the signal to the analysis range of the 3052. The 2 MHz real time bandwidth, and full capabilities of the 3052, may then be used to analyze the signal. A microwave signal ranging up to 21 GHz in coax, or 325 GHz using waveguide mixers (Tektronix analyzers), may be fully examined.

A typical application area is a 2782 Spectrum Analyzer, RF160 Down Converter, and a 3052 Digital Spectrum Analyzer configured to analyze a microwave signal with an 18 GHz carrier. By tuning the 2782 to the carrier frequency, and applying its wideband IF output, the RF160 down converts the carrier to the analysis range of the 3052. The 3052 (with Option 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 RF160 Down Converter depicted in a measurement system. In this case a microwave carrier signal is applied to a Tektronix 2782 Spectrum Analyzer. The IF output of the analyzer is then down converted by the RF160, effectively extending the analysis range of the 3052.

CHARACTERISTICS

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 – Standard: – 70 dBc for two input signals at – 30 dBm. Option 25: – 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 No Input Signal) – –110 dBm at the output.

Image Rejection – Standard: Image at either 160 or 110 MHz, rejection is 0 dB.

Option 25: Image at 37.5 to 42.5 MHz, rejection 80 dB.

Noise Figure – Standard: 15 dB. Option 25: 9 dB.

INPUT SIGNALS

Acceptable IF Frequencies – Standard: 160 and 110 MHz. Option 25: 25 MHz only.

SIGNAL INPUT (50 Ω REAR PANEL CONNECTOR)

Optimum Input Power – Standard and Option 25: – 30 dBm.

Maximum Input Level Without Damage – + 20 dBm.

REFERENCE INPUT

Rear Panel Connectors – Two BNC 50 Ω inputs direct coupled to each other and AC coupled to the RF160 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.

REFERENCE OUTPUT

Front and Rear Panel Connector – 50 Ω TTL level with independent 50 Ω reverse terminations.

POWER REQUIREMENTS

Line Frequency – 47 Hz to 63 Hz.

Line Voltage – 90 to 132 V ac; 180 to 264 V ac.

Input Power – Operating power is typically 15.5 W (25 W maximum). Operating current is typically 0.25 A, 0.42 A maximum.

ENVIRONMENTAL

Altitude – Operating: 10,000 ft. Nonoperating: 15,000 ft.

Temperature – Operating: 5°C to 40°C.

Nonoperating: – 20°C to + 60°C.

Relative Humidity – Noncondensing: 5 to 95% over a temperature range of 10°C to 30°C.

Shock – Operating and Nonoperating: 10 G.

Vibration – Operating: 2 G, 5 to 55 Hz.

EMI – Complies with FCC and VDE requirements.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	483	18.75
Height	44.5	1.75
Depth	527	20.75
Weight	**kg**	**lb**
Net	4.2	9.25

ORDERING INFORMATION

RF160 Down Converter (Standard 160, 110 MHz IF Input) Includes Instruction Manual — **$9,950**

OPTIONS

Opt. 25 – 25 MHz IF input exclusively — **NC**

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**

WARRANTY

On-site, 90 days parts and labor.

MAINTENANCE

Calibration Period – 1 year.

Service Support – On-site assembly level board exchange, and at Tektronix designated service centers.

SPECTRUM ANALYZER ACCESSORIES

ORDERING INFORMATION

POWER SPLITTER

75 Ω/50 Ω BNC Output, 50 Ω BNC Input – Order 067-1232-00 **$250**

CABLES, PADS AND ADAPTORS

50 Ω Coaxial Cable – BNC to BNC 5.5 in. Order 012-0214-00 **$55**

50 Ω Coaxial Cable – BNC to BNC Conn, 18 in. Order 012-0076-00 **$18.25**

50 Ω Coaxial Cable – BNC to BNC Conn, 42 in. Order 012-0057-01 **$20**

75 Ω Coaxial Cable – BNC to BNC Conn, 42 in. Order 012-0074-00 **$20**

75 Ω to 50 Ω Minimum Loss Adapter – With dc block, 5.7 dB loss. Order 011-0112-00 **$65**

75 Ω to 50 Ω Matching Attenuator – With 11.25 dB conversion factor from dBm to dBV with dc block. Order 011-0118-00 **$85**

"F" Female to BNC Male Adapter – Order 013-0126-00 **$20**

BNC Female to "F" Male Adapter – Order 103-0158-00 **$6.00**

"N" Female to BNC Male Adapter – Order 103-0058-00 **$9.50**

BNC Female 75 to N Male 50 Adapter – Order 103-0273-00 *1

DC BLOCKS

N(F) to N(M) – 10 kHz to 21 GHz, 50 V dc maximum. Order 015-0509-00 **$310**

DC Block 015-0509-00 is rated over the coaxial frequency range of 10 kHz to 21 GHz. Its electrical characteristics, rugged construction, and type "N" connectors make it the preferred solution for EMI/RFI and other applications requiring the blocking of 275X and 49X front ends. Characteristics – Operating Frequency: 10 kHz to 21 GHz. Insertion Loss: 1.0 dB maximum. VSWR: 1.4:1 maximum, 10 kHz to 18 GHz; 1.6:1 maximum 18 to 21 GHz. Voltage Rating: 50 V dc maximum. Impedance: 50 Ω Construction: Passivated Stainless Steel. Connectors: Type "N" male and female per MIL-C-39012. Dimensions: 2.150.84 (dia.) inches maximum.

BNC to BNC – Maximum dc potential 50 V. Order 015-0221-00 **$115**

PROTECTIVE VINYL COVERS

2750/490 Series Rear Panel Connector Cover – Order 337-3274-00 **$5.00**

Rain Cover – for 2710. Order 016-0848-00 **$18.00**

GRATICULES, FILTERS

CRT Light Filter – for 2710
(Clear) Order 337-2775-01 **$1.95**
(Gray) Order 337-2775-02 **$2.35**

CRT Filters – For 2750/490 Series
Light (Amber) Order 378-0115-01 **$3.30**
Light (Gray) Order 378-0115-02 **$6.00**
Mesh—Order 378-0227-01 **$85**

CARTS

K217 – Lab Cart (2750 Series) **$570**
K212 – Portable Instrument Cart (490 Series) **$380**

PROBES

A variety of probes are available in varying frequency and impedance ranges that can be used with the 7L5, 2710, and all 2750/490 Series spectrum analyzers.

FET Probe P6201 – DC to 900 MHz **$1,350**
FET Probe P6202A – DC to 500 MHz **$780**
1101A Probe – Power Supply for 271 **$450**
Conventional Probe P6056 – DC to 3.5 GHz, 6 ft **$240**
Conventional Probe P6057 – DC to 1.4 GHz, 6 ft **$225**
Current Probe P6022 – DC to 150 MHz **$530**

CAMERAS

A camera can greatly enhance the versatility of a spectrum analyzer. Many different units are available. However, the most popular units for the 2710 and 2750/490 Series spectrum analyzers are:

C-4 Low-Cost Camera – Standard: 2710
Opt. 02: 490/2750 Series **$430**

C-5C Camera –
Opt. 01: 490/2750 Series **$500**
Opt. 02: 2710 Series **$500**

CARRYING CASES

Hard Case – Transit for the 2750 Series
Order 016-0962-00 **$450**

Hard Case – Transit for the 490 Series
Order 016-0658-00 **$990**

Soft Case – For the 490 Series
Order 016-0659-00 **$140**

Transit Case – for 2710
Order 016-0792-01 **$280**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – Universal Euro 220 V/6A, 50 Hz **NC**
Opt. A2 – UK 240 V/5A, 50 Hz **NC**
Opt. A3 – Australian 240 V/6A, 50 Hz **NC**
Opt. A4 – North American 240 V/12A, 60 Hz **NC**
Opt. A5 – Switzerland 220 V/6A, 50 Hz **NC**

WARRANTY-PLUS SERVICE PLAN

Tektronix *Warranty-Plus* Offerings for the 2750 Series, 490 Series, and 2710 Spectrum Analyzers provide for both routine and remedial service, depending on the plan selected. See pages 219 and 224.

Plan M1 – Provides two routine calibrations, one each in years two (2) and three (3) of product ownership, and two years of remedial maintenance in years two (2) and three (3) of ownership.

Plan M2 – Provides four years coverage of remedial service in years two (2), three (3), four (4), and five (5) of product ownership.

Plan M3 – Provides for four years of routine calibrations, one each in years two (2), three (3), four (4) and five (5) of product ownership, and four years of remedial maintenance in years two (2), three (3), four (4), and five (5) of ownership.

MISCELLANEOUS

Manual – Service for 2710
Order 070-6024-00 *1

Accessory Pouch – For 2710
Order 016-0677-00 *1

Viewing Hood – For 2710
Order 016-0566-00 **$21**

Carrying Strap – For 2710
Order 346-0199-00 **$19.25**

Diplexer Assembly – For use with 2750/490 Series Spectrum Analyzers and WM490 Series Waveguide Mixers. Includes TNC to SMA adapter and SMA semi-rigid coax.
Order 015-0385-00 **$290**

Diplexer Assembly Cable – Required for use with Diplexer Assembly.
Order 012-0649-00 **$37**

LITERATURE

Numerous Application Notes and magazine article reprints on spectrum analyzer measurements are available. Notes on baseband, EMI, two-way radio and television measurements, noise and pulse testing, and others have been written to help you with your measurements.

In addition, our staff of specialists stands ready to help you solve any special measurement problems. Contact your local Tektronix sales office or representative.

*1 *Contact your local sales representative.*

2755AP and K217

494AP and K212

TM 500 and TM 5000 instruments provide the answers to a broad range of test and measurement needs. You can choose from over 60 compact plug-ins to create mutifunction packages for a wide range of applications, or to solve unique application problems. These modular instruments can function individually or as part of a computer-controlled network.

With over 60 cost effective plug-ins from which to choose, the Tektronix TM 500 line of manual instruments lets you create just the system you need. And all TM 500 instruments are electrically and mechanically compatible with the TM 5000 GPIB programmable instruments, so they can be used in TM 5000 mainframes side-by-side with the TM 5000 programmables. This compatibility yields cost effective solutions to system applications where not all functions or measurements need to be programmable.

The TM 5000 programmable instruments are designed for ease of use and flexibility in automated testing and measurement applications. You get the benefits of advanced programming capability, complex interfacing, and compactness as standard features.

Programming is simple because TM 5000 instruments are GPIB compatible and support Tek's Standard Codes and Formats, assuring that the language and syntax between instruments are consistent and easy to use. Standardized instruments-data formats open up the lines of bus communication and make your test and measurement system easy to set up and operate.

For the TM 500 line of manual instruments, there's a travel mainframe for service work and field testing; a rack mount model for production test; or standard mainframes, compact and convenient for bench or desk, that accept one to six instruments. Rollabout carts are available for lab configurations with Tek oscilloscopes.

The TM 5000 instruments operate in either TM 5003 or TM 5006 mainframes to form compact, configurable, automated test systems that occupy less than half the rack space of ordinary rack mounted equipment and decrease the number of GPIB cables and power outlets. One cable and one power cord per main frame are all that is required. The TM 5003 has three compartments, the TM 5006 has six. All TM 5000 and many of the TM 500 instruments are UL listed.

Adherence to standard form and fit means that any TM 500/TM 5000 instruments can be replaced in a system without the uncabling, unstacking, restacking, and recabling that is necessary with most instruments. Rebuilding the system for different tasks takes seconds, not hours.

The TM 500/TM 5000 line of modular instruments is designed so that connections between modules and/or external equipment can be made by the mainframe rear interface board and optional rear-panel connectors.

While the connections can be made in each of the mainframes, ordering the rear interface (Opt. 02) provides the BNC connectors for the rear panel.

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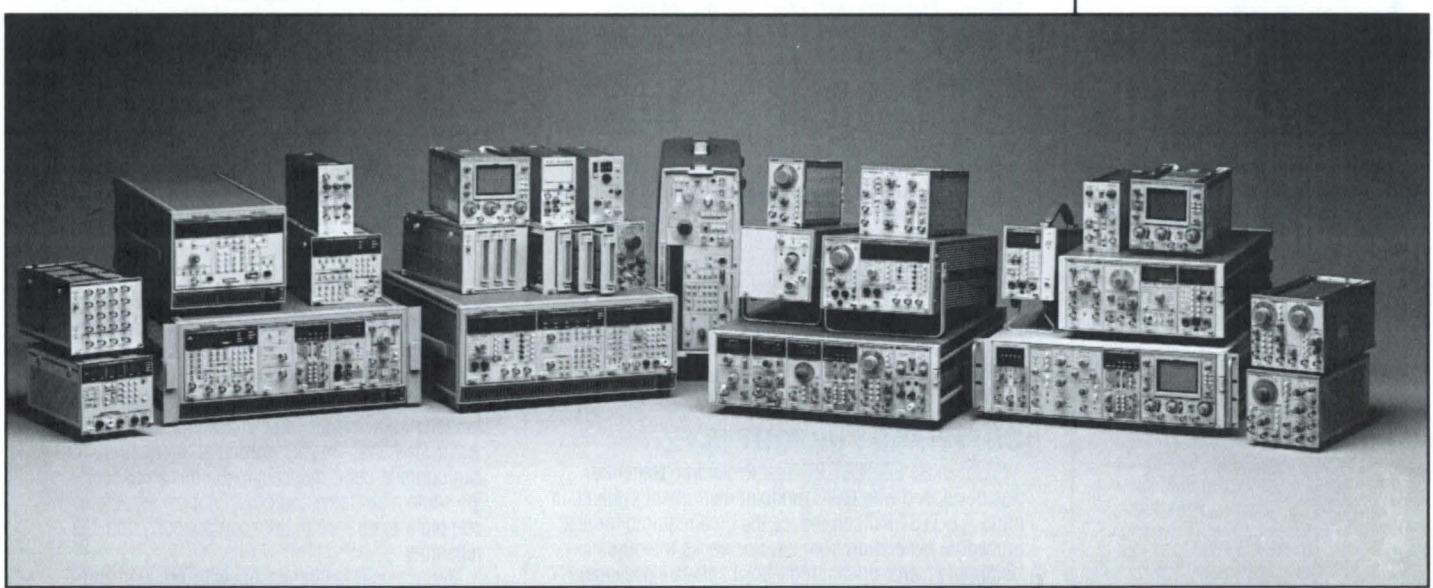


TM 500/TM 5000
Modular Instruments

- *Reduce Your Cost of Benchtop Automatic Testing*
- *Save Space and Time*
- *Use Less Bench or Rack Space*
- *Save Hours of Configuring Cabling/Recabling Your Test System.*
- *Specially Designed to Work With Tek's Various Test Procedure Generation Software Packages*
- *Programmers and Non-Programmers Can Generate Automated Testing Procedures Faster*

NEW WaveWriter
Arbitrary Waveform Generation Software

- *PC-Based Software*
- *Create and Modify Waveforms for AFG 5101/ 5501, VX 5790, etc.*
- *Microsoft Windows-Based Software*
- *Compatible with TekTMS Test Development Software*
- *Create/Modify by Equation, Freehand Draw, Autoline, Math Functions*

APPLICATION AND CONSTRUCTION NOTES

The TM 500 and TM 5000 instrument lines are supported by a series of Application and Construction Notes that communicate up-to-date technical information. Application Notes outline the steps necessary to solve complex problems, or to achieve optimal performance and versatility from your instruments. Subjects include: integration, v-to-f conversion, generating delayed pulses, and transducer measurements.

Construction Notes provide information to build custom circuits using a blank plug-in kit and standard components. These notes are developed from the actual construction of more common special circuits, and include parts lists, schematics, and other construction details. Some of the available notes include power-supply circuits, thermal true RMS converter, and analog multipliers.

NEW WaveWriter

ARBITRARY WAVEFORM GENERATION SOFTWARE

WaveWriter™ is the new software support package for creating and modifying arbitrary waveforms for the Tektronix AFG 5101, AFG 5501, and the VX 5790 Arbitrary Waveform Generators. 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 also supports the 2400 series line of digital storage oscilloscopes with template generation for the Save-On-Delta feature. Therefore, with WaveWriter, the user can create the exact tolerances or templates with which to capture a differentiated signal or identify a failure.

For more information on WaveWriter, please turn to page 342 in the Test and Measurement Software section of this catalog.

SOFTWARE SUPPORT IS EZ

Tektronix's EZ-TEST PC Test Procedure Generator was developed with GPIB modular instrument systems in mind. EZ-TEST PC can reduce the time required for test procedure generation from days or weeks to hours. Using this menu-driven, high-level software package, even the inexperienced programmer can create complex test procedures without writing a line of code. No knowledge of the test language is required. You simply need an IBM compatible PC such as the Tektronix PEP 301.

And Tek's experienced software specialists can help you develop a unique software package for your specialized applications. Utilizing EZ-TEST PC, or a variety of high-level languages, the Tek specialist can build test procedure software that is easy to learn and to use. System startup time will be kept to a minimum. And all software documentation, including the application source code, will be provided.

AUXILARY INSTRUMENTS

Several specialty plug-ins that are compatible with the TM 500/TM 5000 mainframes are available both through Tektronix and other vendors. Specialty plug-ins from Tektronix include the TR 502/TR 503 Tracking Generator, DP-100 Digital Video Probe, OT 501, OT 502, and OT 503 Optical Transmitters, OR 501 and OR 502 Optical Receivers.

Other vendors selling TM 500 compatible plug-ins include; Argos, Efratom, Lasertron, Stavely Zetek, Spectracom, and Pulse Instruments.

CREATE YOUR OWN APPLICATION PACKAGE

The New Electronic Bench Series (EBS) packages link the versatility of the modular instruments offering with a portable scope, which allows you to specify a grouping of instruments to fit your application.

By filling all the compartments of the chosen mainframe with TM 500 and/or TM 5000 instruments, you will save 10% off the catalog price. In addition the 10% discount can be extended to include a 2200 series or 2430A oscilloscope when ordered at the same time.

With EBS packages you select a complement of stimulus, measurement, and power supply modules to fit your application along with one of the three-, four-, or six-wide mainframes (and save 10% off the catalog price).

VERSATILE AND COST-EFFECTIVE

Versatility and cost efficiency are as important a part of the TM 500/TM 5000 modular concept as solving applications problems. With the Tektronix TM 500/TM 5000 modular instruments you can assemble a highly versatile test system that fits your particular application. And you can upgrade performance capabilities as needed, using the same mainframe and power supply as before, with complete assurance of total compatibility and Tek reliability.

Reduce your testing costs...with Tek Test and Measurement Modular Instruments!

SIGNAL SOURCES

FUNCTION AND PULSE GENERATORS

THEORY AND SPECIFICATIONS

Pulse and 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.

Pulse Generators

If your application simply involves driving digital circuits with simulated clocks or simple bursts of pulses, then a pulse generator is the appropriate choice. Pulse generators are relatively inexpensive, and they offer the risetime capability needed to drive ECL and high-speed CMOS logic.

By gating a pulse generator with an external signal, you can cause it to output single pulses or pulse bursts in regular patterns.

Function Generators

Function generators are more general-purpose than pulse generators. 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.

Gated, Swept and Modulated Function Generator Outputs

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.

There are extensive applications for modulated signals. In addition to simulating buffer- and output-stage RF amplifiers, amplitude modulated signals can stimulate detectors and automatic gain and level control stages in receivers. With frequency modulation, driving the input with a binary digital signal simulates frequency shift keying, as used in modems. Driving the input with a multi-level digital signal can simulate the frequency hopping waveforms of spread-spectrum communications systems.

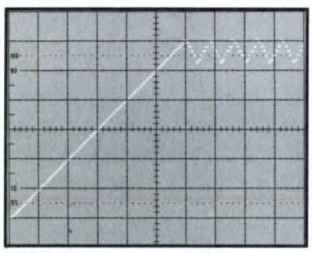
GPIB-programmable function generators make it easy to incorporate the features of function generators in benchtop ATE. (Programmability also means that you can enter complex setups either from the keyboard or via the IEEE-488 interface and recall them quickly later.) This capability increases throughput in automated test systems. In manual test environments, it lets you preset your test parameters and then turn over the actual running of the test to less skilled personnel.

GPIB AND BENCHTOP ATE CODES AND FORMATS AND TM 5000 MODULARITY

When you use GPIB, Tektronix' Codes and Formats standard makes programs easy to write and read and provides consistency across the company's entire product range.

For benchtop ATE, a single GPIB cable, routed to the back panel, can serve all the instruments plugged into a single mainframe, reducing cable cost and electromagnetic interference.

The TM 5000 concept makes it easy to interconnect instruments, even non-programmable TM 500 instruments. The illustration shows how a PFG 5105 can be used with TM 500 instruments to obtain high output voltages, fast risetimes, low repetition rates, sweeps with shaped amplitudes, and even signals for optical fiber testing.



AFG 5101 created drive signal for a mechanical stress tester.

ARBITRARY FUNCTION GENERATORS

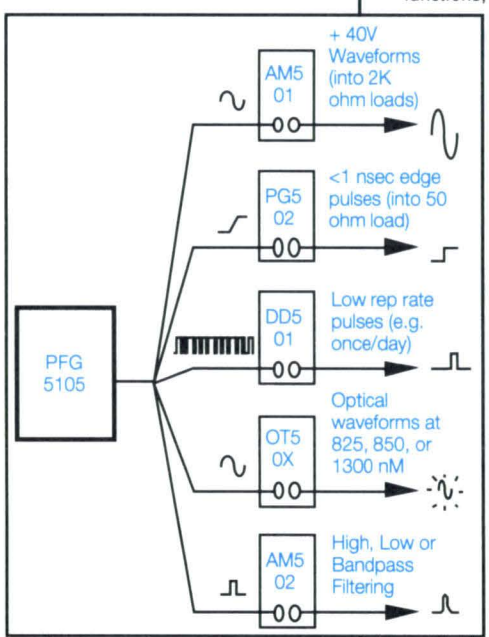
Arbitrary Function Generators generally provide all of the features of programmable function generators, plus the ability to create any arbitrary waveform. In a sense, they perform the opposite function of a digitizing oscilloscope. That is, where the scope captures a waveform and converts it to an array of digitally stored points; the AFG takes an array of points and transforms them to a time-varying signal. In fact, (within the 12 MHz bandwidth of the instrument), you can take a digitized signal captured by a scope, download it to the Tektronix AFG 5101 and output it repeatedly. More generally, there are several methods of creating arbitrary waveforms. Instead of a scope, you can use a digitizing tablet connected to a GPIB controller and generate the required points by actually drawing the required waveform. Alternatively, you could use a software package such as the Tektronix WaveWriter, to clearly and simply describe the mathematical functions representing a waveform. WaveWriter automatically generates a set of points that accurately describes the mathematical function you've entered, and then downloads them to the AFG.

It isn't even necessary to program over the GPIB. Because the AFG 5101 has an extremely fast waveform execution buffer, you can see your waveforms as you create them. This means that with a scope connected to the AFG output, you can define a repetitive signal point-by-point, using the keypad on the front panel, watching as you construct it. An autoline feature constructs straight lines from user-defined endpoints. To speed construction of common waveforms that are composites of basic functions, the AFG 5101 provides five predefined 1000-point waveforms that can be combined and edited. These are the sinewave, square-wave, triangle, and up and down ramps.

The output frequency that can be achieved by arbitrary function generator depends on how fast the instrument's digital-to-analog converter reads through addresses (which depends on the inherent speed of the D-to-A and the clock speed) and the number of points needed to define a waveform or signal. For example, the AFG 5101 will execute a 10 point signal at frequencies from 1μHz to 1 MHz.

The maximum frequency of arbitrary waveforms is 5 MHz. However, the instrument's function generator output is 12 MHz. The arbitrary function capability of instruments such as the AFG 5101 extends to the sweep function used to modulate the frequency of the standard sinusoidal output. This has some interesting uses. For example, the illustration to the left, shows how, by pausing the sweep at certain frequencies, you can create intensified marker zones on an oscilloscope recording the behavior of a circuit connected to the AFG.

You can also output markers from the front panel to modulate your scope's Z-axis input.



Interconnect TM 500 instruments to get the signal you require.

UNPRECEDENTED APPLICATIONS

The availability of Arbitrary Function Generators opens the possibility of enhancements to old testing applications along with some applications that are entirely new.

For example, it is common to subject mechanical assemblies to vibration tests with swept vibration frequencies and frequency dwells resonance points. However, by driving vibration table amplifiers from arbitrary function generators, it is possible to accurately simulate real world environments such as missile launches. The scope trace below shows an AFG 5101 created drive signal for a mechanical stress tester. It was created to raise a test sample to maximum tension and then subject it to a series of fatigue cycles.

As a more exotic example, it is possible to digitize animal calls using a scope, store them in AFG memory, and play back modified versions while studying animal responses to them.

Specifications

Pulse generators: The key specifications are pulse period, duration, and duty factor, followed by transition time. Some pulse generators can output pulse pairs, which are used in testing the ability of digital circuits to discriminate between closely spaced events. Be sure to match the instrument's output impedance to the kind of logic under test. That is, do not load CMOS with a 50 ohm source.

Function Generators: If you plan to use symmetry controls to produce pulse trains, then the same considerations apply as for pulse generators. In addition, frequency range, accuracy and resolution are key specs, followed by amplitude flatness across the output frequency range, jitter and stability. After that, match features to your needs. If the instrument is intended for a specific application, or if the circuits you work with are limited in terms of frequency or logic type, you may not need the most expensive instrument. If you are using an external signal to frequency modulate the output, determine whether you want to sweep from frequency to frequency (VCO operation) or whether you want to control the deviation from a carrier frequency (FM operation) and select accordingly.

The same factors apply to choosing programmable function generators, with additional considerations of programming ease. Look for consistency and easy readability in the manufacturer's programming language. If you want to be able to use the instrument for quick spot measurements outside of a benchtop ATE system, verify that the instrument is easy to program from the front panel. In either context, you will need to determine whether the instrument can store enough front panel setups to meet your application needs and whether the setups remain in memory when power is removed (non-volatile memory).

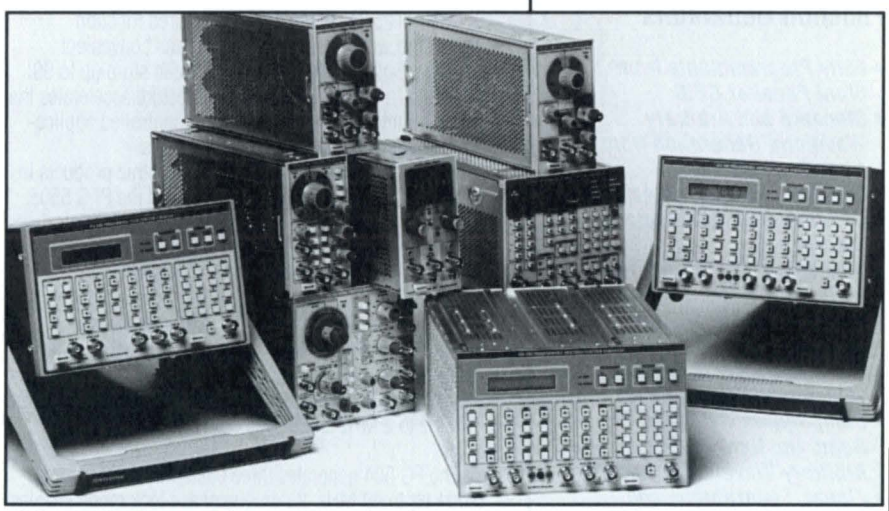
Arbitrary Function Generators: All the factors listed above apply to arbitrary function generators. In addition, consider the resolution and size of the arbitrary function memory. (The AFG 5101 has 8K of 12-bit bytes.) Finally, look at how easy it is to program arbitrary functions, and how easy they are to edit.

FUNCTION GENERATORS

For test and measurement problems requiring waveform generation, the high-performance TM 5000/TM 500 Function Generators offer both precision and multifunctionality for versatile solutions. Whether the application requires TM 5000 GPIB programmability (AFG 5101/5501, PFG 5105/5505, FG 5010) or manual operation (FG 501A, FG 502, FG 503, FG 504), Modular Instruments from Tektronix offer a wide selection to meet the need.

The AFG 5101 Arbitrary Waveform and Function Generator provides accurate "real-world" simulation by combining analog and arbitrary waveform generation with the ability to generate user defined sweep shapes. It is really three generators in one. And with the *NEW* WaveWriter Software, the creation and modification of waveforms for the AFG 5101/5501 are quick and easy. Glitches can be added to existing signals to test tolerances in circuit designs.

Or signals can be created from standard functions such as sine, square, or Pulse-functions, and mathematically combined for unlimited versatility.



TM 5000/TM 500 Pulse and Function Generators

FUNCTION GENERATOR SELECTION GUIDE

Application/Feature	FG 501A	FG 502	FG 503	FG 504	FG 5010	AFG 5101/5501	PFG 5105/5505
Sine, Square, Triangle Waveforms	•	•	•	•	•	• + DC	• + DC
Pulse	•	•		•	•		•
Ramp	•	•		•	•		
Arbitrary Waveforms						•	
Frequency Range (Hz) with var. symmetry	0.002 to 2 M 200 k ± 10%	0.1 to 11 M	1 to 3 M	0.001 to 40 M 4 M	0.002 to 20 M 4 M	0.012 to 12 M	0.012 12 M
Amplitude (Vpp) open circuit into 50 Ω	30 15	10 5	20 10	30 15	20 10	19.98 9.99	19.98 9.99
Offset (V dc) open circuit into 50 Ω	± 13 ± 6.5	± 5 ± 2.5	± 7.5 ± 3.75	± 7.5 ± 3.75	± 7.5 ± 3.75	± 9.98 ± 4.99	± 9.98 ± 4.99
Peak Signal + Offset (V dc) open circuit Into 50 Ω	± 15 ± 7.5	± 10 ± 5	± 15 ± 6	± 20 ± 11.25	± 15 ± 7.5	± 9.98 ± 4.99	± 9.98 ± 4.99
Output Impedance	50 Ω	50 Ω	50 Ω	50 Ω	50 Ω	50 Ω	50 Ω
Sine Wave Amplitude Flatness (Hz) (10-kHz ref, 50-Ω load)	± 0.1 dB, 20 to 20 k; ± 0.5 dB, 20 k to 1 M; ± 1 dB, 1M to 2 M	± 0.5 dB, 20 to 20 k; ± 1.5 dB, 0.1 to 11 M	± 0.5 dB, 20 to 20 k; ± 2 dB 0.1 to 3 M	± 0.5 dB, 0.001 to 40 k ± 2 dB to 40 M	± 3%, 0.002 to 1 k; +3.5%, 1 k to 1 M; ± 5%, 1 to 5 M; +5% –10%, 5 to 20 M	0.5 dB, 0.012-120 k , ± 2.0 dB to 1.2 M, ± 3 dB to 12 M 1 kHz ref	0.5 dB, 0.012-120 k ± 2.0 dB to 1.2 M, ± 3 dB to 12 M 1 kHz ref
Sine-Wave Distortion (Hz, Maximum Output, 50-load)	≤ 0.25%, 20 to 20 k*2; ≤ 0.5%, 20 to 100 k Harmonics ≤ –30 dB, 100 k to 2 M	≤ 0.5%, 10 to 50 k*2 Harmonics: ≤ –30 dB at all other frequencies	≤ 0.5%, 1 to 30 k; ≤ 1%, 30 to 300 k; ≤ 2.5%, 300 k to 3 M	≤ 0.5%, 20 to 40 k*1 Harmonics: ≤ –30 dB, 40 k to 1 M; < –20 dB, 1 to 40 M	± 0.5%, 20 to 19.99 k ≤ 1%, 20 to 19.99 k Harmonics: > 30 dB down, 100 k to 20 M	< 0.6%, 121 Hz to 120 k Harmonics: < – 30 dB above 120 k	< 0.6%, 121 Hz to 120 k Harmonics: < – 30 dB above 120 k
Trigger Input	± 90° variable start phase control	No	No	20 MHz max, ± 80° start phase control to 10 MHz	± 90° variable start phase control	Fixed phase	Fixed phase
Amplitude Modulation	No	No	No	Yes	Yes	Yes	Yes
Voltage-Controlled Frequency (FM)*1	Up to1000:1 frequency change with 10 V external signal.					5.0 V for 500:1	5.0 V for 500:1
IEEE STD 488.1 1987					Yes	Yes	Yes
Price	$970	$1,145	☎ $710	$3,375	$4,125	$3,495/$4,125	$2,995/$3,595

*1 *15°C to 35°C ambient* *2 *20°C to 30°C ambient*

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

AFG 5101/AFG 5501

Function Generators

- ***Fully Programmable from Front Panel or GPIB***
- ***Standard and Arbitrary Waveform Generation from 1 μHz to 12 MHz***
- ***Two Non-Volatile, Selectable 8K Memories for Waveform Storage***
- ***Non-Volatile Storage for up to 99 Front Panel Settings***
- ***10 mV to 9.99 V p-p into 50 Ohms***
- ***0.2% Accuracy (0.005% with Synthesizer Option)***
- ***Sine, Square, Triangle, Ramp Up, Ramp Down, Arbitrary Waveforms, and DC***
- ***Linear, Logarithmic, and Arbitrary Sweep Capabilities***
- ***Convenient Creation and Modification of Waveforms with WaveWriter™ Software***

ORDERING INFORMATION

AFG 5101 Programmable Arbitrary/ Function Generator (plug-in) **$3,495**
Includes: Instrument manual (070-6759-00); Reference guide; Instrument interfacing guide (070-6930-00).

AFG 5501 Programmable Arbitrary/ Function Generator (monolithic) **$4,125**
Includes: Instrument manual (070-6759-00); Reference guide; Instrument interfacing guide (070-6930-00).

OPTIONS

Opt. 02 – Adds a frequency lock synthesizer **+$350**

ACCESSORY

Service Manual – Contact your local Sales Representative.

The PFG 5105 combines full-featured function generation with pulse generation in one convenient package. Both the AFG and the PFG can store up to 99 complete front panel settings. This feature accelerates the programming process for computer controlled applications and enhances benchtop capabilities.

Tektronix realizes the need for monolithic products in specific applications. The AFG 5501 and the PFG 5505 have been developed to meet these needs. Both products come with a dedicated power housing and carrying handle and do not require a TM mainframe.

The FG 5010 provides full GPIB programmability, accuracy within 0.1 of reading to 20 MHz, variable symmetry, complementary output, and a host of other features.

The FG 501A provides low distortion waveforms from 0.02 Hz to 2 MHz and is well suited to audio applications.

The FG 504 generates three basic waveforms from 0.001 Hz to 40 MHz. Its unique phase lock mode enables conversion of digital signals to high or low frequency sine waves, pulses, or triangles.

The FG 501A, FG 502, and FG 503 are lower frequency generators that provide a low cost alternative for straight forward applications in biological, geophysical, and mechanical simulations.

EXTENDED FUNCTIONALITY

The DD 501 Digital Delay is an events-counting device that can be used with pulse, function and clock generators in such applications as precise digital delay between two related events, divide-by-N frequency divider, precision gate generator, counted burst output from a gated pulse or frequency generator, etc.

AFG 5101/AFG 5501

The AFG 5101/AFG 5501 combine the capabilities of standard analog and arbitrary waveform generation with the ability to generate virtually any sweep shape to allow accurate simulation of real-world functions.

Standard analog functions include sine, square and triangle waveforms, and DC with frequencies from 0.012 Hz to 12 MHz and amplitudes from 10 mV to 9.99 V p-p into 50 ohms. Waveforms can be continuous, triggered, gated, or burst. Trigger can be internally, manually, or GPIB supplied.

Arbitrary waveforms can be defined point by point, generated mathematically, transferred from computer graphics, or captured from an analog source and stored into one of two independently selectable 12 bit by 8K waveform memories for later use.

A sweep generator, from which linear, logarithmic, or user defined sweep shapes can be selected, allows complete customization of waveforms. (A mode exists on the AFG 5101/AFG 5501 which allows viewing and editing of the waveform as it is designed.)

BUILD A WAVEFORM LIBRARY

Once a waveform is generated, it can be stored in non-volatile internal memory. Or, through the GPIB, a complete library of calibration and stimulus waveforms and panel settings can be stored on disk. Up to 99 panel settings can also be stored in internal non-volatile memory.

CONFIGURATIONS

The AFG 5101 is a three-wide plug-in module that fits into the TM 5003 or TM 5006 Power Module Mainframe. The AFG 5501 is the AFG 5101 mounted in a three-wide GPIB power module. The AFG 5101 is at the heart of the EBS 5002 Programmable Arbitrary Stimulus/Measurement Package.

OPTIONS

Option 02 adds a frequency lock synthesizer that provides a stable output waveform by locking the output to an internal quartz crystal. This option operates in continuous mode only, from 12.1 Hz to 12 MHz.

CHARACTERISTICS

Waveforms – Sine, square, triangle, arbitrary, and dc.

OPERATING MODES

Continuous – Output continuous at programmed frequency, amplitude, and offset.

Triggered – Output quiescent until triggered by an internal, external, GPIB, or manual trigger; then generates one cycle at programmed frequency, amplitude, and offset.

Gated – Same as triggered mode except waveform is executed for the duration of the gated signal. The last cycle started is completed.

NBurst – Same as triggered mode for programmed number of cycles from 1 to 9999, as set by the NBurst function.

Sweep – Internal, programmable start frequency, stop frequency, rate (time per step) and marker frequency. Linear, logarithmic, and arbitrary sweep shapes can be continuous, triggered, gated, or burst seleted.

Modulation – The analog generator can be frequency and amplitude modulated. Arbitrary waveforms can be amplitude modulated only.

Increment – Frequency, amplitude, offset, rate, sweep marker, and NBurst can be manually incremented/ decremented by a settable Increment delta. Step rate is 2 steps/s for first 3 steps, then 10 steps/s for successive steps for one continuous keystroke.

FREQUENCY

Range – 0.012 Hz to 12.0 MHz.

Resolution – 3 1/2 digits (1200 counts). Optional synthesizer mode: 4 1/2 digits (12,000 counts).

Accuracy – ±0.2% of reading from 121 Hz to 5 MHz in continuous mode. ±0.5% of reading from 5 to 12 MHz in continuous mode. ±5% of reading from 0.1 to 120 Hz in continuous mode. ±0.005 in optional synthesizer mode, 12.1 Hz to 12 MHz

Jitter – < 0.1% to 5 MHz.

Stability – ±0.2% in continuous mode for all time intervals. ±0.005% in optional synthesizer mode, 12.1 Hz to 12 MHz. ±0.5 for 24 hours in other modes.

Repeatability – ±1% for 24 hours in other than continuous mode.. ±0.005% in optional synthesizer mode, 12.1 Hz to 12 MHz.

OUTPUT

Amplitude Range – 10 mV to 9.99 V p-p into 50 Ω (20 mV to 19.98 V p-p into open circuit). (Open circuit values are 2 times the displayed values.)

Amplitude Resolution – 10 mV from 1 V to 9.99 V p-p into 50 Ω; 1 mV from 0.1 V to 0.999 V p-p into 50 Ω. 1 mV from 10 mV to 0.99 mV p-p into 50 Ω.

Amplitude Accuracy – ±2% ±20% mV of programmed value for 1.0 V to 9.99 V output at 20 to 30°C; ±3% ±5 mV for 10 mV to 999 mV output, specified for a sine, square, or triangle wave output at 1 kHz.

Repeatability – ±1% for 24 hours.

Amplitude Flatness – 0.5 dB from 0.012 Hz to 120 kHz, ±2 dB to 1.2 MHz, ±3 dB to 12 MHz referenced to 1 kHz sine, square, or triangle wave.

Offset Plus Peak Amplitude – Absolute peak amplitude plus offset is limited to a maximum that is dependent on the signal amplitude range. 4.99 V maximum for 1 V to 9.99 V range; 0.499 V maximum for 0.1 V to 0.999 V range; 0.049 V maximum for 0.01 V to 0.099 V range.

Offset Resolution – 3 digits; 1 mV when p-p amplitude is < 999 mV; 10 mV when p-p amplitude is > 1 V (into 50 Ω).

Offset Accuracy – ±0.6% ±20 mV (into 50 Ω).

Repeatability – ±1% ±20 mV for 24 hours.

Output Impedance – 50 Ω.

Output Protection – The instrument is non-destructively protected against short circuits or accidental voltage of up to ±100 V (dc plus peak ac) applied to the main output connector.

WAVEFORM

Sine Distortion – < 0.6% THD (RMS), 121 Hz to 120 kHz at 5 V p-p amplitude at 20 to 30°C. < 1% THD (RMS), 12 Hz to 120 kHz at full temperature and amplitude range. (All harmonics less than –20 dB below fundamental from 121 kHz and above.)

Square Wave Time Symmetry – < 0.5% 121 Hz to 120 kHz; ±1% 0.012 kHz to 1.200 MHz; ±5% 1.21 MHz to 12.0 MHz.

Square Wave Transition Time – < 15 ns 10 to 90% at full output amplitude; elsewhere, < 20 ns, 10 to 90%.

Square Wave Aberrations – < 8% of p-p amplitude ±20 mV from 3.4 to 9.99 V p-p output amplitude. < 10% of p-p amplitude below 3.34 V p-p output amplitude.

Triangle Linearity – 98% to 100 kHz measured from 10 to 90% on waveform.

DC Range – ±10 mV to ±4.99 Vdc from 50 Ω (into 50 Ω).

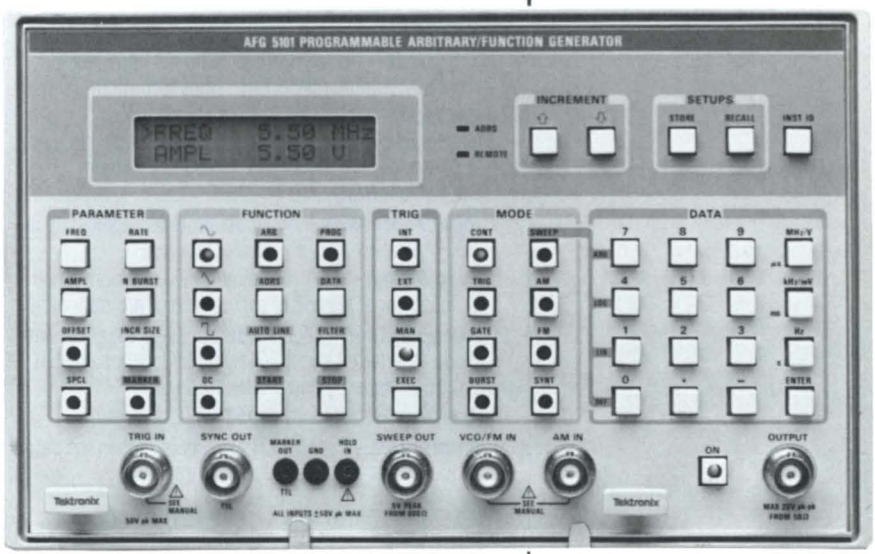
DC Accuracy – ±0.6% ±20 mV in DC function only, (into 50 Ω).

INTERNAL TRIGGER ANALOG FUNCTIONS ONLY

Range – Repetition rate 100 ns to 999.9 sec.

Resolution – 4 digits, 1 ns maximum.

Accuracy – 0.01%.



AFG 5101 Arbitrary Function Generator

GPIB IEEE-488 *

** The AFG 5101/AFG 5501 comply with IEEE Standard 488.1-1987 and with Tektronix Standard Codes and Formats.*

ARBITRARY WAVEFORM

Functions – User defined, or predefined sine, square, triangle, ramp up, and ramp down with 0.01% frequency accuracy. From 0.001 Hz to 10 kHz (1000 point predefined waveforms only).

Horizontal Resolution – 8192 points for each of two independently selectable non-volatile waveform storage memories.

Vertical Resolution – 12 bits.

Output Accuracy – ±2.5% ±20 mV of programmed p–p amplitude when arbitrary data point peak values are ±2047 to –2047 at waveform frequencies of 1 kHz with predefined waveform functions.

Point Duration – 100 ns to 999.9 sec with 4 digits resolution. Accuracy typically better than 0.01%.

Risetime – <150 ns, 10 to 90% (with no filtering).

Setting Time – <300 ns to within 1% of final value with a full scale step (with no filtering).

Waveform Execution – Buffer: 8192 points, volatile. Filters: 4 selectable, single pole filters (3 dB cutoff frequency).

0 – Filter off.
1 – Typically 1 MHz ±20%.
2 – Typically 100 kHz ±20%.
3 – Typically 11 kHz ±20%.
4 – Typically 1.3 kHz ±20%.

FREQUENCY SWEEP

Sweep Types – Linear, logarithmic, arbitrary.

Sweep Time – 100 ns to 999.9 sec per point; 1 ns maximum resolution.

Sweep Width – 1200 – 1 maximum; start and stop frequencies must be in the same range.

Sweep Ranges – 10 kHz to 12 MHz; 1 kHz to 1.2 MHz; 100 Hz to 120 kHz; and so on until 0.012 Hz to 12 Hz.

Start/Stop Frequency Accuracy – ±5% of upper frequency.

Marker accuracy – ±5% of upper frequency.

INPUTS AND OUTPUTS

VCO/FM Input – 5 V p-p for a 500:1 frequency change.

Trigger In – TTL compatible. Nominal impedance: 10 kΩ. Maximum rate: 6 MHz. Minimum width: 20 ns.

AM Input – Input resistance: 10 kΩ nominal. 5 V p-p (0 V to + 5 Vdc) for 100% modulation. Bandwidth: DC to 20 kHz minimum. (AM limited to 30% at certain amplitude levels.)

Input Protection – All inputs protected against up to ±50 V (dc plus peak ac) accidental input.

Sync Output – TTL level squarewave at programmed frequency or at the end of each sweep or arbitrary cycle.

Sweep Output – Source resistance 600 Ω; same wave shape as selected sweep. (Amplitude depends on start and stop frequency and a 5 V limit.)

Arbitrary Hold/Reset Input – TTL compatible.

Marker Out – Positive TTL level pulse, when the output frequency equals provided marker frequency.

IEEE STANDARD 488.1-1987 INTERFACE FUNCTION

Subsets Implemented – SH1, AH1, T6, L4, SR1, RL1, DC1, DT1, E2.

GENERAL

Environmental – Operating: 0 to 50°C. Non-operating: -55 to +75°C.

Power Consumption – 50 VA maximum, limited by internal fuse.

Power Dissipation – AFG 5101: 30 W AFG 5501: 90 W

Memory – Non-volatile, stores up to 99 complete front panel settings. Two selectable 8192 arbitrary waveform memories.

Display – 2 line alphanumeric, 16 character LCD. Provides for descriptive error messages. Variable back lighting and contrast.

PHYSICAL CHARACTERISTICS

	AFG 5101		AFG5501	
Dimensions	**mm**	**in**	**mm**	**in**
Width	233	8.0	234	9.2
Height	127	5.0	141	5.5
Depth	279	11.0	432	17.0

PFG 5105/PFG 5505

Pulse/Function Generators

- *0.012 Hz to 12 MHz; Accuracies to 0.005 with Synthesizer Option*
- *Programmable Width and Delay*
- *10 mV to 9.99 V p-p into 50 Ohms*
- *Continuous, Triggered, Gated and Burst, AM, VCF and Linear Sweep Modes*
- *Non-Volatile Storage for 99 Front Panel Settings*

ORDERING INFORMATION

PFG 5105 Function Generator **$2,995**
Includes: Instrument manual (070-7331-00); Reference guide; Instrument interface guide (070-7329-00).

PFG 5505 Function Generator **$3,595**
Includes: Instrument manual (070-7331-00); Reference guide; Instrument interface guide (070-7329-00).

PFG 5105/PFG 5505

The PFG 5105/PFG 5505 Programmable Pulse/Function Generators combine the advantages of pulse generation with the versatility of full-featured function generation and complete programmability. Its waveform generation capabilities include pulse, double pulse, sine, triangle, square, and dc outputs from 0.012 Hz to 12 MHz in continuous, triggered, gated, burst, swept, and AM/VCF modes. A synthesizer option is available that locks the output to an internal quartz crystal for frequency accuracies of 0.005% (continuous mode only).

An additional internal-rate trigger clock is provided for allowing the creation of unique sequences of waveforms. This can be especially useful for creation of custom burst sequences.

In addition to complete programmability, the PFG 5105 has the ability to store up to 99 front panel settings which can be called up either from the front panel or through the GPIB. This feature reduces programming time and enhances standalone bench applications.

FLEXIBLE FRONT PANEL

A SPCL function key extends the functions of the front panel, letting you change the GPIB address and/or terminators, or alter the contrast and back-lighting of the front panel. Use the INCREMENT keys to scroll through the SPCL codes for the desired operation.

CONVENIENT LCD DISPLAY

The PFG 5105 features a two-row LCD display with 16 characters in each row. Character mnemonics describe the function or parameter being displayed, with its current value and its units of measure. Errors are displayed as 3-digit code numbers (same as GPIB code) with an accompanying description. Pressing the INST ID key causes instant display of the generator's GPIB address and EOI / LF termination.

PAIRED PULSE GENERATION

Double pulse generation is very convenient when evaluating a circuit's ability to differentiate between two closely spaced pulses. Paired pulses can be generated at selected repetition rates with the delay control determining the time between the two pulses.

TM 5000 SERIES COMPATIBILITY

As a member of the Tektronix TM 5000 family of programmable modular test instruments, the PFG 5105 is fully GPIB compatible and adheres to Tek Standard Codes and Formats, insuring ease of configurability and communication for integrated systems use configurations.

PFG 5105 occupies three slots in any TM 5000 Mainframe and can be combined with any of the TM 5000 instruments to form completely programmable stimulus and measurement systems.

PFG 5505 is a standalone version of the PFG 5105.

OPTIONS

Opt. 02 adds a frequency lock synthesizer that provides a stable output waveform by locking the output to an internal quartz crystal. This option operates in continuous mode only, from 12.1 Hz to 12 MHz.

CHARACTERISTICS

Waveforms – Sine, square, triangle, pulse, double pulse, and dc.

OPERATING MODES

Continuous – Output continuous at programmed frequency, amplitude, and offset.

Triggered – Output quiescent until triggered by an internal, external, GPIB, or manual trigger; then generates one pulse event or one function cycle at programmed frequency, amplitude and offset.

Gated – Same as triggered mode except waveform is executed for the duration of the gated signal. The last cycle started is completed.

Burst – Same as triggered mode for programmed number of cycles from 1 to 9999, as set by the NBURST function.

Sweep – Linear, programmable start frequency, stop frequency, and rate (time per sweep). Sweeps can be continuous, triggered, gated, or burst.

Modulation – Generator can be frequency and amplitude modulated.

Increment – Frequency, amplitude, offset, rate, width, delay, and NBurst can be manually incremented/decremented by a settable INCREMENT delta. Step rate is 2 steps/s for first 3 steps, then 10 steps/s for successive steps for one continuous keystroke.

FREQUENCY

Range – 0.012 Hz to 12.0 MHz

Resolution – 3 1/2 digits (1200 counts); Optional synthesizer mode: 4 1/2 digits (1200 counts)

Accuracy – ±0.01% for pulse modes with internal triggering. ±0.2% of reading from 121 Hz to 5 MHz in continuous mode. ±0.5% of reading from 5 to 12 MHz in continuous mode; ±5% of reading from 0.1 to 120 Hz in continuous mode; ±0.005% in optional synthesizer mode, 12.1 Hz to 12 MHz.

Jitter – < 0.1% to 5 MHz.

Stability – ±0.2% in continuous mode for all time intervals. ±0.005% in optional synthesizer mode, 12.1 Hz to 12 MHz. ±0.5% for 24 hours in other modes.

Repeatability – ±1% for 24 hours in other than continuous mode. ±0.005% in optional synthesizer mode, 12.1 Hz to 12 MHz.

OUTPUT CHARACTERISTICS

Amplitude Range – 10 mV to 9.99 V p-p into 50 Ω (20 mV to 19.98 V p-p into open circuit).

Amplitude Resolution – 10 mV from 1 to 9.99 V p-p into 50 Ω; 1 mV from 0.1 to 0.999 V p-p into 50 Ω; 1 mV from 10 to 99 mV p-p into 50 Ω.

Amplitude Accuracy – ±2.0% ±20% mV of programmed value for 1.0 to 9.99 V output at 20 to 30°C; ±5% ±5 mV for 10 to 999 mV output, specified for a sine, square, or triangle wave output at 1 kHz.

Repeatability – ±1 for 24 hours.

Amplitude Flatness – 0.5 dB from 0.012 Hz to 120 kHz, ±2 dB to 1.2 MHz, ±3 dB to 12 MHz referenced to 1 kHz sine, square or triangle wave.

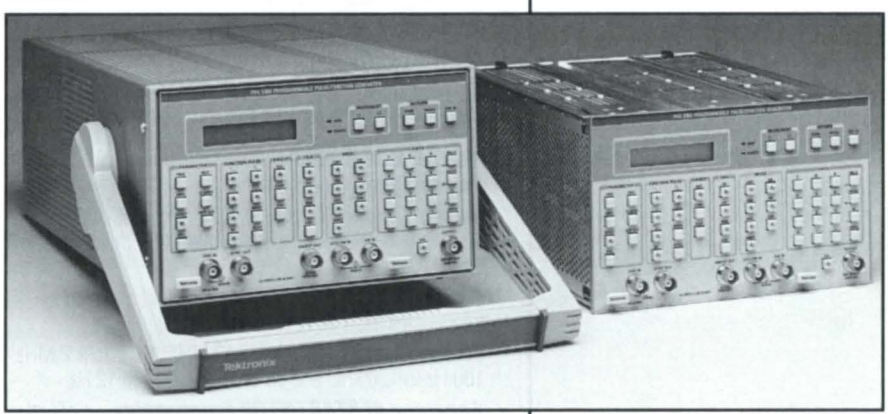
Offset Range – 4.99 V from 1 to 9.99 V into 50 Ω; 0.499 V from 0.1 to 0.999 V into 50 Ω; 0.049 V from 0.01 to 0.099 V into 50 Ω.

Offset Resolution – 3 digits; 1 mV when p-p amplitude is <999 mV; 10 mV when p-p amplitude is >1 V, into 50 Ω.

Repeatability – ±1% ±20 mV for 24 hours.

Output Impedance – .50 Ω

Output Protection – instrument is nondestructively protected against short circuits or accidental voltage of up to 100 V (dc + peak ac) applied to the main output connector.



PFG 5505/5105 Pulse Function Generators.

WAVEFORM CHARACTERISTICS

Sine Distortion – <0.6% THD (RMS), 121 Hz to 120 kHz at 5 V p-p amplitude at 20 to 30°C. <1% THD (RMS), 12 Hz to 120 kHz at full temperature and amplitude range.

Square Wave Time Symmetry – <0.5%, 121 Hz to 120 kHz; ±1%, 121 kHz to 1.2 MHz; ±5%, 1.21 MHz to 12.0 MHz.

Pulse and Square Wave Transition Time – <15 ns 10 to 90% at full output amplitude; elsewhere < 20 ns, 10 to 90%.

Pulse and Square Wave Aberrations – < 8% of p-p amplitude ±20 mV from 3.4 to 9.99 V p-p output amplitude. <10% of p-p amplitude below 3.34 V p-p output amplitude.

Triangle Linearity – 98% to 100 kHz measured from 10 to 90% on waveform.

Pulse Width and Delay – 40 ns to 99.9 ms.

Resolution – 3 digits, 10 ns maximum.

Accuracy – ±5% of programmed value, ±10 ns.

Repeatability – ±1%, ±5 ns.

Pulse Duty Cycle – Delay plus width may be up to 85% of period.

Double (Paired) Pulse – 2 pulses of selected width up to 6 MHz separated by selected delay period.

DC Range – ±10 mV to ±4.99 V dc from 50 Ω into 50 Ω load.

DC Accuracy – ±0.5% ±20 mV in DC function only, into 50 Ω.

GPIB IEEE-488 *

**The PFG 5105/PFG 5505 complies with IEEE Standard 488.1-1987 and with Tektronix Standard Codes and Formats*

FG 5010

Programmable Function Generator

- *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*

ORDERING INFORMATION

FG 5010 20 MHz Function Generator Includes: Instruction manual (070-3467-01); Instrument Interfacing Guide (070-4613-00); Reference Guide (070-3561-00).	**$4,125**

GPIB IEEE-488 *

**The FG 5010 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

INTERNAL TRIGGER

Range – Repetition rate 100 ns to 999.9 s.

Resolution – 4 digits, 100 ns maximum.

Accuracy – 0.01%.

SYNTHESIZER OPTION

Range – 12.1 Hz to 12 MHz.

Resolution – Frequency resolution (LSD of display) is 10 MHz on lowest range and 1 kHz on highest frequency range (4.5 digits, or 12,000 counts).

Accuracy – ±50 ppm averaged measurements.

Stability – ±10 ppm/°C or better.

Setting time – Typically less than 2 s plus 100 cycles.

Jitter – ±0.1% from 12.1 Hz to 12 MHz.

FREQUENCY SWEEP

Sweep Type – Linear only.

Sweep Time – 100 ns to 999.9 s per point. 100 ns (4 digit) max resolution. 1 sweep equals 256 points for the time base.

Sweep Width – 1200:1 maximum; start and stop frequencies must be in the same range.

Sweep Ranges – 10 kHz to 12 MHz; 1 kHz to 1.2 MHz; 100 Hz to 120 kHz; and so on until 0.012 to 12 Hz.

Accuracy of START/STOP Frequencies – ±5% of upper frequency, typical.

INPUTS AND OUTPUTS

VCF Input – 5V p-p for a 500:1 minimum frequency change.

Trigger IN –TTL compatible. Nominal impedance: 10 kΩ. Maximum rate: 6 MHz. Minimum width: 20 ns.

AM Input – Input resistance: 10 kΩ nominal. 5 V p-p (0 to ±5 V dc) for 100% modulation. Bandwidth: dc to 20 kHz minimum.

Input Protection – All inputs protected against up to ±50 V (dc peak ac) accidental input.

Sync Output – TTL level squarewave at programmed frequency.

Sweep Output – Source resistance 600 Ω ; same waveshape as selected sweep. Amplitude depends on start and stop frequency and a 5 V limit.

GPIB PROGRAMMING

Interface – IEEE 488.1 1987 compatible

Subsets – SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0, E2

ENVIRONMENTAL CHARACTERISTICS

Temperature – Operating: 0 to 50°C. Non-operating: –20 to 60°C.

Electrical Discharge – Operating Max Test Voltage: 15 kV, 150 pF through 150 Ω . Non-operating Max Test Voltage: 20 kV, 150 pF through 150 Ω .

GENERAL

Power Consumption – 50 VA maximum limited by internal fuse.

Power Dissipation – 30 W (PFG 5105); 90 W (PFG 5505).

Memory – Non-volatile, stores up to 99 complete front panel settings.

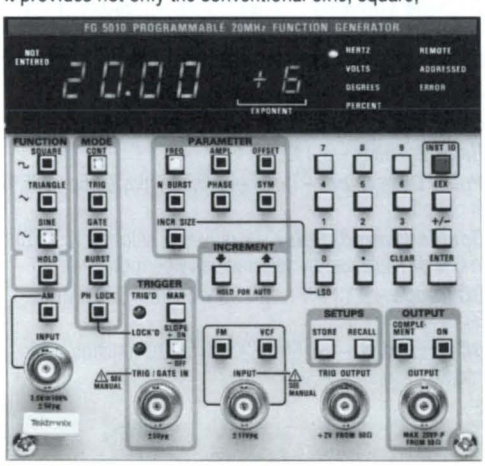
Display – 2 line alphanumeric, 16 character LCD. Provides for descriptive error messages. Variable back lighting and contrast.

PHYSICAL CHARACTERISTICS

	PFG 5105		PFG 5505	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	135	5.3	234	9.2
Height	127	5.0	140	5.5
Depth	310	12.2	432	17.0
Weight	**kg**	**lb**	**kg**	**lb**

FG 5010

The FG 5010 Programmable Function Generator provides waveform generation from 0.002 Hz to 20 MHz. It provides not only the conventional sine, square, triangle, waveforms, but also incorporates variable symmetry which is usable throughout the frequency range and extends pulse and ramp capabilities beyond those of conventional generators. The FG 5010 also provides trigger, gate counted burst, phase lock, AM, FM, and VCF modes. Variable phase enhances the trigger, gate, burst, and phase-lock modes.



All functions are fully programmable either from the front panel or over the GPIB. The ability to store up to 10 complete front panel settings reduces programming requirements and enhances 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 complement and ± trigger slope allow interfacing to circuits with the proper waveform phase, especially important in pulse and digital applications. Waveform hold can freeze the output voltage of any 200 Hz or less waveform at its instantaneous value. With the output amplitude set to 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

Frequency Range – 0.002 Hz to 20 MHz.

Accuracy – Continuous mode, ±0.1.%; Trigger, Gate, Burst Modes, Frequency ≤ 200 Hz, ±0.1%; frequency > 200 Hz, ±5.0%.

Resolution – Continuous mode, 4 digits; Trigger, Gate, Burst modes, Frequency ≤ 200 Hz, 4 digits; Frequency > 200 Hz, 3 digits.

Frequency Stability – ≤ 0.05% of full scale for 1 hour, ≤ 0.05% of full scale for 24 hours.

Amplitude – Range: 20 mV to 20 V p-p from 50 Ω (into open circuit).

Triangle Amplitude Flatness – ±2%, 0.002 Hz to 1 kHz; ±3.5%, 1 Hz to 100 kHz; ±4%, 100 KHz to 1 MHz, + 4%,–5%, 1 to 5 MHz; + 4%,–20% 5 to 20 MHz

Square Amplitude Flatness – ±2%, 0.002 to 1 kHz; ±3.5%, 1 kHz to 1 MHz; ±5%, 1 to 10 MHz; ±10%, 10 to 20 MHz.

Square Wave Response – ≤ 10-ns rise/fall; ≤ ±(5% + 20 mV) aberrations.

Symmetry – 10 to 90%, 1% steps, ±2% accuracy.

Range above 4 MHz is limited by 25 ns minimum triangle transition time (decreases to 50% at 20 MHz).

Triangle Linearity – > 98% to 2 MHz; > 90% to 20 MHz.

Trigger Output – 0 ±100 mV to ≥ 2 V from 50 Ω into an open circuit.

Trigger Input – 1 M Ω/50 Ω selectable; 0.0 V/0.5 V selectable.

Phase Lock – 20 to 20 MHz (Auto Scan).

Counted Burst – 1 to 9,999.

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%.

Output Hold Mode – 0.002 to 200 KHz.

GENERAL

Power Consumption – 60 W

IEEE Standard 488.1 1987 Interface Function Subsets Implemented –SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0.

FG 504

The output of the FG 504 can be phase locked, gated, or triggered by a reference signal. This lets you convert from one waveform to another, such as pulses to sine waves, as well as adjusting phase relationships. Post-attenuator offset enables use of the full ±7.5 V offset range with small signals. The FG 504 output can be swept, or amplitude or frequency modulated by external signals. In addition, the FG 504 can supply internally generated linear- or logarithmic-swept frequencies of up to a 1000:1 range with convenient control of start and stop frequencies.

The FG 504 also provides trigger output, external voltage-control input, and sweep output.

For more Function Generator characteristics, see selection guide, page 247.

CHARACTERISTICS

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 temp.

Attenuator in 10 dB Steps – 0 to –50 dB

VAR Control – Variable control provides up to –20 dB additional attenuation.

Triangle Amplitude – ≤ ±0.5dB to 40 KHz; ±2 dB, 40 kHz to 40 MHz.

Square Amplitude – ±0.5 dB to 20 MHz; ±2 dB to 40 MHz.

Square-Wave Response – ≤ 6 ns rise/fall fixed, 10 ns to 100 ms variable; ≤ 5% p-p + 30 mV aberrations.

Triangle Linearity – ≥ 99%, 10 Hz to 400 kHz; ≥ 98%, 400 kHz to 4 MHz. ≥ 90%, 4 MHz to 40 MHz.

Trigger Output – + 2 from 50 Ω.

External Trigger Input – Impedance ≥ 10 kΩ; Sensitivity ≤ 1 V p-p; Trigger level; –1 to + 10 V.

Phase Lock – 100 to 40 MHz ±80° phase range,

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.

Output Hold Mode – 0.001 to 400 Hz.

FG 503

The FG 503 Function Generator provides high-quality low-distortion sine, square, and triangle waveforms. Six decade frequency multiplier steps, a custom position for user-determined frequency multiplication, a dial calibrated from 1.0 to 30 (uncalibrated from 0.1 to 1.0), and a frequency vernier control working together to select frequencies in overlapping ranges from 1 Hz to 3 MHz. The output frequency can be swept over a 1000:1 ratio by an external voltage. Output amplitude and offset controls are provided. A trigger output is available for controlling external devices or equipment. Amplitude up to 10 V peak-to-peak can be developed across a 50 Ω load (20 V peak-to-peak open circuit). Selectable offset up to 3.75 V dc across 50 Ω (7.5 V dc open circuit) is also featured.

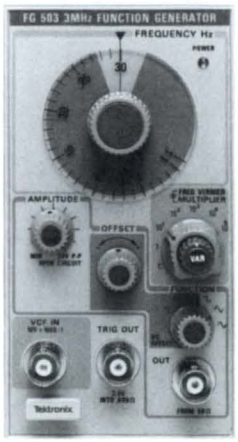
CHARACTERISTICS

Frequency Range – 1 to 3 MHz (0.01 to 5 MHz usable).

Dial Accuracy – ±5%of F.S 1Hz to 3 MHz

Custom Frequency Range – With user installed cap.

Frequency Stability – ≤ 0.1% for 1 hour, ≤ 0.5% for 24 hours, constant temperature.



FG 504

- *0.001 Hz to 40 MHz*
- *Three Basic Waveforms, Plus a Wide Range of Shaping With Variable Rise/Fall Times and Symmetry Controls*
- *Logarithmic or Linear Sweep*
- *Up to 30-V P-P Output*
- *Built-In Attenuator*
- *AM and FM*
- *Phase-Lock Mode*
- *External and Manual Trigger or Gate*
- *Counted Burst With DD 501*

ORDERING INFORMATION

FG 504 40 MHz Function Generator **$3,375**
Includes: Instruction manual (070-2655-00).

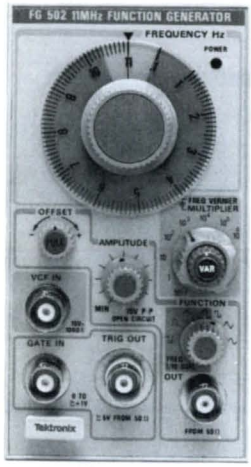
FG 504 T 40 MHz Function Generator **$4,195**
Includes: FG 504, TM 503A Mainframe, and Blank Panel (016-0195-03).

FG 503

- *1.0 Hz to 3 MHz*
- *Three Waveforms*
- *VCF*

ORDERING INFORMATION

FG 503 3-MHz Function Generator **$710**
Includes: Instruction manual (070-1727-01).



FG 502

- *0.1 Hz to 11 MHz*
- *Five Waveforms*
- *VCF and Gated Burst*

ORDERING INFORMATION

FG 502 11-MHz Function Generator **$1,145**
Includes: Instruction manual (070-1706-01).

FG 501A

- *0.002 Hz to 2 MHz*
- *30 V Peak-to-Peak, 13-V Offset*
- *5 to 95 Variable Symmetry*
- *Trigger or Gate, Slope*
- *60-dB Step Attenuator*
- *≤0.25% Sine-Wave Distortion*
- *≤25 ns Rise/Fall*

ORDERING INFORMATION

FG 501A 2 MHz Function Generator **$970**
Includes: Instruction manual (070-2957-00).

DD 501

- *Digital Events Delay*
- *Delay to 99,999 Events*
- *Divide by N Up to 20 MHz*
- *Pulse Counting to 65 MHz*
- *Time Delay With External Clock*
- *Compatible with Most Attenuator Probes*

ORDERING INFORMATION

DD 501 Digital Delay **$2,295**
Includes: Instruction manual (070-6759-00).

Amplitude Flatness – within ±2dB referenced at 10 kHz

Square Wave Response – ≤ 60 ns rise/fall; ≤ 3% p-p aberrations.(50 Ω load).

Triangle Linearity – Typically ≥ 99%, 1 to 100 kHz; ≥ 95%, 100 kHz to 3 MHz.

Trigger Output – + 2.5 to 600 Ω load.

FG 502

The FG 502 Function Generator provides low-distortion sine, square, and triangle waveforms, and positive or negative ramps and pulses. Output frequency is continuously variable from 0.1 Hz to 11 MHz. The high-frequency range from 1 to 11 MHz permits the versatility of the function generator to be extended into the medium radio frequency range. VCF input permits the FG 502 to be used as a sweep generator or as an FM generator.

External-gate input permits the FG 502 output in any of its modes to be controlled by an externally supplied pulse to generate bursts of various output waveforms. The FG 502 is used in wireless or radio remote-control equipment and in certain phases of the telephone industry.

CHARACTERISTICS

Frequency Range with Var. Symmetry – 0.1 to 11 MHz (1.1 MHz Pulse, Ramp).

Dial Accuracy – ≤ 3% to 1 MHz, ≤ 5% to 10MHz.

Sine Amplitude – ≤ ±1.5dB referenced at 10 KHz.

Triangle Amplitude – ±3 dB ref to Sine Wave.

Square Amplitude – ±3 dB ref to Sine Wave.

Square Wave Response – ≤ 20 ns rise/fall; ≤ 3% p-p aberrations.

Triangle Linearity – Typically ≥ 99%, 0.1 to 110 kHz > 97%,
100 kHz to 1.1 MHz; ≥ 95%, 1 to 11 MHz.

Trigger Output – + 2.5 to 50 Ω load.

External Input – Impedance ≈1 kΩ; ≥ +2 V gate signal required.

FG 501A

The FG 501A provides low-distortion outputs from 0.002 Hz to 2 MHz. It is capable of generating five basic waveforms—sine, square, triangle, ramp, and pulse—at output levels up to 30 V peak-to-peak with up to ±13 V of offset from a 50 Ω source. Waveform triggering and gating are provided with a variable phase control to permit up to ±90° of phase shift for generating haversines, sine pulses, and haver triangles. A step attenuator provides 60 dB of output signal attenuation in 20 dB steps with an additional 20 dB of variable attenuation. Variable symmetry from 5% to 95% provides ramps and pulses. Pulse rise time is ≤ 25 ns. Audio sine-wave distortion is ≤ 0.25 and audio amplitude flatness is within 0.1 dB.

CHARACTERISTICS

Dial Accuracy – ≤3%, 20 to 2 on dial.

Attenuator (dB) in 20 dB Steps – 0 to – 60.

Attenuator with AMPL Control – > 20dB additional.

Triangle Amplitude – ±0.5 dB, 20 to 200 kHz; ±2 dB, 200 kHz to 2 MHz.

Square Amplitude – ±0.5 dB, 20 to 2 MHz.

Square Wave Response – ≤ 25 ns rise/fall; < 3% p-p aberrations.

DD 501

The DD 501 Digital Delay is an events-counting device that can be used with pulse, function, and clock generators in such applications as precise digital delay between two related events, divide-by-N frequency divider, precision gate generator, counted burst output from a gated pulse or frequency generator, etc.

Basically, the DD 501 has two modes of operation. In the gating mode, the DD 501 generates a gate that starts with the application of a start pulse and continues until a selected number of event pulses have occurred. It can be used for generating a counted burst of N pulses when used with a pulse generator capable of being gated.

In the delayed-trigger mode, the DD 501 generates a trigger pulse after the selected number of event pulses have occurred. Besides being used strictly for generating precision delays, the delayed-trigger mode can also be used as a frequency count-down divider. In both modes, the desired number of events (from 0 to 99,999) is selected by front-panel thumbwheel switches.

CHARACTERISTICS

EVENTS DELAY

Count – 10 to 99,999 events.

Maximum Count Rate – 65 MHz.

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

INPUT CHARACTERISTICS

All characteristics apply to both events and start inputs.

Input Impedance – 1 MΩ, 20 pF.

Slope – Either + or –, selectable.

Sensitivity – 85 mV p-p at 30 MHz.

Minimum Detectable Pulse Width – 5 ns.

Threshold Level Range – From -1.0 to +1.0 V (–10 to 10 V with 10X probe). Can be externally programmed or monitored at front-panel jacks.

TRIGGER OUTPUT

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

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

PULSE GENERATORS

Whether testing wide-band systems, simulating data transmission signals, or driving a laser, the TM 500 series Pulse Generators have the required capabilities to meet your needs. The general purpose, yet versatile PG 508 features independently variable rise and fall times for close approximations of real world events. The new PG 503 offers fast 200 ps transition times for testing the new high-speed ECL and GaAS logic families. The PFG 501/5505 offers pulse and function capabilitiy in a GPIB programmable instrument. These multipurpose generators can also be used for stimulus of high-impedance MOS, HTL, and CMOS logic circuits.

For added functionality, the DD 501 Digital Delay Generator can add precise delays and gate signals to use in conjunction with any of the TM 500/5000 Pulse Generators.

In 50 Ohm systems, the repetition rates, amplitudes, and transition times of the PG 501 and PG 502 are designed to be compatible with common TTL, DTL, and ECL circuits.

PG 501, PG 502, PG 508 Pulse Generators

PULSE GENERATOR SELECTION GUIDE

Characteristic	PFG 5105/5505	PG 508	PG 501	PG 502	NEW PG 503
Pulse Period	83 ns to 83.3 s 0.012 Hz to 12.0 MHz	≤ 20ns to ≥ 200 ms 50 MHz to 5 Hz	≤ 20ns to ≥ 200ms 50 MHz to 5 Hz	≤ 4 ns to ≥ 100 ms 250 MHz to 10 Hz	≤ 4 ns to ≥ 100 ms 250 MHz to 10 Hz
Pulse Duration	40 ns to 99.9 ms	≤ 10ns to ≥ 100 ms	≤ 10ns to ≥ 100 ms	≤ 2ns to ≥ 50ms	≤ 2ns to ≥ 50ms
Square-Wave Mode	•	•		•	•
Duty Factor	Up to 85%	≥ 70% to 0.2 µs period ≥ 50%at 20ns period	≥ 70% to 0.2µs period ≥ 50% at 20ns period	≥ 50%	≥ 50%
Pulse Delay	40 ns to 99.9 ms	≤ 10ns to ≥ 100ms*1	Fixed, 8 ns	Fixed, 17 ns	
Double Pulse	•	•			
Transition Times	Fixed, < 15 ns At Full Output	≤ 5.5 ns ≥ 50ms, variable	Fixed, ≤ 3.5 ns	Fixed, ≤ 1ns	Fixed, ≤ 200 ps (20 to 80% @ 1 V range)
Aberrations	< 8% ± 20mV from 3.4V to 9.99 V Output	≤ 5% + 50mV into 50 Ω	± 3.5% into 50 Ω	± 5% (duration ≥ 5ns)	± 8% at 1 V steps
Amplitude (Vp-p from 50- source impedance)	9.99 V	≥ 10, ± 10-V window	≥ 5	5, ± 5-V window	2.5 V, 2.5 V window
IEEE STD 488.1 1987	YES				
Price	$2,995/$3,595*2	$2,595	☎ $895	$3,195	Contact your local sales representative

*1 *Add 60 ns for delay from external trigger.* *2 *For more information on the PFG 5105/5505, see page 250.*

PG 508

The PG 508 is a versatile, general-purpose, 50 MHz pulse generator. The circuitry of the PG 508 is designed so that rise and fall waveforms closely simulate real-world waveforms. This capability is particularly useful in research-and-development applications demanding versatility in rise and fall times, such as testing of amplifiers, slew-rate testing, comparator simulation, and logic-circuitry performance tests.

For example, controllable rise and fall times are extremely desirable when working with CMOS where logic power consumption increases with slower rise times. Also, variable rise and fall times are used to reduce ringing (transient distortion) problems associated with too fast a pulse.

The PG 508 features a vernier control on the rise and fall times controllable from 100 to 1. This completely overlaps the next decade range and increases the PG 508's versatility in applications simulating different rise and fall times, especially the output of nonlinear devices. This overlap feature can also be used to generate a ramp signal or simulate unequal slew rates in an amplifier.

Also adding to the simplicity of using the PG 508 is the capability of changing output amplitude while variable rise and fall times remain constant.

CHARACTERISTICS

External Input Impedance – 1MΩ or 50 Ω

Trigger level – 3 to +3V

Trigger Sensitivity – 80 mVp-p to 10 Mhz, 250 mV to 50 MHz

Trigger Output – (50% square wave of follows external signal): ≥ +2V from 50 Ω, ≈ 35ns before pulse (23 ns in square wave or external duration modes).

PG 508

- ***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***

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

NEW PG 503

- *10 Hz to 250 MHz*
- *≤200 ps Rise Time*
- *2.5 V Output, ±2.5 V Window*
- *Independent Pulse Top and Bottom Level Controls*
- *Complementary Outputs*
- *Manual Trigger Button*

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 ReverseTermination*
- *Manual Trigger Button*
- *Optional Rise Time Limiter*

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*

ORDERING INFORMATION

PG 508 50 MHz Pulse Generator **$2,595**
Includes: Instruction manual (070-2044-01).

PG 508T 50-MHz Pulse Generator **$3,295**
Includes: PG 508, TM 503A Mainframe, and 016-0195-03 Blank panel. For counted burst order the DD 501 Digital Delay Suggested 10-inch BNC 50 Ω cable (2 required) for interconnecing PG 508 and DD 501. Order 012-0208-00

PG 503 250 MHz Generator *1
(not shown)
Contact your local sales office.

PG 502 250-MHz Pulse Generator **$3,195**
Includes: Instruction manual (070-1598-01).

PG 501 50 MHz Pulse Generator ☎ **$895**
Includes: Instruction Manual (070-1361-01).

DD 501 Digital Delay **$2,295**
Includes: Instruction manual (070-1818-01).

RECOMMENDED PROBES

See Signal Acquisition section.

P6062B – 1X/10X, dc to 100 MHz. **$190**
P6108A – 10X, dc to 100 MHz. **$90**
P6122 – 10X, dc to 100 MHz. **$63**

OPTIONAL ACCESSORIES

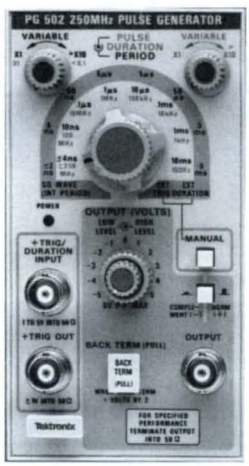
50 Ω Cable – Order 012-0482-00 **$29**
Trigger Generator –
Order 016-0597-00 **$260**
Rise Time Limiter –
Order 015-0249-00 **$200**

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

*1 *Contact your local sales representative*

NEW PG 503

The PG 503 is a 250 MHz general purpose, fast rise pulse generator useable in either the TM 500 or TM 5000 series mainframes. It is identical to the PG 502 except for output which is now differential; the risetime is faster, and the amplitude range is 2.5 V within a ±2.5 V window. The fast risetime makes the PG 503 ideal for testing the new high-speed ECL and GaAs logic families.



PG 502 Pulse Generator

PG 502

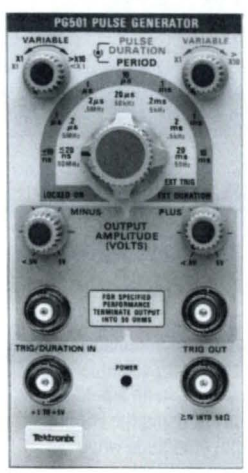
The PG 502 features fast rise and fall times, independent top and bottom pulse levels, and adjustable pulse duration. The fast rep rate makes the instrument ideal for design and testing of fast logic and switching circuits.

CHARACTERISTICS

External Input Impedance – 50 Ω

Trigger Level – +1V

Trigger Output – (50% square wave of follows external signal) ≥+2 V from 50 Ω, ≈10 ns before pulse.



PG 501 Pulse Generator

PG 501

The PG 501 is a 50-MHz Pulse Generator featuring simultaneous plus and minus outputs, a wide range of pulse-period durations and duty factors, trigger output, and external trigger/duration input. Its performance and ease of operation make it well-suited to basic digital and analog applications.

MANUAL (ONE-SHOT) TRIGGER ASSEMBLY

For instruments that do not have a manual trigger (such as the PG 501), or where remote triggering is required, the Manual Trigger Assembly initiates a pulse or a full chain of events at the push of a button.

The Trigger Assembly produces a debounced output pulse nominally 2 ms in width and 3 V in amplitude (from 50 ohms) with rapid rise and fall times. It will send pulses as fast as the operator can cycle the pushbutton.

AUTOMATED TRIGGERING WITH THE DD 501

The PG 508 can be adapted with the DD 501 to provide automated triggering in a gated or delayed trigger mode. For more information on the DD 501 see the Function Generators section.

50 OHM PRECISION COAXIAL CABLE

The PG 502, PG 506, and SG 503 are internally calibrated for use with this 3-ft, 50 Ohm, coaxial cable into a 50 Ohm load.

RISE TIME LIMITER

For use with the PG 502 Pulse Generator which has a pulse rise and fall time of less than one nanosecond. In some applications, such as TTL logic where slower rise time is needed, this fast pulse can be limited to six nanoseconds by using the rise time limiter.

MODULAR POWER SUPPLIES THEORY AND SPECIFICATIONS

Power supplies used as test equipment differ from supplies sold as OEM components in that they offer a broader range of output and limiting adjustments. In addition, instrumentation supplies have tighter regulation specifications and often provide their own metering.

Some supplies are GPIB programmable, some are not. For benchtop ATE, where it is routinely necessary to observe the test system's performance at the limits of the supply voltage, programmability is necessary. However, non-programmable supplies may be sufficient for development breadboarding.

FLOATING OUTPUTS AND MULTIPLE SUPPLIES

Because the outputs of most instrumentation supplies need not be referenced to ground, it is possible to connect them in series. Series connection can give you either a higher output voltage or the positive and negative voltages required by some linear and logic ICs. Parallel connection (which requires that both supplies be set to the same output level) provides higher current capability.

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.

VOLTAGE AND CURRENT LIMITING AND CROSSOVER

Instrumentation supplies function as either constant voltage or constant current sources. In constant voltage mode, you must set a maximum current limit and in constant current mode, you must set a maximum voltage limit. When the load impedance causes the supply to exceed these limits, the limiting mode crosses over to the complementary function.

For example, suppose you have set an output voltage of 13.8 Volts, with a current limit of 1 Ampere. If the load tries to draw more than 1 Ampere (perhaps because the output of the supply is shorted), current will be limited to that value and the output voltage will be reduced accordingly.

Similarly, if you are in constant current mode, with the level set to 40 mA and the voltage limit set to 5 V, if the load impedance increases, regulation will cross over when the output voltage tries to go higher than 5 V.

Some simple voltage supplies use current foldback to handle excessive load demand. As load impedance decreases, current increases until its limit is reached. Beyond that, both current and voltage drop.

Certain fixed voltage supplies, such as the 5 V logic supply in Tek's PS 5010, are protected by a "crowbar" circuit that shorts the output when a certain threshold is exceeded.

REMOTE SENSING

Supplies that offer remote sensing let you regulate voltage according to the actual potential at the load, rather than the potential at the instrument output terminals. This permits more precise regulation at high current levels because it compensates for the IR drop in the supply leads. If you do not use remote sensing on supplies that have this feature, the sense terminals are clamped to the output terminals by pull-up resistors. When you use remote sensing, you must take some precautions to keep noise from being picked up by the sense leads because this could modulate the regulated output. Always use shielded twisted pair for sense wiring, and, to avoid a ground loop, ground the shield at the supply or at the device under test, but not at both places. To avoid creating a feedback loop, do not run the sense leads immediately adjacent to the main supply leads.

If you are matrix switching the output of the power supply, be sure to set the timing of the switching relays so that the main supply is connected to the load after the sense leads and that it is disconnected before the sense leads. Otherwise, you will apply an overvoltage to the load. If you can not accomplish this with your switching arrangement, turn the supply off before switching.

When using multiple supplies in series or parallel, connect the remote sense terminals in the same manner as the main supply terminals.

NOISE SUPPRESSION

At its output terminals, a voltage supply looks like a low impedance voltage source. Lead inductance increases this impedance, and there can be significant inductance in a test system, because the lead length from test fixture to test supply is typically much longer than in any product design. Because of this, it is important to bypass the load with a low dissipation, low inductance capacitor of one or more microfarads.

SPECIFICATIONS

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. Some manufacturers sum all of these into an overall accuracy figure. Noise and ripple provide another figure of merit, sometimes specified as PARD, for Periodic And Random Deviations. It is expressed in peak-to-peak millivolts.

POWER SUPPLIES

Design engineers require power supplies that are flexible enough to meet their needs and compact enough to allow a complete, custom-designed test system to fit neatly on a crowded workbench. To ensure versatility and convenience in your test system, the TM 5000/TM 500 power supplies can be rear-interfaced with other instruments to reduce front-panel clutter while providing capabilities not otherwise available. For example, the output level can be monitored via the rear interface by a companion TM 5000/TM 500 digital multimeter without the need for extra cabling at the front of the instrument. Remote sensing terminals available at the rear interface allow sensing of the applied voltage at the load, thereby minimizing the effects of loading on the supply.

POWER SUPPLIES

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*

PS 5004

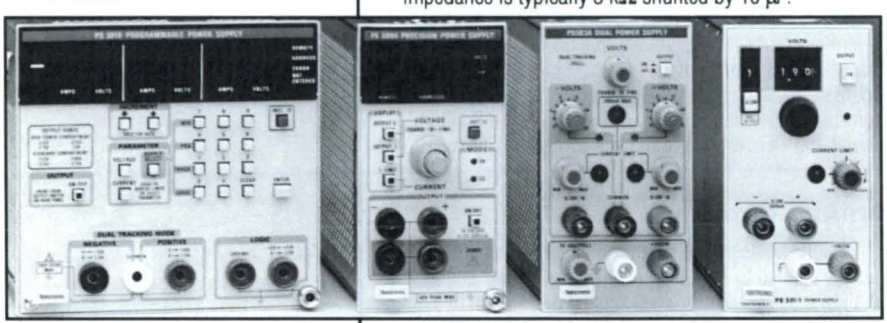
- *0 to 20 V Floating Output*
- *0.01 Accuracy*
- *500 V/0.1 mA Resolution*
- *Constant Voltage or Constant Current With Autocrossover*
- *Voltage- and/or Current-Monitoring Display*
- *Remote Sensing*

PS503A

- *Independent Controls*
- *Dual Tracking Voltage Control*
- *0 to 20 V at 1 A (in High-Power Compartment)*
- *Fixed Output 5 V at 1 A*
- *Remote Resistance Programming*

PS501-1

- *Floating Output, 0 to 20 V*
- *0 to 400 mA*
- *Precise Regulation*
- *Low Ripple and Noise*
- *Fixed Output 5 V at 1 A*
- *3 1/2-Digit Ten-Turn Dial*



TM 5000/TM 500 Power Supplies

GPIB IEEE-488 *

** The PS 5010 and PS 5004 comply with IEEE Standard 488.1-1987, and Tektronix Standard Codes and Formats*

PS 5010

The PS 5010 Programmable Power Supply provides a complete and rapid high-performance solution for many system power-supply applications. Its three supplies provide the most commonly used voltages, and the three digital displays automatically indicate all six voltage- and current-limit parameters. Automatic crossover from voltage to current limit and a powerful set of GPIB status reporting messages allow the user to be constantly aware of the PS 5010's status.

The PS 5010's dual floating supply provides 0 to +32 V and 0 to –32 V, both with respect to a common front-panel terminal. Or 0 to 64 V across the terminals of both supplies together – with current up to 0.75 A throughout the total voltage range and 1.6 A below 15 V. The logic supply provides 4.5 to 5.5 V with respect to ground, with current to 3 A. The user can program the outputs on and off, and can lock out the front-panel controls with GPIB commands.

CHARACTERISTICS

POSITIVE AND NEGATIVE FLOATING SUPPLIES

Voltage Mode – Overall Accuracy (total effect) ±(0.5% + 20 mA), Source Effect (line regulation) ±(0.01% + 2 mV)

Load Effect (load regulation) – 10 mA for a 1 A change in load current.

Temperature Coefficient (typical) – < (0.01% + 0.1mV)/°C

Resolution (step size) – 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 (0.750 A at 15 V and below) in two standard-power compartments.

Overall Accuracy – ±(5%+20 mA) Source Effect (line regulation) ±1 mA Load Effect: ±10 mA. Output impedance is typically 5 kΩ shunted by 10 μF.

PARD (Ripple and Noise) – 10 mA p-p, 5 mA (RMS), 20 Hz to 20 MHz, at front panel.

Resolution – 50 mA ±15 mA

Change Response Time – 20 ms up or down.

Isolation (V dc +peak ac) – 150 V peak front panel, 42 V peak rear interface.

LOGIC SUPPLY

CONSTANT VOLTAGE MODE

Overall Accuracy – ±50 mV

Source Effect (line regulation) – 1 mV

Load Effect (load regulation) – 10 mV for a 1 A change in load current; 1 mV when many rear interface and remote sensing.

Temperature Coefficient (typical) – < 500 μV/°C

Resolution (step size) – 10 mV ±10 mV

Pard (mV) (periodic and random deviations) – 10 mV p-p, 2 mV RMS, 20 Hz to 20 MHz

CURRENT LIMIT

Range – 100 mA to 3.0 A (Foldback characteristic below 4.5 V, maximum short circuit current is <1.5 A).

Overall Accuracy – ±(5% + 20 mA)

Resolution – 100 mA ±30 mA

Scaled Output – 10 mA =1 mV ±(2% + 2 mV) available at rear interface (not ground referenced).

Overvoltage Protection – SCR crowbar typically trips at 6 to 7 V.

Isolation (V dc + peak ac) – ground reference.

Power Consumption – 250 V A maximum in high power compartment, 200 V A in standard compartment. IEEE Standard 488.1-1987 Interface Function Subsets Implemented same as PS 5004.

Power Module Compatibility –The PS 5010 is not compatible with TM 500 mainframes.

PS 5004

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 ±10.01 ±2 mV.

The PS 5004 operates in either a constant-voltage or constant-current mode with autocrossover between the two. Front-panel annunciators indicate the mode at all times. The operating mode is also reported over the bus, and the PS 5004 can be programmed to assert SRQ when operating conditions cause it to change modes. The 4 1/2-digit display shows actual output voltage, selected current limit, or actual output current. The actual output voltage is shown even when the PS 5004 is operating in the current-limited or unregulated mode. Display resolution is 1 mV or 0.1 mA.

The buffered high-impedance sense terminals allow proper regulation of the supply with up to 3 Ω of resistance in either of the sense leads.

CHARACTERISTICS

CONSTANT VOLTAGE MODE

Range – 0 V + 20.0000 V ±0.5 mV steps.

Overall Accuracy – (total effect) ±(0.01% + 2mV) from + 15°C to + 30°C, derating to ±(0.035% + 3 mV) at 0°C and + 50°C

Source Effect (line regulation) – ≤ 0.5 mV.

Load Effect (load regulation) – ≤ 1 mV.

Temperature Coefficient (typical) – ≤(30 ppm +100 µV)/°C.

Resolution (step size) – 500 µV.

Pard (periodic and random deviations) – ≤3 mV p-p.

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)

Power Consumption – 35 VA Maximum

IEEE Standard 488.1-1987 Interface Functions Subsets Implemented – SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0.

Power Module Compatibility – The PS 5004 is not compatible with TM 500 mainframes.

PS 503A

The PS 503A provides dual floating variable 20-V supplies, plus a fixed 5-V, 1-A supply. The PS 503A features superior tracking, over-voltage protection, and remote resistance programming of voltage. When operated in the high-power compartment of a TM 504, TM 506, RTM 506, or TM 5006 mainframe, the PS 503A can provide up to 1 A from both of the 20 V supplies. A 0 to 40 V variable supply with up to 1 A of current can be configured by grounding one of the two outside terminals of the variable supplies. The two variable supplies can be set individually, then varied in a tracked mode with a single control. In addition, the plus and minus floating outputs can be programmed remotely, by either voltage programming or resistance programming via the rear interface.

CHARACTERISTICS

± 20V SUPPLY

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

Resolution (step size) – 50 mV

Pard (periodic and random deviations) – 3 mV p-p

POWER SUPPLIES SELECTION GUIDE

Characteristic	PS 501-1	PS 503A	PS 5004	PS 5010
# of Supplies	2	2	1	3
Max Voltages	0 to 20 V - +5	20 to +20 V +5	0 to 20 V	+ and -32 V Logic (+4.5 to 5.5 V)
Max Amps	400 mA 1 A	1 A 1 A	305 mA	1.6 A 3 A
IEEE-488 Interface			•	•
TM 500/TM 500	1	1	1	2
Price	$850	$795	$1,900	$3,150

+5V SUPPLY

Isolation (V DC + peak AC) – ground reference.

Current Limit – 1A

Load regulation – ≤50 mV for a ±10% line change.

Line regulation – ≤100 mV for a 1 A load change.

Pard (periodic and random deviations) – 5 mV p-p

PS 501-1

The PS 501-1 supplies 0 to 20 V (floating) and adjustable current limiting to 400 mA, with constant-current operation above the limit setting. The PS 501-1 features precise regulation and better than 2 mV resolution over its voltage range. A multi-turn dial with mechanical digital readout provides accurate setting of the output voltage. A fixed 5 V supply provides up to 1 A.

CHARACTERISTICS

0 TO 20 V SUPPLY

Isolation – 350 V (DC + peak AC)

Current Limit – <10 mA to at least 400 mA.

Line regulation – 5mV for a ±10% line voltage change.

Load Effect (regulation) – ±1 mV for a 400 mA load change.

Temperature Coefficient (typical) – < 0.01%/°C

Resolution (step size) – 1.6 mV

Pard (periodic and random deviations) – 0.5 mV p–p with 400 mA load.

+5V SUPPLY

Isolation – ground referenced.

Current Limit – 1 A

Source Effect (line regulation) – 50 mV for a ±10% line voltage change.

Load Effect (regulation) – ±100 mV for a 1 A load change.

Pard (periodic and random deviations) – 5 mV p-p with 1 A load.

ORDERING INFORMATION

PS 5010 Power Supply **$3,150**
Includes: Instruction manual (070-3391-00); Instrument interfacing guide (070-4610-00); Reference guide (070-3402-00).

PS 5004 Precision Power Supply **$1,900**
Includes: Instruction manual (070-4442-00); Instrument interfacing guide (070-4789-00); Reference guide (070-4596-00).

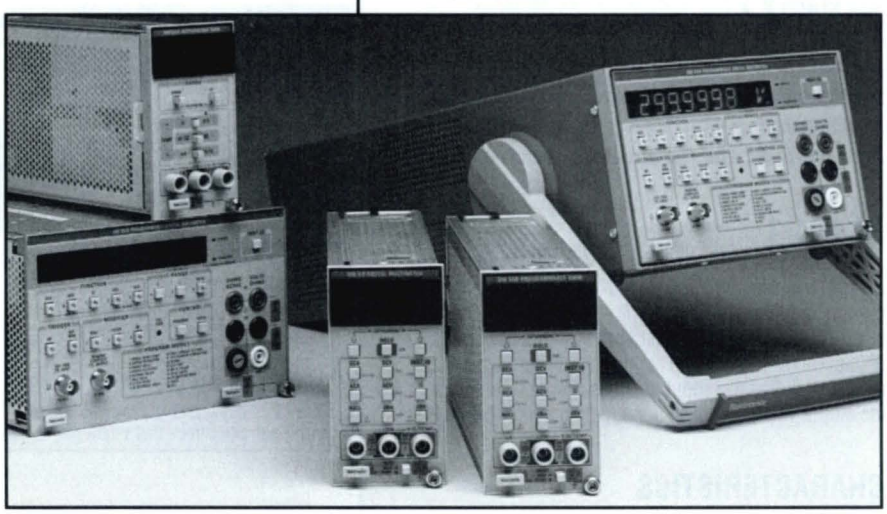
PS 503A Power Supply ☎ **$795**
Includes: Instruction manual (070-1834-01).

PS 501-1 Power Supply **$850**
Includes: Instruction manual (070-1301-02).

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

DIGITAL MULTIMETER THEORY AND SPECIFICATIONS

Digital Multimeters (DMMs) are based on analog-to-digital voltage converters. For dc voltage measurements, the input signal is scaled by a precision attenuator before being applied to the A-to-D converter. For dc current measurements, the attenuated input signal is applied to a precision resistor and the resulting voltage drop is measured. There are two approaches to resistance measurements. The most common method uses a series of precision current sources to create a voltage drop across the unknown being measured.



TM 5000/TM 500 Digital Multimeters

One approach to resistance measurement is sometimes called the "four wire" approach. This involves a precision voltage source in series with a reference resistor. The instrument measures the voltage across both the known and the unknown resistors in the resulting divider and calculates the unknown. The advantage of this approach is that the voltage source does not need to be accurate, just stable. Beyond voltage, current and resistance measurements, DMMs often provide dB measurement, which is simply a calibrated voltage measurement, and temperature measurement, using calibrated temperature probes or thermocouples. Some provide a NULL function, which permits users to make measurements relative to a predetermined baseline value.

UNDERSTANDING DMM SPECIFICATIONS

Accuracy: Tektronix specifies a percent of the reading, plus a percent of the full scale range. Some other manufacturers use percent of full-scale plus or minus so many counts or so many digits in the display. This can be confusing unless you understand how the number of digits in the display affects the resulting accuracy figure. First, consider a meter whose accuracy specification is given as 0.1% of the reading plus 0.1% of full-scale. If it is set to its 20 V range, what are the resulting accuracies for applied signals of 20 Volts and 2 Volts? At the high reading, the accuracy would be 0.02 V + 0.02 V = 0.04 V, which is 0.2%. At the lower reading, the accuracy would be 0.002 V + 0.02 V = 0.042 V, which is 1.1%. As has always been the case, readings at the lower end of a range are less accurate than readings near the top of the range.

But consider two other DMMs, one with 3 1/2 digits and one with 4 1/2 digits, both with a specified accuracy of 0.1% of reading plus one least significant digit. On the 3 1/2 digit DMM, that second part of the accuracy specification, as a percent of full scale, is ten times worse than on the 4 1/2 digit meter. To see the effect, consider the same two measurements on the 20 V scale; i.e., 20 Volts and 2 Volts. At 20 Volts, for the 3 1/2 digit meter, the accuracy would be 0.1 percent plus one count out of 2000 (0.05 percent), for a total error of 0.15 percent. For the 4 1/2 digit meter, it would be 0.105 percent. That's not much difference.

However, when the voltage to be measured is 2 Volts, the 3 1/2 digit DMM now shows an error of 0.6%, while the 4 1/2 digit DMM has an error of only 0.15%. Even though they appeared to have the same specifications, the meter with the extra digit has considerably enhanced accuracy at the lower ends of its ranges.

TRUE RMS MEASUREMENTS AND CREST FACTOR

Some meters read the average value of a time varying signal and use a constant scale factor of 1.11 to convert that to RMS. The calculation is based on the assumption that the input signal is a pure sine wave, in which case the average value is 0.637 times the peak and the RMS value is 0.707 times the peak (707/637 = 1.11.)

This type of meter gives erroneous readings when the input is not a pure sine wave. For example, a half-wave rectified sine wave has an RMS value of 0.386 times the peak. However, an average-reading meter that uses the 1.11 scale factor will show a reading of 0.353 times the peak – more than 10% in error. All Tek DMMs provide true RMS readings.

CREST FACTOR

This specification is related to true RMS capability. The crest factor of a waveform is the ratio of its peak value to its RMS value. In a true RMS-reading DMM, the crest factor specifies the dynamic range of the instrument, or in more pragmatic terms, the square-wave duty cycle for which it will return accurate measurements. For example, the 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.

BANDWIDTH

Some DMMs specify reasonably high frequency bandwidths. However, while a 20 kHz bandwidth means that you can measure sinusoidal signals up to that limit, this specification does not mean that you can measure a 20 kHz pulse train, whose Fourier components go well beyond 20 kHz.

One rule of thumb is that since most of the energy in a square wave is contained in the fundamental and the third and fifth harmonics, you can divide the pulse repetition frequency by 5 to determine the maximum frequency that can be accurately measured. Another approach when considering the bandwidth needed in the DMM would be to consider the risetime of the input signal, rather than its repetition rate.

NMRR AND CMRR

DMM specs often list both normal mode rejection ratio (NMRR) and common mode rejection ratio (CMRR). Generally, NMRR applies to dc measurements. It is a measure of the instrument's ability to reject line noise on a dc signal. DMMs achieve NMRR by taking measurements over time periods that cover an integral number of power line cycles. For example, some TM 500 and TM 5000 products use a measurement period of 200 ms, which covers both 50 and 60 Hz (5 cycles of 50 Hz or 6 cycles of 60 Hz.) High end instruments often allow you to select measurement speed, but you have to be aware that when you select certain speeds, you may be sacrificing some NMRR.

CMRR also describes the ability of the instrument to reject interfering signals, but only under differential input conditions. That is, it applies when a common interfering signal is present on both lines of a balanced, push-pull signal applied to the DMM's dual inputs.

However, in evaluating CMRR, it is important to remember that DMMs do not have true differential amplifiers. The capacitive loading in the low input is significantly greater than in the high. As a result, CMRR is frequency-sensitive. One further point to note is that some manufacturer's CMRR specifications include NMRR. The resulting specification is only valid at the power line frequency.

SPECIAL CONSIDERATIONS

NULL

Some instruments allow you to make relative measurements by storing an offset NULL value. On Tek instruments that offer this feature, you press the NULL button (or invoke the function via GPIB) to store the currently displayed value. Alternatively, the baseline value may be downloaded via the GPIB. In either case, subsequent measurements will be made relative to this value, even if the range is changed. One example of the use of this feature is in resistance measurements, compensating for the resistance of the test leads. By invoking NULL with the probe tips shorted together and the instrument at its lowest range, the test lead resistance will be recorded and automatically subtracted from subsequent measurements.

dB Measurements and NULL

In ac amplifiers, it is often desirable to measure gain, attenuation, and filter stages in terms of decibels, rather than in terms of voltage or current gain. This is because decibels are additive. That is, when an input signal level of -30 dBV comes out of a 10 dB gain stage, it has a level of -20 dBV. Many DMMs provide dBV (decibels referred to 1 Volt) and dBm (decibels referred to 1 mW across a 600 Ohm load, which happens to be 0.775 Vrms). If the instrument has a NULL feature, decibel measurements can be made relative to any signal level by selecting either dBm or dBV invoking the NULL function manually or over the GPIB.

THERMAL CONTACT POTENTIAL ERROR

The high resolution and accuracy made possible by the current generation of DMMs raises some potential measurement problems that were not significant with earlier instruments. For example, the alligator clips used in most test leads are plated steel, while resistor leads are usually tinned copper. This creates thermocouples with a typical output of 50 μV/°C every time a resistor is measured. A one degree temperature difference across a 50 Ohm resistor would represent a 0.1% error!

Some DMMs deal with this by making offset-corrected resistance measurements. Measure the voltage across the unknown, first with current drive, then without, and subtract the difference.

DIGITAL MULTIMETER SELECTION GUIDE

Application Feature	DM 504A	DM 5110/511	DM 5120/DM 5520
Number of Digits	4 1/2	4 1/2	6 1/2
DC Volts Ranges	200 mV to 1000 V	200 mV to 1000 V	300 mV to 300 V
DC Volts Best Accuracy	±0.05%	±0.05%	±0.008%
DC Volts Best Resolution	10 μV	10 μV	0.1 μV
AC Volts Ranges	200 mV to 500 V	200 mV to 500 V	300 mV to 300 V
AC Volts Best Accuracy	±0.6%	±0.3%	±0.15%
AC Volts Best Resolution	10 μV	10 μV	1μV
AC or DC Current Ranges	200 μA to 2 A	200 μA to 2 A	300 μA to 3 A
dB Ranges	N/A	+ 54 dB to – 50 dB	+ 49 dB to – 54 dB
Resistance (HI-LO) Ranges	200 Ω to 20 MΩ	200 Ω to 20 MΩ	300 Ω to 300 MΩ
Temperature Measurement Range	– 62 to + 230°C	– 62 to + 230°C	N/A
True RMS	•	•	•
Autorange	•	•	•
IEEE Standard 488 Interface	No	• (DM 5110 Only)	•
Mainframe Compatibility	TM 500 or TM 5000	TM 5000/5000 for DM 51 TM 5000 for DM 5110	TM 5000 (DM 5120 Only)
Price	☎ $595	DM 511 - $745 DM 5110 - $895	DM 5120 - $995 DM 5520 - $1,295

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

DIGITAL MULTIMETERS

The Tektronix TM 5000/TM 500 Modular Digital Multimeter selection now includes the new Single-Wide, Programmable DM 5110 as well as the manual DM 511. In conjunction with the high-performance DM 5120/DM 5520 and the economical DM 504A, there now exists a broad selection of performance, size and price to match most application.

The DM 5110 represents the optimum choice for programmability, small size, performance, feature, 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.

The DM 5120 is the highest performance Digital Multimeter in the line with advanced features such as 6 1/2 digit resolution, 1000 readings per second (in the 3 1/2 digit mode), and four-wire resistance measurements. The DM 5520 is a monolithic or standalone version of the same multimeter with its own power housing and power cord.

The TM 5000/TM 500 Digital Multimeters offer a compact solution to your measurement needs, without compromising performance. These instruments provide accuracy and flexibility on the laboratory bench, in field service, in maintenance applications, or in automatic system applications.

DM 5120/DM 5520

PROGRAMMABLE DIGITAL MULTIMETERS

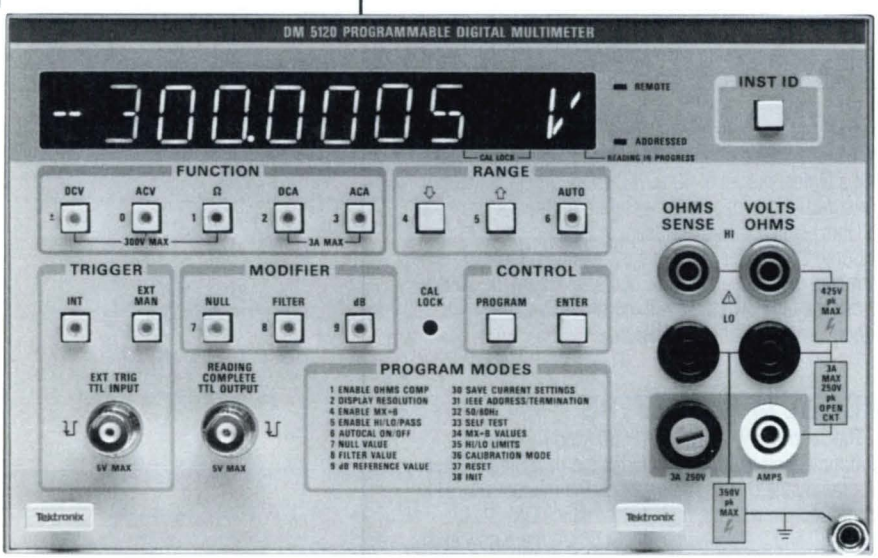
- *61/2 Digit, Fully Autoranging (100 nV, 100 μΩ, 1 nA Resolution)*
- *1000 Readings per Second*
- *DC Volts, True RMS AC Volts, Ohms, DC Amps, True RMS AC Amps*
- *dB Calculations*
- *4-Wire Resistance Measurements*
- *Hi/Lo/Pass Limit Testing*
- *Offset Compensated Ohms*
- *Math Functions*
- *Standalone Digital Multimeter (DM 5520)*
- *DM 5120 occupies 3 slots in any TM 5000 mainframe*

DM 5120/DM 5520

The DM 5120 Programmable Digital Multimeter provides autoranging voltage, current and resistance measurements at up to 6 1/2-digit resolution. DC voltage measurements with 100 nanovolt resolution can be performed to the full range of the multimeter. True RMS ac voltage and current, and a crest factor of 3:1 provide the reliability required for all ac measurements, regardless of the waveshape. Standard four-wire ohms measurement eliminates the errors caused by cable resistance, and the offset compensated ohms automatically subtracts thermal contact potentials.

The dynamic range of the DM 5120 lets you detect low- or high-level signals with a minimum of signal conditioning. A user-programmable filter function is provided to eliminate the effects of external noise. And a user-programmable "null" eliminates offsets.

The DM 5120 incorporates an easy-to-read, 3,000,000 count, LED display. Each count represents 1/3 ppm at full scale. Measurement units are displayed as part of the reading, providing unambiguous test results.



DM 5120 Programmable Digitial Multimeter

A fast autoranging feature permits the shortest possible test setup time, as well as dramatically increased throughput on your production line. Just connect the DM 5120 to the DUT, select the measurement function you want, and the DM 5120 will automatically find the proper range.

Built-in math functions such as PASS/FAIL limit testing, dB measurements, NULL, MX+B and others add measurement power, while hands-off calibration makes on-line instrument maintenance easy.

And if speed is critical, the DM 5120 will provide 1000 count voltage and current reading rates at 3 1/2 digit resolution. High-speed data acquisition and analysis is possible with the DM 5120 connected to a GPIB controller/processor.

GPIB PROGRAMMING

Programming the DM 5120 over the GPIB is straightforward. Utilization of Tek's Standard Codes and Formats makes programming easy.

A selection of eighteen programming modes are available at the instruments's front panel, including: Initialize, Self-Test, Display Resolution, Enable Ohms Compensation, dB Reference Value, Hi/Lo Limits, and MX+B Values, among others. Program modes are printed right on the front panel, eliminating the need to keep an operating manual at hand.

Eliminates Errors In Resistance Measurements

Low resistance measurements are prone to errors caused by cable resistance and slight differences in temperature between contacts – the thermal contact potential. The DM 5120 incorporates standard four-wire ohm measurements to eliminate cable resistance errors.

The offset compensated ohms feature eliminates errors caused by thermal contact potentials. In a two step process the contact potential is determined by measuring the voltage with no current applied. The resistance value obtained is then automatically subtracted from the resistance value determined when current is applied. This feature is especially useful in measurement systems with multiple switches, which have the effect of adding unwanted resistance to the DUT.

GPIB IEEE-488 *

**The DM 5120 and DM 5520 comply with IEEE Standard 488.1-1987 and with Tektronix Standard Codes and Formats.*

CHARACTERISTICS

DC –

		Accuracy (6-1/2 digits)*1 ± (% of reading + counts)			Temperature Coefficient
Range	Resistance	24 Hours 23 ± 1°C	90 Days 18 to 28°C	1 Year 8 to 28°C	± (% rdg+cnt)/C 0–18°C to 28–50°C
300 mV	>1 GΩ	0.0020 + 20*2	0.005 + 20*2	0.008 + 20	0.0006 + 10
3 V	>1 GΩ	0.0013 + 10	0.003 + 20	0.0038 + 20	0.0004 + 1
30 V	11 MΩ	0.0015 + 10	0.006 + 20	0.008 + 30	0.0013 + 3
300 V	0.0 MΩ	0.0030 + 10	0.009 + 20	0.009 + 30	0.0013 + 1

**1 For 5 1/2 digit accuracy, divide 6 1/2 digit count error by 10. For 4 1/2 digit accuracy, count error is 5*

**2 When properly zeroed.*

Analog Settling Time – < 1 ms (< 2 ms on 300 mV range), to 0.01% of step change.

CMRR – >120 dB at dc, 50 or 60 Hz ± (0.05%) with a 1 kΩ unbalance in either lead.

NMRR – 60 dB at 50 or 60 Hz ± (0.05%).

Linearity – Linearity is defined as the maximum deviation from a straight line between the readings at zero and full range. 10 ppm of range for 3, 30, and 300 V ranges; 15 ppm of range for 300 mV range; at 23 ±1°C.

Maximum Input Voltage – Hi to Lo: 300 V dc, 425 V peak, whichever is less. Lo to GND 350 V (dc + peak ac).

Maximum Resolution – 0.1 µV.

TRUE RMS AC VOLTAGE

Ranges – 300 mV, 3 V, 30 V, 300 V.

Accuracy*1 – 5 1/2 digits.
For sinewave inputs greater than 2000 counts –
20 to 50 Hz ± (2% or reading +100 counts).
50 to 200 Hz ± (0.3% of reading + 100 counts).
200 Hz to 10 kHz ± 0.15% of reading + 100 counts).
10 to 20 kHz ± (0.4% of reading + 200 counts). For sinewave inputs greater than 20,000 counts -3 dB bandwidth typically 300 kHz 20 to 100 kHz*2 ± (1.5% of reading + 300 counts).

Crest Factor – ≤3:1.

Nonsinusoidal Measurement Accuracy –
For fundamental frequencies <1 kHz, crest factor <3.
300 mV, 3 V ± (0.25% of reading) 30 V, 300 V ± (0.6% of reading).

Maximum Resolution – 1 µV.

Input Impedance –
Hi to Lo: 1 M Ω shunted by <120 pF.
Lo to GND: >1000 MΩ paralleled by <400 pF.

CMRR – >60 dB at 50 or 60 Hz (±0.05%) with 1 kΩ unbalance.

Settling Time – 1 s to within 1% of change in reading.

Maximum Input Voltage – Hi to Lo 300 V RMS (425 V peak) or 10 MΩ V Hz product, whichever is less. Lo to GND: 350 V (dc + peak ac) or 500 kΩ V Hz product, whichever is less.

*1 *For 4 1/2 digit accuracy, divide count error by 10. For 3 1/2 digit accuracy, count error is 5. In 3 1/2 and 4 1/2 digit modes, specifications apply for inputs >200 Hz.*

*2 *Specification for 300 mV range is ± (2% of reading + 300 counts).*

OHMS

Offset Compensation (Requires Proper Zeroing) – 300 Ω to 30 kΩ range ±10 mV on 300 Ω range ±100 mV on 3 kΩ and 30 kΩ range.

Open Circuit Voltage – ≤5.5 volts.

Maximum Resolution – 100 µΩ.

Linearity – Linearity is defined as the maximum deviation from a straight line between the readings at zero and full scale. 20 ppm of range for 300 Ω to 30 kΩ ranges at 23 ±1°C.

Maximum Input Voltage – 300 V RMS or 425 V peak, whichever is less.

DC AMPS

Accuracy –

(5 1/2 digits) 1 Year, 18 to 28°C	Maximum Voltage Burden
300 µA	± (0.09% of reading + 20 counts) 0.4 V
3 mA	± (0.05% of reading + 10 counts) 0.4 V
30 mA	± (0.05% of reading + 10 counts) 0.4 V
300 mA	± (0.05% of reading + 10 counts) 0.5 V
3 A	± (0.09% of reading + 10 counts) 2.0 V

Maximum Resolution – 1 nA.

Maximum Input – 3 A (250 V) [fuse protected].

ORDERING INFORMATION

DM 5120 Programmable Digital Multimeter **$995**
Includes: Instruction manual (070-7240-00); one set test leads.

DM 5520 Programmable Digital Multimeter **$1,295**
Includes: DM 5120 with power module, Instruction manual (070-7240-00); one set test leads.

Range	Accuracy (61/2 digits)*1 ± (reading + counts) 24 Hours 23 ± 1°C	90 Days 18 to 28°C	1 Year 18 to 28°C	Temperature Coefficient ± (%rdg + cnts)/C 0-18°C & 28-50°C
300 Ω*3	0.0025 + 20 counts	0.008 + 20 counts	0.01 + 20 counts	0.001 + 7 counts
3 kΩ	0.0025 + 20 counts	0.005 + 20 counts	0.007 + 20 counts	0.001 + 1 count
30 kΩ	0.0025 + 20 counts	0.005 + 20 counts	0.007 + 20 counts	0.001 + 1 count
300 kΩ	0.006 + 20 counts	0.02 + 20 counts	0.021 + 20 counts	0.004 + 1 count
3 MΩ	0.007 + 20 counts	0.02 + 20 counts	0.021 + 20 counts	0.03 + 1 count
30 MΩ	0.06 + 50 counts	0.1 + 50 counts	0.1 + 50 counts	0.3 + 1 count
300 MΩ*4	2.0 + counts	2.0 + 5 counts	2.0 + 5 counts	

*1 *For 5 1/2 digit accuracy divide count error by 10. For 4 1/2 digit accuracy, count error is 5 (except 15 on 300 Ω range). For 3 1/2 digit accuracy, count error is 5.*

*2 *Relative to calibration standards.*

*3 *When properly zeroed.*

*4 *Resolution on 300 MΩ range is limited to 5 1/2 digits.*

Note: Four-wire measurement mode accuracy for 300 Ω to 3 MΩ ranges.

AC CURRENT (TRUE RMS)

Accuracy – 5 1/2 digits*1.

1 Yr 18 to 28°C	
3 mA	20 to 45 Hz ± (2% of reading + 100 counts)*2
30 mA 300 mA	45 Hz to 10 kHz ± (0.6% of reading + 100 counts)*2
3 A	
300 µA	20 to 45 Hz ± (2% of reading + 100 counts) 45 Hz to 1 kHz ± (0.9% of reading + 100 counts) 1 to 10 kHz ± (4.0% of reading + 100 counts)

Crest Factor – (Up to 2/3 full scale) ≤ 3:1.

Maximum Resolution – 1 nA.

Maximum Voltage Burden

300 mA	0.4 V
3 mA	0.4 V
30 mA	0.4 V
300 mA	0.5 V
3 A	2.0 V

*1 *For sinewave inputs >2000 counts. For 4 1/2 digit accuracy, divide count error by 10. For 3 1/2 digit accuracy, count error is 5. In 3 1/2 and 4 1/2 digit modes, specifications apply for sinewave inputs >200 Hz.*

*2 *Accuracies correct for non-sinusoidal measurements on fundamental frequencies <1 kHz and crest factor <3.*

Settling Time – 1 second within 0.1% of change in reading.

Maximum Input – 3A (250 V) [fuse protected].

dB (Current) Accuracy –
1 year, 18 to 28°C; 20 Hz to 10 kHz;
320 µA to 3 A, 9.9 to 69 dB ±0.2 dB;
2 µA to 320 µA, – 54 to – 9.9 dB ±0.9 dB.

Maximum Resolution – 0.01 dB.

Reference Level (Default) – 1 mA = 0 dB.

Maximum Reading Rates*[3]

DCV, DCA, ACV, ACA Readings/Second
Continuous into Internal Buffer

	AUTOCAL	
Resolution	Off	On
3 1/2 digit	1000	1000
4 1/2 digit	333	333
5 1/2 digit	35 (29)	8.2 (7.5)
6 1/2 digit		8.2 (7.5)

Ω Readings/Second
Continuous into Internal Buffer

	AUTOCAL	
Resolution	Off	On
3 1/2 digit	40	24
4 1/2 digit	38	18
5 1/2 digit	16(13)	9.5 (7.5)
6 1/2 digit*[4]		5 (7.5)

Offset Compensated Ohms: Rates are 0.5 x normal MUX on ohms rates.

[3] Reading rates are for on-range on-scale readings with internal filter off for 3V, 3 kΩ, and 3 mA ranges. 6 1/2 and 5 1/2 digit rates are for 60 Hz operation. Values in parenthesis are for 50 Hz operation.

[4] Internal filter on.

DB (AC VOLTAGE)

Accuracy –
1 year, 18-28°C – 34 to 49 dB (20 mV to 300 V):
20 Hz to 20 kHz ± 0.2 dB; 20 kHz to 100 kHz ± 0.4 dB;
- 54 to + 34 dB (2 mV to 20 mV);
20 Hz to 20 kHz ±1.1 dB;
20 kHz to 100 kHz ± 3 dB typical.

Maximum Resolution – 0.01 dB.

Reference Level (default) – 1 V rms = 0 dB.

ELECTRICAL

Warm-Up Time – 2 hours to rated accuracy.

Power Consumption – 11 W, DM 5120; 120 W, DM 5520.

GPIB Programming –
Interface: IEEE-488.1 1987 Compatible
Subsets: SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0,

PHYSICAL CHARACTERISTICS

Temperature – Operating: 0 to + 50°C. Nonoperating: – 20 to + 65°C.

Humidity – 75% RH, to 35°C. 35% RH, to 50°C.

Dimensions –
DM 5120: Triple-wide TM 5000 Plug-in.
DM 5520: 23.4 cm (9.2 in.) x 14.0 cm (5.5 in) x 43.2 cm (17.03 in.)
Weight: 5.7 kg (15.4 lbs)

NEW DM 5110/511

The new 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.

A FULL RANGE OF FUNCTIONS.

Both units give you a choice of either autoranging or manual operation for all standard functions – voltage, current or resistance measurements. Also included are true RMS ac measurements and dB calculations plus features not normally found in a low-cost DMM.

The normal resolution mode of 4 1/2 digits, together with a minimum range of 200 mV, allows voltages as small as 50 µV to be resolved; a 3 1/2 digit mode provides for faster test throughput. Basic accuracy ±0.05%. And 50 Hz or 60 Hz mode selection provides normal-mode-rejection ratio improvement.

FRONT-PANEL CONVENIENCE.

Operation of the DM 5110/DM 511 is via twelve front-panel "soft keys" which are used to select function and range.

When programming the DM 5110, they are also used to set the GPIB address and termination.

In addition to 7-segment readout and function/range annunciators, front-panel LEDs are included with both units as NULL, HOLD and AUTO mode indicators. The DM 5110 offers LEDs for two additional modes: REM (indicating remote operation) and ADDR (indicating the instrument is being addressed to talk or listen). The DM 5110 also includes a front-panel ID button to request a display of a GPIB address and termination, and to generate an SRQ under certain circumstances.

A manually-operated front-panel switch is used to select front or rear connection to Volts and Ohms measurement modes. The switch is not operable over the GPIB, but its status can be queried and monitored remotely. (Caution – maximum input voltage on the rear connector pins is 60 Vdc ±pk ac.)

NULL mode operates with all functions and allows you to apply a display offset to make a relative measurement.

HOLD mode stops the instrument from measuring and displays the last measurement made. The HOLD key toggles the instrument between HOLD and RUN modes.

The TRIG key lets you make a single measurement and then automatically return to HOLD.

COMPARE mode makes it possible to compare measurements against user-defined HI and LO limits. A beeper indicates when a measurement is out of limits.

Temperature measurements are made using an optional Tektronix P6602 Temperature Probe, or an equivalent platinum resistance probe. DM 5110/DM 511 will measure temperatures from – 62° to 240°C.

NEW

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*
- *50 Hz or 60 Hz Mode Selection*
- *Standard IEEE-488 Interface (DM 5110 only)*
- *Front and Rear Interfacing*

ELECTRICAL CHARACTERISTICS

DC VOLTS

***Accuracy*[*1] –** (4 1/2 digits, auto or manual ranging, front or rear input):

Range	18°–28°C	0°–18°C, 28°–50°C
200 mV	±(0.05% of reading + 0.015% of full scale)	±(0.15% of reading + 0.04% of full scale)
2 V	±(0.05% of reading + 0.01% of full scale)	±(0.1% of reading + 0.02% of full scale)
20 V	±(0.05% of reading + 0.015% of full scale)	±(0.15% of reading + 0.025% of full scale
200 V	±(0.05% of reading + 0.01% of full scale)	±(0.1% of reading + 0.02% of full scale)
1000 V	±(0.05% of reading + 0.02 % of full scale)	±(0.1% of reading + 0.02% of full scale)

CMRR (with 1 kΩ unbalance) – ≥ 100 dB @ dc, ≥ 80 dB @ 50/60 Hz.

NMRR – ≥ 50 dB @ 50/60 Hz (±0.2 Hz).

Max. Resolution – 10 µV.

Step Response Time – < 50 msec to 0.05% of step.

Input Resistance – 10 MΩ ±0.5%.

Max. Input Voltage – Front panel, LOW to GND and V/Ω/Temp to LOW or GND: 1000 V pk; Rear connector, HI to LO and HI or LO to Chassis: 60 V dc + pk ac.

TRUE RMS AC VOLTS

***Accuracy*[*1] –** (4 1/2 digits, auto or manual ranging, front or rear input, 200 mV to 500 V range):

Input Frequency	18°–28°C	0°–18°C, 28°–50°C
20 Hz to 100 Hz:[*1]	±(0.8% of reading + 0.05% of full scale)	±(1.1% of reading + 0.075% of full scale)
100 Hz to 10 kHz:[*1]	±(0.3% of reading + 0.05% of full scale)	±(0.6% of reading + 0.075% of full scale)
10 kHz to 20 kHz:[*2]	±(0.6% of reading + 0.05 % of full scale)	±(0.9% of reading + 0.05% of full scale)
20 kHz to 50 kHz:[*3]	±(1.0% of reading + 0.05% of full scale)	±(1.3% of reading + 0.075% of full scale)

CMRR (with 1 kΩ unbalance) – ≥ 60 dB @ 50/60 Hz.

Max. Resolution – 10 µV.

Step Response Time – < 0.3 sec to 1% of step.

Input Impedance – 2 MΩ ±0.1%, paralleled by < 50 pF.

Max. Input Voltage – Front panel, V/Ω/Temp to LOW: 500 V rms or 600 Vdc. Front panel, V/Ω/Temp or LOW to GND: 1000 V pk; Rear connector, HI to LO and HI or LO to Chassis: 60 V dc + pk ac.

Crest Factor – 3:1 for 0.1% additional error.

*[*1] For inputs > 200 counts, 200 mV to 200 V ranges; > 50 counts, 500 V range.*

*[*2] For inputs > 500 counts, 200 mV to 200 V ranges; > 250 counts, 500 V range.*

*[*3] For inputs > 2000 counts, 200 mV to 200 V ranges; > 500 counts, 500 V range.*

dB (TRUE RMS AC VOLTAGE)

***Accuracy*[*1] –** (4 1/2 digits, auto or manual ranging, front or rear input):

Range, dBV	Range, dBm	18° – 28°C	28° – 50°C	0° – 18°C Frequency
– 34 to + 54	– 32 to + 56	±0.3 dB	±0.4 dB	20 Hz – 20 kHz
– 54 to – 34	– 52 to – 32	±0.6 dB	±0.8 dB	20 Hz – 10 kHz
– 60 to – 54	– 58 to – 52	±1.0 dB	±1.5 dB	20 Hz – 10 kHz

Max. Resolution – 0.01 dB.

Response Time – < 0.3 sec to 1% of step.

Input Impedance – 2 MΩ ±0.1%, paralleled b < 50 pF

Max. Input Voltage –
Front panel, V/Ω/Temp to LOW: 500 V rms or 600 V dc.
Front panel, V/Ω/Temp or LOW to GMD: 1000 V pk;
Rear connector, HI to LO and HI or LO to Chassis:
60 V dc + pk ac.

OHMS

***Accuracy*[*1] –** (4 1/2 digits, auto or manual ranging, front or rear input):

Range	18° – 28°C	0° – 18°C 28° – 50°C	Source Current	Vmax
200 Ω	±(0.05% of reading + 0.02% of full scale)	±(0.25% of reading + 0.04% of full scale)	1.0 mA	0.2 V
2 kΩ	±(0.05% of reading + 0.01% of full scale)	±(0.25% of reading + 0.03% of full scale)	1.0 mA	2.0 V
20 kΩ	±(0.05% of reading + 0.02% of full scale)	±(0.25% of reading + 0.04% of full scale)	10 µA	0.2 V
200 kΩ	±(0.05% of reading + 0.01% of full scale)	±(0.25% of reading + 0.03% of full scale)	10 µA	2.0 V
2 MΩ	±(0.1% of reading + 0.02% of full scale)	±(1.0% of reading + 0.04% of full scale)	0.1 µA	0.2 V
20 MΩ	±(0.1% of reading +	±(1.0% of reading +	0.1 µA	2.0 V

Response Time – < 0.2 sec, 200 Ω to 200 MΩ ranges; < 2 sec, 20 MΩ range.

Max. Input Voltage, All Ranges – Front Panel: 300 V pk. Rear Connector: 60 V pk.

Max. Resolution – 10 mΩ.

Max. Open-Circuit Voltage – < 11 V.

DC AMPS

***Accuracy*[*1] –** (4 1/2 digits, auto or manual ranging, front panel only):

Range	18° – 28°C	0° – 18°C, 28° – 50°C
200 µA, 2 mA, 20 mA 200 mA, 2000 mA	±(0.1% of reading + ±0.01% of full scale)	±(0.3% of reading + 0.025% of full scale)

Response Time – < 50 ms to 0.05% of step.

Input Resistance –

Range	≈ Resistance
200 µA	1.0 kΩ
2 mA	100 Ω
20 mA	10.2 Ω
200 mA	1.2 Ω
2000 mA	.26 Ω

Max. Open-Circuit Input Voltage (mA to LOW) – 250 V pk.

Max. Input Current – 2 A any range.

Max. Floating Voltage – 1000 V pk, mA or LOW to GMD

Max. Resolution – 10 nA

GPIB IEEE-488 *

**The DM 5110 complies with IEEE Standard 488.1-1987 and Tektronix Standard Codes and Formats*

ORDERING INFORMATION

DM 5110 Programmable 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).

DM 511 Autoranging Digital Multimeter. **$745**
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. **+$260**

OPTIONAL ACCESSORIES

Service Manual – Order 070-7479-00 **$50**

Temperature Probe – P6602 **$275**

High Voltage Probe – Order 010-0277-00 **$185**

RF Probe – P6420 **$175**

AC AMPS

Accuracy[*1] (4 1/2 digits, auto or manual ranging, front panel only, all ranges):

Frequency	18° – 28°C	0° – 18°C, 28° – 50°C
20 Hz to 100 Hz (input > 200 counts)	± (0.8% of reading + 0.05% of full scale)	± (1.1% of reading + 0.075% of full scale)
100 Hz to 10 kHz (input > 200 counts)	± (0.3% of reading + 0.05% of full scale)	
100 Hz to 10 kHz: (input > 200 counts)		± (0.6%of reading + 0.075% of full scale)

Crest Factor – 3:1 for 0.1% additional error
Response Time – < 0.3 sec to 1% of step.
Input Resistance –

Range	≈ Resistance
200 µA	1.0 kΩ
2 mA	100 Ω
20 mA	10.2 Ω
200 mA	1.2 Ω
2000 mA	.4 Ω

Max Open-Circuit Input Voltage (mA to LOW) – 250 V pk.
Max Input Current – 2 A any range.
Max Floating Voltage – 1000 V pk, mA or LOW to GMD.

TEMPERATURE

Accuracy[*1] (4 1/2 digits, front panel, input only):

Measurement Range	0°– 18°C 8 – 28°C	28°– 50°C	Probe Status
– 62° to + 150°C	± 0.6°C	± 1.5°C	Instrument calibrated to probe
+ 150° to + 240°C	± 1.6°C	± 2.5°C	
– 62° to + 150°C	± 3.5°C	± 4.5°C	Any probe
+ 50° to + 240°C	± 6.0°C	± 7.0°C	

MISCELLANEOUS

Reading Rate –
4.5 Digits (NORMAL): > 3/s;
3.5 Digits (FAST): > 25/s.
Power Consumption – < 10 W.
Over-range Indication – Flashing display.
Warm-up Time – 30 minutes (60 minutes after storage in high humidity environment).

ENVIRONMENTAL SPECIFICATIONS

Temperature – Operating: – 0° to + 50°C; Non-Operating: -55° to + 75°C.
Humidity – < 5%, 0° to + 30°C; < 75%, + 30° to + 40°C; < 45%, above + 40°C.
ALTITUDE – Operating: 4.6 km (15,000 ft); Non-Operating: 15 km (50,000 ft).

PHYSICAL CHARACTERISTICS

Net weight –
DM 5110: 1.1 kg (2.45 lb);
DM 511: 1.0 kg (2.2 lb).
Dimensions – Single TM 5000/TM 500 compartment.

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, Ohms and Temperature Functions*
- *0.07% DC Voltage Accuracy*
- *Diode Test and Audible Continuity (Beeper) Modes*

ORDERING INFORMATION

DM 504A Digital Multimeter **$595**
Includes: Instruction manual (070-6945-00); one set of test leads.

Opt. 01 – Adds P6602 Temperature Probe calibrated for use with DM 504A. [*1]

[*1] *Contact your local sales representative.*

DM 504A AUTORANGING DIGITAL MULTIMETER

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.

All measurement ranges, except temperature, diode measurements, and audible continuity (beeper), can be automatically or manually selected.

An audible "beeper" mode is provided for testing continuity. A beeper symbol is displayed when the 200 ohm mode is selected, indicating that a beeper will sound a continuous tone for measurements less than 10 ohms. In the 2 megohm, 200 kilohm and 2 kilohm ranges a diode measurement indicator will illuminate on the display, indicating that V max is adequate for diode testing.

Temperature measurements are made using an optional Tektronix P6602 Temperature Probe, or an equivalent platinum resistance probe. The DM 504A will measure temperatures from – 62° to 230°C.

CHARACTERISTICS

ELECTRICAL

DC Volts

Ranges – 200 mV, 2 V, 20 V, 200 V, 1000 V.

Accuracy – For automatic or manual ranging 18 to 28°C: All ranges ± (0.05% of reading ± 0.02% of full scale).

Range	+ 0° to 18°C, 28° to 50°C:
200 mV range	± (0.15% of reading + 0.06% of full scale);
2 V range	± (0.15% of reading + 0.02% of full scale);
20 V range	± (0.15% of reading + 0.04% of full scale);
200 V range	± (0.15% of reading + 0.02% of full scale);
1000 V range	± (0.15% of reading + 0.02% of full scale).

Common Mode Rejection Ratio – (Within 1 kΩ unbalanced) 100 dB at dc, 80 dB at 50/60 Hz.

Normal Mode Rejection Ratio – 60 dB at 50/60 Hz (±0.2 Hz).

Max. Resolution – 10 μV.

Step Response Time – <1 s.

Input Resistance – 10 MΩ ±0.5%.

Max. Input Voltage – 1000 V peak.

TRUE RMS AC VOLTS

Ranges – 200 mV, 2 V, 20 V, 200 V, 500 V.

Accuracy*1 –

For automatic or manual ranging – 18° to 28°C: 200 mV to 200 V range, 30 Hz to 20 kHz. For input signals >10% to 100% of full range, accuracy is ±(0.6% of reading + 0.06% of full scale). For signals >25%, and 10 kHz to 20 kHz add 4.1% additional error.

500 V range, 60 Hz to 20 kHz. For input signals >100 V to 500 V RMS, accuracy is ±(0.6% of reading + 0.1% of full scale).

40 Hz to 60 Hz ±(1% of reading + 0.1% of full scale)

0° to 18°C, 28° to 50°C: 200 mV to 200 V range, 30 Hz to 20 kHz. For input signals >10% to 100% of range, accuracy is ±(0.8% of reading + 0.11% of full scale). For signals 25%, and 10 kHz to 20 kHz add 4.1% additional error.

500 V range, 60 Hz to 20 kHz. For input signals >100 V to 500 V RMS, accuracy is ±(0.9% of reading + 0.1% of full scale).

40 Hz to 60 Hz ±(1.3% of reading + 0.1% of full scale).

RESISTANCE

Ranges – 200 Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2 MΩ, 20 MΩ.

Accuracy*1 – For automatic and manual ranging.

Common Mode Rejection Ratio – (With 1 kΩ unbalance) – 60 dB at 50 or 60 Hz.

Max. Resolution – 10 μV.

Response Time – < 2 s.

Input Impedance – 10 MΩ ±0.5% paralleled by <100 pF.

Max.Input Voltage – Volts/Ohms/TEMP to LOW: 500 V RMS or 600 V DC, VOLTS/ohms/TEMP to GND: 1000 V peak.

LOW to GND: 1000 V peak.

Crest Factor – 5 at full scale on all ranges except 500 V (500 V = 2).

Response Time – < 2 seconds on 200 Ω to 2 MΩ range < 15 seconds on 20 MΩ range < 0.15 seconds on 200 Ω "beeper."

Maximum Input Volts – 300 V peak.

Maximum Resolution – 10 mΩ.

Maximum Open Circuit Voltage – < 11 V.

**1 Valid for six months or 1000 hours, whichever occurs first.*

Range	18° to 28°C 28 to 50°C	0 to 18°C,	Source	Vmax full-scale
200 Ω (beeper)	±(0.05% of reading ±0.05% of full scale)	±(0.25% of reading ±0.1% of full scale)	1.0 mA	0.2 V
200 Ω	±(0.05% of reading ±0.02% of full scale)	±(0.25% of reading ±0.04% of full scale)	1.0 mA	0.2 V
2 kΩ	±(0.05% of reading ±0.01% of full scale)	±(0.25% of reading ±0.03% of full scale)	1.0 mA	2.0 V
20 kΩ	±(0.05% of reading ±0.02% of full scale)	±(0.25% of reading ±0.04% of full scale)	10 μA	0.2 V
200 kΩ	±(0.05% of reading ±0.01% of full scale)	±(0.25% of reading ±0.03% of full scale)	10 μA	2.0 V
2 MΩ	±(0.1% of reading ±0.02% of full scale)	±(1% of reading ±0.04% of full scale)	0.1 μA	0.2 V

DC CURRENT/AC CURRENT

Ranges – 200 μA, 2 mA, 20 mA, 200 mA, 2000 mA.

Accuracy*1 – dc current: for automatic or manual ranging 18° to 28°C. ±(0.1% of reading + 0.01% of full scale). 0° to 18°C, 28° to 50°C. ±(0.3% of reading + 0.025% of full scale).

AC Current – For automatic or manual ranging.

Response Time – DC Current: < 1 s. AC Current: < 2 s.

Input Resistance

Range	Resistances	
	DC current	AC current
200 μA	1.0 kΩ	1.0 kΩ
2 mA	100.0 Ω	100.0 Ω
20 mA	10.2 Ω	10.2 Ω
200 mA	1.2 Ω	1.2 Ω
2000 mA	0.28 Ω	0.4 Ω

Max. Open-Circuit Input Voltage (mA to LOW) – 250 V peak.

Max. Input Current – 2 A any range.

Max. Floating Voltage – mA to GND, 1000 V peak; LOW to GND, 1000 V peak.

Max. Resolution – 10 nA.

Max. Floating Voltage – mA to GND, 1000 V peak, LOW to GND, 1000 V peak.

Maximum Resolution – 10 nA.

TEMPERATURE

Range – – 62° to +230°C.

Accuracy – Using Tektronix P6602 Temperature Probe: 18° to 28°C ambient. Probe calibrated to instrument (probe/DMM calibration performed at 0°C). ±0.6°C. From – 62° to 150°C. ±1.6 from 150° to 230°C. Any probe: ±3.5°C from – 62° to 150°C. ±1.6°C from 150° to 230°C.

OTHER CHARACTERISTICS

Reading Rate – > 2.0 times/s.

Over-range Indication – Flashing display.

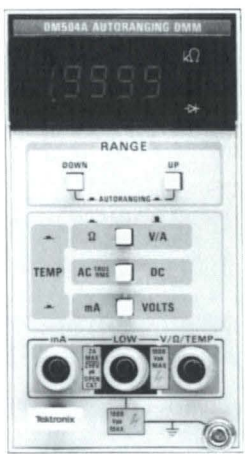
Warm-up Time – 30 minutes (50 minutes after storage in high humidity environment).

PHYSICAL CHARACTERISTICS

Dimensions – Single TM 500/TM 5000 compartment.

Weight – 0.93 kg (2.04 lb).

**1 Valid for six months or 1000 hours, whichever occurs first.*



ORDERING INFORMATION

DMM OPTIONAL ACCESSORIES

The following accessories may be ordered as options for use with any of the three TM 500/TM 5000 Digital Multimeters.

Test Leads – $1,325
(Black) 4 ft. Order 012-0425-00
(Red) 4 ft. Order 012-0426-00 $24
(Black) 4 ft. Order 012-0426-01 $24

Test Lead Set – ALM 01

Temperature Probe – $275
P6602 (DM 504A , DM 511 and DM 5110).

Adapter –
Female-BNC-to-Dual-Banana. $11
Order 103-0090-00.

Axial Lead Components Adapter – $110
Order 013-0072-00

High-Voltage Probe – $185
(DM 504A , DM 511 and DM 5110)
Order 010-0277-00.

Cables – No specification changes.
(1 meter) Order 175-1661-00. $29
(3 meter) Order 175-1661-02. *1

Kelvin Clip Lead Set –
(DM 5120) Order 012-1296-00. $160

**1 Contact your local sales representative.*

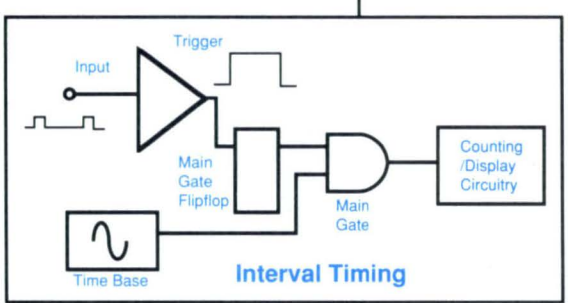
DIGITAL COUNTER/TIMER THEORY AND SPECIFICATIONS

FREQUENCY COUNTERS/ TIMERS

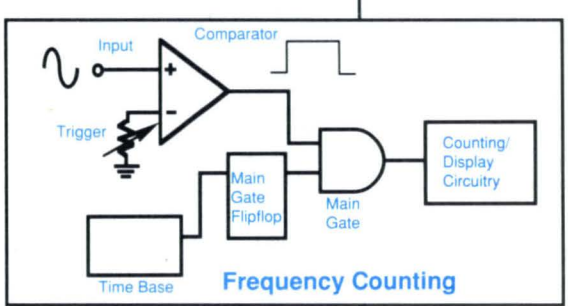
Both frequency and timing measurements rely on a stable time base, which produces a train of regular pulses. In a counter, a voltage comparator or Schmitt trigger generates a pulse for each cycle of a sinusoidal input.

Not all inputs are sinusoidal, so, more generally, the trigger pulse turns on when any input signal passes above one threshold and turns off when it passes through another, lower, threshold. The instrument counts the pulses that occur during a time interval controlled by the time base and converts this to a frequency reading on the display. In a timer, a converse process takes place. Externally, there is a start event and stop event, and the instrument counts the number of pulses output by the time base between these events, either case, there is some ambiguity to the measurement because the length of the counting period may not be an integral multiple of the period between counts. As the following diagram shows, depending on where the gate falls relative to the events being counted, the count may differ by plus or minus one. Other sources of error are noise, which may cause false triggering, jitter in the applied signal, and errors in the instrument time base. Generally, when the applied signal is repetitive, solutions to the _1 count problem involve averaged measurements, taking as many as several million samples. This enhances both resolution and accuracy.

To understand how averaging enhances resolution, consider the situation in the above diagram, in which the gate timing exceeds an integral relationship with the event pulses by one-third of a period. If the gate and the pulses are truly asynchronous, then it is probable that out of 100 measurements, 33 will show ten counts and 67 will show eleven counts. Averaged, this is 10.33 counts. Practically, averaging is limited by standard deviation, and ultimately, by the accuracy of the time base. These explanations are considerably simplified. Practical instruments incorporate input attenuator/amplifiers to handle a wide range of input voltages. They offer triggering and coupling controls, trigger output signals, and often, GPIB programmability.



Interval Timing

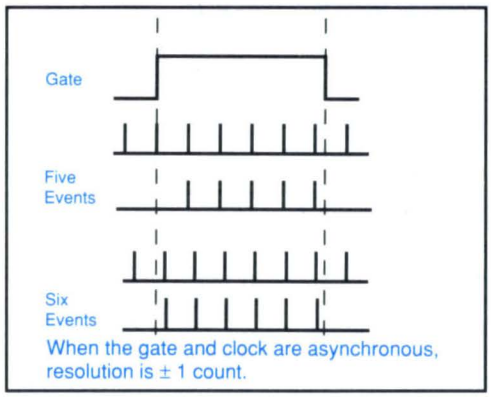


Frequency Counting

APPLICATIONS

Tek 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 Tek 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 abberrations, such as ringing. Some instruments will automatically measure risetimes and falltimes.



When the gate and clock are asynchronous, resolution is ± 1 count.

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.

Tek 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 Tek 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.

MODULAR COUNTER/TIMERS AND OSCILLOSCOPES WITH INTERNAL COUNTER/TIMERS

A modern trend, pioneered by Tektronix, is to incorporate counter and timer features into digital oscilloscopes. Also, some Tek spectrum analyzers that can measure to 325 GHz incorporate frequency counters. Such multi-function instruments have advantages when you need to see the signal upon which you are making timing or frequency measurements.

However, there are many applications in which a separate instrument, used alone, or in conjunction with a scope or spectrum analyzer, offers a superior solution. This is for at least two reasons. First, used alone, TM 500 or TM 5000 modular instruments are less expensive than scopes. Second, either used alone, or in

conjunction with scopes, they make averaged measurements more quickly than the scope can and display their results more prominently. In automated testing, this greater speed can result in an increase in test throughput of one or more orders of magnitude.

SPECIFICATIONS CONSIDERATIONS

Range

Input frequency range usually depends on coupling mode and input impedance. If you require high resolution, look for direct counting; some instruments use a prescaler to divide down the input signal.

Tektronix offers counter/timers with bandwidths to 350 MHz. Beyond this input range, up to 1 GHz, Tektronix recommends a suitable oscilloscope, such as the 11402 Digitizing Oscilloscope or the DSA 602 Digitizing Signal Analyzer. And, for precise digital frequency measurements from 1 to 325 GHz, try a spectrum analyzer such as the 2755AP or the 2756P.

Sensitivity

As with range, sensitivity is another area in which the input impedance affects the specification.

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 mimimize time base errors, all Tek TM 500 and TM 5000 modular counter/timers use an oven-controlled-crystal time base.

In the case of the DC 5010/DC 510, 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, as was explained above, 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/DC 510, single event resolution is 3.125 ns, but resolution with averaging is 1 ps.

Most Applications Accommodate Averaging

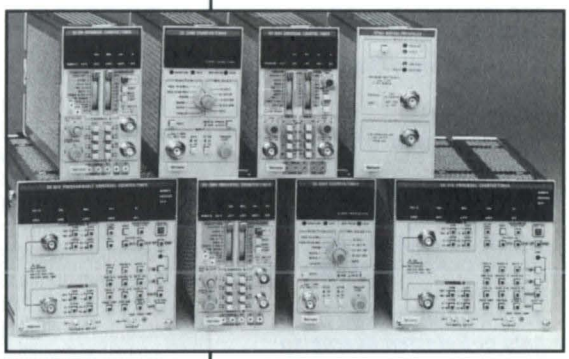
However, there are ballistic and nuclear "time of flight" experiments in which experimenters get only one shot at an interval measurement. For maximum resolution in these experiments, one solution is a counter that utilizes interpolation algorithms to enhance resolution on one-shot events. However, for anything this critical, it would be better to use a digitizing scope and capture the actual waveform.

DIGITAL COUNTER/TIMERS

A COUNTER FOR EVERY PURPOSE

The TM 500/TM 5000 family of modular instruments includes seven digital counter/timers, which provide a wide variety of price/performance features. The DP 501 digital prescaler extends the frequency measurement capability of all counters to 1.3 GHz.

The 350 MHz DC 5010/DC 510, and the 135 MHz DC 5009/DC 509, are universal counter/timers that feature reciprocal frequency measurements and an especially wide range of other measurement functions, plus features such as autotrigger, auto-averaging, arming, probe compensation, and more. The DC 5004, DC 5010 and DC 5009 are GPIB programmable; this capability can be added to the DC 504A, DC 510 and DC 509 as field modifications. In performance other than programmability, the DC 510 and DC 5010 are equal, as are the DC 5009 and DC 509, the DC 504A and DC 5004.



For versatility in counting, the DC 503A 125 MHz Universal Counter/Timer features eight measurement functions, including period, width, and time-interval averaging. Both input channels have the full 0 to 125 MHz frequency range, 20 mV RMS sensitivity, and separate controls for input coupling, attenuation, trigger level, and trigger slope. The 10 MHz clock provides 100 ns resolution of single-shot time interval measurements, and 10 ps resolution with averaging.

The 100 MHz DC 5004/DC 504A features autorange, period and width averaging, an internal 100X multiplier to provide high resolution of low frequency signals. The DC 5004 adds TM 5000 compatibility, GPIB programmability, and 8-digit resolution over the GPIB. It is an excellent alternative for applications requiring low cost GPIB compatibility.

The DP 501 Digital Prescaler adds 1.3-GHz frequency-counting capability to all of the above counters.

DIGITAL COUNTER SELECTION GUIDE

Application/Feature	DC 510/DC 5010	DC 509/DC 5009	DC 503A	DC 5004/DC 504A
Frequency Range With DP 501	350 MHz 1.3 GHz	135 MHz 1.3 GHz	125 MHz 1.3 GHz	100 MHz 1.3 GHz
Number of Digits	9	8	8	6
Ratio Architecture	•	•		
Period Averaging	•	•	•	•
Width Averaging (Single Input)	•	•	•	•
Time Interval Averaging	•	•	•	•
Autotrigger	•	•		
Gated Events Averaging	B during A	B during A	A during B	
Ratio Averaging	•	•	•	
Other	High stability time base, trigger level and shaped outputs, self-test, phase modulated clock, probe compensation, time manual, totalize.	High stability time base, trigger level and shaped outputs, self-test, phase modulated clock, probe compensation, time manual, totalize.	High stability time base, trigger level and shaped outputs, time manual, totalize.	Autorange, 100X resolution multiplier*1
IEEE Standard 488.1-1987	DC 5010 only	DC 5009 only		DC 5004 only
Mainframe Compatibility	DC 510 TM 500/TM 5000 DC 5010 TM 5000 only	DC 509 TM 500/TM 5000 DC 5009 TM 5000 only	TM 500/ TM 5000	TM 500/ TM 5000 DC 5004 TM 5000 only
Page	270	272	275	274
Price	$3,300/$3,600	$1,600/$1,900	$1,725	$995/$760

*1 *8 digits via GPIB (DC 5004)*

DC 5010/DC 510

- *350 MHz both A and B Channels*
- *3.125-ns Single-Shot Resolution*
- *9-Digit Display*
- *1-ps Resolution, with Averaging*
- *Reciprocal Frequency Measurement; Period; Width; Time AB; Events B During A; Totalize A, AB; Ratio; Rise/Fall; Time Manual; Arming; Null*
- *Auto or Selected Averaging to 10 @ in All Modes*
- *Duty-Cycle Independent Autotrigger*
- *DVM Mode for Displaying Trigger-Level Setting*
- *Shaped A and B Channel Outputs*
- *Hysteresis Compensation*
- *Probe Compensation*
- *High Stability Oven Time Base*

DC 5010/DC 510

The DC 5010/DC 510 Universal Counter/Timers feature reciprocal frequency to 350 MHz, period, ratio, events B during A measurements, and time A to B. The powerful reciprocal technique provides high resolution of low frequency signals much faster than conventional counting techniques.

Timing measurements include time interval, width, and rise and fall time features to 3.125 ns single-shot resolution. Measurements can be averaged up to 1 billion times with usable resolution to 1 ps. The pseudo-random, phase-modulated time base provides increased accuracy by eliminating synchronous errors in the time interval and width averaging modes.

Auto trigger senses the applied signal and sets trigger levels to the optimum points. In the DC 5010, trigger levels, the minimum and maximum signal voltage levels, and the trigger voltage are available over the GPIB, and can be viewed on the 9-digit display.

Other features include an arming input that allows measurement of selected inputs from complex waveforms, hysteresis compensation and probe compensation for attenuator type probes.

The DC 510 is upgradeable to the GPIB compatible DC 5010 with a modification kit that can be installed in the field.

CHARACTERISTICS

Display – Nine-digit LED display, automatic decimal point positioning, LED indicators for units, measurement gate, and bus conditions. Overflow is indicated by a blinking display.

CHANNEL A AND CHANNEL B INPUT

Frequency Range – 50 Ω termination:
> 0 to ≥ 350 MHz dc coupled.
100 kHz to ≥ 350 MHz ac coupled.
1 MΩ termination > 0 to ≥ 300 MHz dc coupled.
16 Hz to ≥ 300 MHz ac coupled.

Sensitivity – 50 Ω termination dc: ≤ 25 mV RMS sinewave to 350 MHz ≤ 70 mV p-p pulse 1 MΩ termination. DC/AC ≤ 25 mV RMS to 200 MHz. 42 mV RMS to 300 MHz.

***Attenuation* Selectable** – 1X, 5X.

Impedance – 1 MΩ paralleled by 23 pf ±2.2 pF (10%) or 50 Ω ±3% dc.

Dynamic Range – 70 mV p-p to 4 V p-p (x attenuation).

Trigger Level Range –
≥ +2 V to ≤ – 2 V with 4 mV resolution (X1).
≤ ±10 V to ≤ -10 V with 20 mV resolution (X5).

Trigger Level Accuracy – ±1% of F.S. trigger level range, plus ±2% of reading for a dc input V, ±40 mVX Attenuator.

Autotrigger Frequency Range – 10 Hz to ≤ 350 MHz.

Independent Controls – Slope, Attenuation 1X/5X, Couple ac/dc, Impedance 1 MΩ/50 Ω.

Maximum Input Voltage (1 MΩ input impedance)
1X: ±42 V (dc + peak ac) to 200 kHz; ±2 V (dc + peak ac) 2 to 250 MHz.
5X: ±42 V (dc + peak ac) to 1 MHz; ±10 V (dc + peak ac) 1 to 250 MHz.
In 50 Ω Input Impedance: Signals > ±2 V x attenuator will cause input protection circuitry to switch input to 1 MΩ.

Shaped Out – Shaped replica of signal being measured aids proper triggering on complex waveforms (≤ 100 mV typically to 350 MHz into 50 Ω load).

Arming Input – Permits measurements of complex waveforms. A TTL high allows averaging of selected events within a measurement.

FREQUENCY A

Range – ≤ 36 µHz to ≥ 350 MHz.

Resolution –

$$\pm \text{LSD} \pm 1.4 \left(\frac{\text{A Trigger Jitter Error}}{N} \right) (\text{Frequency A})^2$$

Accuracy –
Resolution ± (Time Base Error x Frequency A)

PERIOD A

Range – 3.125 ns to 7.6 hrs.

Resolution –

$$\pm \text{LSD} \pm \frac{1.4 \times \text{A Trigger Jitter Error}}{N}$$

Accuracy – (± Time Base Error x Period A)

RATIO B/A

Range – 10^{-8} to 10^{9} (Frequency Range: ≤ 36 µHz to ≥ 350 MHz). (10^{-11} to 10^{12} w/o decimal point)

Resolution –

$$\pm \text{LSD} \pm \frac{1.4 \times \text{B Trigger Jitter Error} \times \text{Frequency B}}{N}$$

Accuracy – Same as Resolution.

TIME A → B

Range – 2.0 ns to 7.6 hrs.

Minimum Dead Time – 12.5 ns (stop to start).

Resolution –

$$\pm \text{LSD} + \frac{1}{\sqrt{N}} \left(\begin{matrix} \pm \text{A Trigger Jitter Error} \\ \pm \text{B Trigger Jitter Error} \end{matrix} \right)$$

Accuracy – Resolution ± (Time Base Error xTI) ± Channel Delay Mismatch + B Trigger slew error -A Trigger slew error.

Channel Delay Mismatch – < 2 ns between front panel inputs, without null.

EVENTS B DURING A

Range – 10^{-8} to 10^{9}.

Maximum B Frequency – ≥ 350 MHz.

Maximum A Frequency – ≥ 80 MHz.

Maximum A Pulse Width – ≤ 4.0 ns.

Minimum Time Between A Pulses – ≤ 8.5 ns.

Minimum Dead Time Between Pulses – ≤ 8.5 ns.

Resolution –

$$\pm \text{LSD} + \frac{\text{Freq. B}}{\sqrt{N}} \left(\begin{array}{l} \pm \text{Trig. Jit. Error CH A start edge} \\ \pm \text{Trig. Jit. Error CH A stop edge} \end{array} \right)$$

Accuracy – Resolution Frequency B (Stop Slew Rate Error-Start Slew Rate Error) + Frequency Bx (5 x 2 ns).

WIDTH A

Range – ≤ 4 ns to 7.6 hrs.

Minimum Dead Time Between Pulses – 1.6 ns.

Resolution –

$$\pm \text{LSD} + \frac{1}{\sqrt{N}} \left(\begin{array}{l} \pm \text{Start Trigger Jitter Error} \\ \pm \text{Stop Trigger Jitter Error} \end{array} \right)$$

Accuracy – Resolution ± (Time Base Error x Width A) + (Stop Slew Rate Error - Start Slew Rate Error) ± 2 ns.

Repetition Rate – ≥ 80 MHz.

TIME MANUAL

Range – 3.125 ns to 3.125 x 10^4 s (≈ 8 hrs).

Resolution – ± LSD 100 ms.

Accuracy – Resolution ± (Time Base Error x Time).

TOTALIZE A

Range – 0 to 10^9 counts.

Repetition Rate – 0 to ≥ 350 MHz.

TOTALIZE A + B

Range – 0 to 10^9 counts (A+B ≤ 10^9).

Repetition Rate – 0 to ≥ 350 MHz.

TOTALIZE A - B

Range – -1 x 10^8 to 10^{12} (either A > 10^{12} or B > 10^{12} will cause overflow).

Repetition Rate – 0 to ≥ 350 MHz.

RISE/FALL A

Range – 5.0 ns to 7.6 hrs.

Repetition Rate – Minimum time between rising (falling) edges is 12.5 ns (80 MHz).

Input Amplitude – (1.4 to 8 V) 1.4 Vp–p min, + 4 to – 4 V dc + peak ac max (50 Ω), (0.7 to 4 V) 700 mV p-p min, + 2 to – 2 V dc + peak ac max (1 MΩ).

Resolution –

$$\pm \text{LSD} + \frac{1}{\sqrt{N}} \left(\begin{array}{l} \pm \text{Start Trigger Jitter Error} \\ \pm \text{Stop Trigger Jitter Error} \end{array} \right)$$

Accuracy – Resolution ± (Time Base Error x Risetime/Falltime) ± 2 ns ± 4 mV x Slew Rate A Error (near 10%) ± 4 mV Slew Rate A Error (near 90%).

PROBE COMPENSATION

Display – 1 or 0 in each channel.

Accuracy – Probe Attenuation x Counter Attenuation x 0.300 (%).

RESOLUTION AND ACCURACY DEFINITIONS

Trigger Jitter Error (Seconds RMS) –

$$\frac{\sqrt{(e_{n1}(^2 + (e_{n2})^2} \text{ (Volts RMS)}}{\text{Input Slew Rate at Trigger Point (V/s)}}$$

Where: e_{n1}=140 μV RMS typical counter input noise for 1 M Ω filter on; 240 μV RMS typical for 1 MΩ, filter off and 340 μV RMS typical for 50 Ω and e_{n2}=RMS Noise Voltage of input signal at trigger point measured with 350 MHz bandwidth.

Slew Rate Error (Seconds) –

Trigger Level Error (V)*[1]

Input Slew Rate at Trigger Point (V/s)

***[1]Trigger level error =**

All functions except Width and Events B During A	Positive Slope	Trigger accuracy times ATTN factor
	Negative Slope	(Trigger accuracy ± 10 mV) times ATTN factor
Width A	Start Edge	Trigger accuracy times ATTN factor
	Stop Edge	(Trigger accuracy + hyst) times ATTN factor
	Start Edge	(Trigger accuracy + hyst) times ATTN factor
	Stop Edge	Trigger accuracy time ATTN factor
Events B During A	Same as Width, except each number is multiplied by (Frequency B)	

Note: Input hysteresis is typically 50 mV p-p x attenuation. N = Number of events averaged.

The minimum number of averages is selected by the Averages button and the up and down buttons in decade steps from 1 to 10^9. At Channel A repetition rates above ≈ 250 Hz, the actual number of averages will be:

N=[Frequency A(Hz) x 4 ms] + Averages.

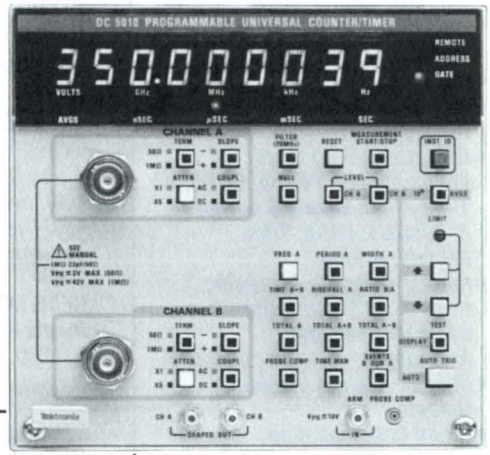
N=Averages setting (below 250 Hz).

This calculation typically leads to better than expected resolution in the displayed answer for small N with only minimal impact on measurement time. It does mean, however, that Arming must be used where only N=1 is for signals ≥ 250 Hz.

In the Auto mode, the counter measures with a fixed measurement time of about 300 ms (or the time for one event, whichever is greater).

N=Frequency A (Hz) x 0.3 s (N always ≥1).

Time Base Error – The sum of all errors specified for the time based used.



GPIB IEEE-488 *

**The DC5010 complies with IEEE Standard 488.1-1987 and Tektronix Standard Codes and Formats*

ORDERING INFORMATION

DC 5010 Programmable Universal Counter/Timer **$3,600**
Includes: Shaped output cable (012-0532-00); instruction manual (070-3897-02); instrument interfacing guide (070-4611-00); reference guide (070-3553-00).

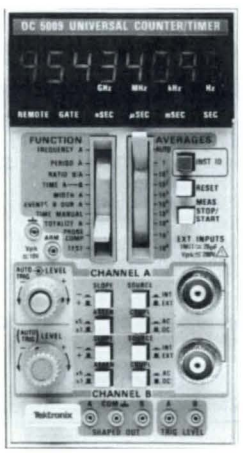
DC 510 Universal Counter/Timer. **$3,300**

RECOMMENDED PROBE

P6125 – 5x Passive Probe **$90**

DC 5009/DC 509

- *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 in All Modes •Duty – Cycle Independent Autotrigger*
- *Shaped A and B Channel Outputs*
- *Probe Compensation*
- *High Stability Oven Time Base*



GPIB IEEE-488 *

** The DC 5009 complies with IEEE Standard 488.1-1987 and with Tektronix Standard Codes and Formats.*

STANDARD HIGH STABILITY TIME BASE

Crystal Frequency – 10 MHz.

Temperature Stability – $\pm 2 \times 10^{-7}$ 0 to + 50°C after warm-up.

Warm-Up Time – + 2×10^{-7} of final frequency in 10 minutes when cold started at 25°C.

Aging Rate – ≤ $\mu 1 \times 10^{-6}$/day at time of shipment, 4×10^{-8}/week after 30 days of continuous operation, 4×10^{6}/ year after 60 days of continuous operation.

Setability – Adjustable to within $\pm 2 \times 10^{-8}$.

REAR INTERFACE

Inputs – Arming; reset; external time base (1, 5, or 10 MHz), prescale.

Outputs – 10 MHz clock.

OTHER CHARACTERISTICS

Power Consumption – 19.3 W.

GPIB Data Output Rate – ≈10 readings/s maximum (DC 5010 only).

TM 5000 Power Module Compatibility – The DC 5010 is not compatible with TM 500 series mainframes; the DC 510 is compatible with both.

DC 5009/DC 509

The DC 5009/DC 509 single-width Universal Counter/Timers provide all of the measurement functions of the higher performance DC 5010/DC 510 except rise time/fall time, null, and totalize A ± B.

The powerful reciprocal-frequency measurement technique allows up to eight digits of resolution of low-frequency signals in one second or less of measurement time. The DC 5009/DC 509 has the same automatic averaging feature as the DC 5010/DC 510; selected averaging of up to 108 events provides usable time-interval resolution of 5 ps.

The TM 5000 rear-interfacing capability allows the DP 501 to be controlled over the GPIB through the DC 5009. The DP 501 allows frequency measurements to 1.3 GHz.

A field-installable modification kit is available to upgrade a manual DC 509 Universal Counter/Timer to a GPIB programmable DC 5009 Universal Counter/Timer.

CHARACTERISTICS

Display – Eight-digit LED display, automatic decimal point positioning, LED indicators for units, and measurement gate. Overflow is indicated by a blinking display.

CHANNEL A AND B INPUT

Frequency Range – > 0 to ≥135 MHz dc coupled; ≤10 Hz to ≥135 MHz ac coupled.

Sensitivity – ≤ 20 mV RMS (56.6 mV p-p) to ≥100 MHz, 40 mV RMS (113 mV p-p) from 100 MHz to ≥135 MHz, 115 mV p-p at minimum, pulse width of 3 ns.

Attenuation – Selectable 1X, 5X.

Impedance – 1 MΩ ±2% paralleled by ≤ 30 pF.

Trigger Level Range – +3.200 to – 3.175 V with 25 mV resolution (X1), +16 to -15.875 V with 125 mV resolution (x5).

Trigger Level Accuracy – ±15 mV ±40 μV/°C referenced to 25°C.

Dynamic Range – 3.2 ≤ input voltage ≤ +3.2. X1: Vin p-p ≤ 3 V; X5: V p-p 15 Vin (for input signal risetime p-p ≤ 3 V; X5: V p-p 15 Vin (for input signal risetimes ≤ 5 ns).

Autotrigger Frequency Range – *Sensitivity* ≤125 mV p-p x attenuation; ≤ 20 Hz to ≥100 MHz. Range: ±3.2 V x attenuation. Resolution: 25 mV x attenuation.

Independent Controls – Slope ± attenuation 1X/5X, Couple ac/dc, Source Internal/External.

Maximum Input Voltage – 1X: ≤ 200 V peak; ≤ 400 V p-p from dc to 50 kHz, derate to ≤15 V p-p at 135 MHz. 5X: ≤ 200 V peak; ≤ 400 V p-p from dc to 5 MHz, derate to ≤ 25 V p-p at 135 MHz.

Shaped Out – Shaped replica of signal being measured, aids proper triggering on complex waveforms. Amplitude 0 V to ≥ +0.3 V from 50 Ω.

Trigger Level Out – A dc level corresponding to the actual trigger level. Accuracy within ±10 mV of internal trigger level.

Arming Input – Permits measurements of complex waveforms. A TTL high allows averaging of selected events within a measurement.

FREQUENCY A

Range – ≤100 μHz to ≥135 MHz.

Resolution –

$$\pm \text{LSD} \pm 1.4 \times \frac{\text{A Trigger Jitter Error}}{N} \times (\text{Frequency A})^2$$

Accuracy –
Resolution ± (Time Base Error x Frequency A).

PERIOD A

Range – ≤ 7.40 ns to ≥ 3.05 hrs.

Resolution –

$$\pm \text{LSD} \pm 1.4 \times \frac{\text{A Trigger Jitter Error}}{N}$$

Accuracy – Resolution ± (Time Base Error x Period A).

RATIO B/A

Range – 10^{-7} to 10^{8} (Frequency Range: CH A to ≥135 MHz; CH B to ≥125 MHz).

Resolution –

$$\pm \text{LSD} \pm 1.4 \times \text{B Trigger Jitter Error} \left(\frac{\text{Frequency B}}{N} \right)$$

Accuracy – Same as Resolution.

TIME A – B

Range – ≤15 ns to ≥ 3.05 hrs.

Minimum Dead Time – 15 ns (stop to start).

Resolution –

$$\pm \text{LSD} + \frac{1}{\sqrt{N}} \begin{pmatrix} \pm \text{A Trigger Jitter Error} \\ \pm \text{B Trigger Jitter Error} \end{pmatrix}$$

Accuracy – Resolution ± (Time Base Error x Time A-B) + (B Trigger Slew Error-A Trigger Slew Error) ± (Channel Delay Mismatch).

Channel Delay Mismatch – < 2 ns between front panel inputs and < 2 ns between rear interface inputs.

Repetition Rate – < 35 MHz.

EVENTS B DURING A

Range – 10^{-7} to 10^{8}.

Maximum B Frequency – 125 MHz.

Minimum A Pulse Width – 15 ns.

Minimum Time Between A Pulses – 15 ns.

Minimum Time Between "A" Start Edge and First "B" Event – 15 ns.

Resolution –

$$\pm \text{LSD} + \frac{\text{Freq. B}}{\sqrt{N}}\left(\begin{matrix}\pm \text{Trig. Jit. Error CH A start edge} \\ \pm \text{Trig. Jit. Error CH A stop edge}\end{matrix}\right)$$

Accuracy – Resolution + Frequency B (Stop Slew Rate Error – Start Slew Rate Error).

WIDTH A

Range – ≤15 ns to ≥ 3.05 hrs.

Minimum Dead Time Between Pulses – 15 ns.

Resolution –

$$\pm \text{LSD} + \frac{1}{\sqrt{N}}\left(\begin{matrix}\pm \text{Start Trigger Jitter Error} \\ \pm \text{Stop Trigger Jitter Error}\end{matrix}\right)$$

Accuracy – Resolution ± (Time Base Error x Width A) + (Stop Slew Rate Error-Start Slew Rate Error) ± 5 ns.

TIME MANUAL

Range – 0 to 3.05 hrs. May be extended with GPIB.

Resolution – ± LSD (100 ms).

Accuracy – ± Resolution ± (Time Base Error x Time).

TOTALIZE A

Range – 0 to 1.09 x 1012 counts. May be extended with GPIB.

Repetition Rate – > 0 to ≥135 MHz.

PROBE COMPENSATION

Display – 1 or 0 for each channel.

Accuracy –

$$\frac{\text{Probe Attenuation x 50 mV x 100 (\%)}}{V_{IN} \text{ at Probe}}$$

(2.5% nominal for X5 probe with 10 V p-p at the probe).

RESOLUTION AND ACCURACY: DEFINITIONS

Trigger Jitter Error (Seconds RMS) –

$$\frac{\sqrt{(e_{n1}(^2 + (e_{n2})^2 \text{ (Volts RMS)}}}{\text{Input Slew Rate at Trigger Point (V/s)}}$$

Where: e_{n1} = 120 µV RMS typical counter input noise.

e_{n2} = *TMS Noise Voltage of input signal at trigger point measured with 150 MHz bandwidth.*

Slew Rate Error (Seconds) –

$$\frac{\text{Input Hysteresis/2}}{\text{Input Slew Rate at Trigger Point (V/s)}}$$

Note: Input hystersis is typically 20 nV p-p.

N=Number of Events Averaged.

The minimum number of averages is selected by the averages control in decade steps from 1 to 10^{8}. At channel A repetition rates above ≈250 Hz, the number of events averaged will be:

N=[Frequency A (Hz) x 4 ms] + Averages.

N=Averages setting (below 250 Hz).

In the Auto mode, the counter measures with a fixed measurement time of about 300 ms.

N=Frequency A (Hz) x 0.3 s. (N is always ≥1).

Time Base Error – The sum of all errors specified for the time base used.

STANDARD HIGH STABILITY TIME BASE

Crystal Frequency – 10 MHz.

Temperature Stability – ± 2 x 10^{-7} after warm-up, 0 to + 50°C.

Warm-up Time – Within 2 x 10^{-7} of final frequency in <10 minutes when cold-started at 25°C.

Aging Rate – 1x10^{-8}/day at time of shipment, 4x103–3^{8}/week after 30 days of continuous operation, 1x10^{-6}/year after 60 days of continuous operation.

Setability – Adjustable to within 2 x 10^{-8}.

REAR INTERFACE

Inputs – Channel A and Channel B input to 50 MHz (50 Ω impedance, maximum input 3.6 V peak); arming; reset; external time base (1,5, or 10 MHz), prescale.

Outputs – Channel A and Channel B shaped outputs; Channel A and Channel B trigger level outputs; 10 MHz clock; gate out.

OTHER CHARACTERISTICS

Power Consumption – 15 W.

GPIB Data Output Rate – ≈10 readings/s maximum (DC 5009 only).

TM 5000 Power Module Compatibility – The DC 5009 is not compatible with TM 500 Series mainframes; DC 509 is compatible with TM 500 and TM 5000 mainframes.

ORDERING INFORMATION

DC 5009 Programmable Universal Counter/Timer **$1,900**
Includes: Tip jack to BNC adapter cable (175-3765-01); instrument interfacing guide (070-4612-00); reference guide (070-3560-01); instruction manual (070-3888-00).

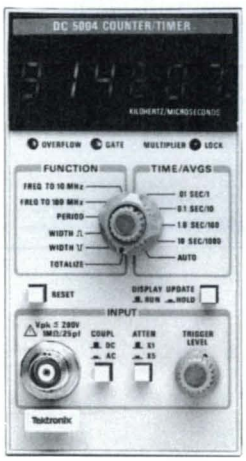
DC 509 Universal Counter/Timer **$1,600**
Includes: Instruction Manual (070-3464-00).

RECOMMENDED PROBE

P6125 5x Passive **$90**

DC 5004/DC 504A

- *DC to 100 MHz*
- *Period and Period Averaging*
- *Width and Width Averaging*
- *Autoranging*
- *100X Resolution Multiplier*



GPIB IEEE-488 *

**The DC 5004 complies with IEEE Standard 488.1-1987 and with Tektronix Standard Codes and Formats.*

ORDERING INFORMATION

DC 5004 GPIB Compatible Counter/Timer **$995**
Includes: Instruction manual (070-6918-00), IIG and reference guide.

DC 504A Counter/Timer. ☎ **$760**
Includes: Instruction manual (070-4291-00).

RECOMMENDED PROBE

P6125 5 x Passive **$90**

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

DC 5004/DC504A

The easy-to-use DC 5004/DC 504A Counter/Timer measures frequency from dc to 100 MHz, with an internal prescaler being used for frequencies above 10 MHz. Both direct and prescaled counting are done through the same input connector; no need to change connectors when changing frequency range. Autoranging permits virtual hands-off operation for most measurements. The 100X resolution multiplier automatically provides 0.01 Hz resolution in one second or 0.001 Hz resolution in ten seconds on signals from 10 Hz to 25 kHz.

The DC 5004/DC 504A features period and width averaging of up to 1000 events. Selectable dc coupling of the input eliminates the potential errors associated with making width measurements on signals of varying duty cycle with counters that are only ac coupled. Input trigger sensitivity is 30 mV RMS across the entire 100 MHz frequency range. The trigger-level range of ±2 V and the selectable 5X attenuator provide a triggering range of up to ±10 volts.

The totalize mode permits totalizing up to 999,999 events – and beyond, with overflow – with a Display Update-Run/Hold control to hold the display while the internal counter continues to advance.

For applications requiring TM 5000/GPIB compatibility, the DC 5004 adds this capability to many of the features of the DC 504A, providing 8-digit resolution over the GPIB.

CHARACTERISTICS

Display – Six-digit LED readout with automatic decimal-point positioning and leading-zero suppression. LED annunciators indicate gate open, resolution multiplier lock, and display overflow.

INPUT

Frequency Range – Front Panel: DC coupled to 100 MHz. AC coupled is 10 Hz to 100 MHz. Rear Interface: DC coupled is 0 to 50 MHz. AC coupled is 10 Hz to 50 MHz.

Sensitivity – 1X Attenuation: 30 mV RMS sinewave to 100 MHz; 85 mV p-p (at a minimum pulse width at 5 ns). 5X attenuation accuracy is within 2% at dc.

Attenuation – Selectable 1X, 5X.

Impedance – Front Panel, 1X, 5X: 1 MΩ, paralleled by ≈25 pF. Rear Interface, 1X, 5X: 50 Ω ±10% at dc.

Dynamic Range – 1X: 2.0 V p-p signal within a ±2 V dc window. 5X: 10 V peak, ±10 V dc.

Trigger Level Range – ±2.0 V x attenuation minimum.

Maximum Input Voltage – Front Panel: 1X is 200 V peak; 400 V p-p from dc to 50 kHz, derate to 15 V p-p from 1.33 to 100 MHz. 5X is 200 V peak; 400 V p-p from dc to 5 MHz, derate to 20 V p-p at 100 MHz. Rear Interface: ≤ 4 V peak.

FREQUENCY TO 100 MHZ

Gate Time (Resolution) – 10 ms to 10 s (1 kHz to 1 Hz), selectable in decade steps; or autoranging (10 ms to 1 s only).

Accuracy –

± 1 Count ± Time Base Error x Freq.

Prescale Factor – ÷10.

PERIOD AVERAGE

Range – DC Coupled: 0 Hz to 2.5 MHz. AC Coupled: 10 Hz to 2.5 MHz.

Resolution – 100 to 0.1 ns, in decade steps; or autoranging (100 to 1 ns only).

Events Averaged (N) – 10^0 to 10^3, in decade steps; or autoranging (10^0 to 10^2 only).

Accuracy –

$$\frac{\pm\ 100\ ns}{N} \pm \text{Time Base Error x Period} \pm 1.4 \times \left(\frac{\text{Trigger Jitter Error}}{N}\right)$$

WIDTH AVERAGE

Range – DC Coupled: 200 ns to <10 sec. AC Coupled: 200 ns to 100 ms

Resolution –

$$\frac{100\ ns}{\sqrt{N}}$$

Events Averaged (N) –100 to 103, selectable in decade steps; or autoranging (100 to 102 only).

Accuracy –

$$\frac{100\ ns}{\sqrt{N}} \pm \text{Time Base Error x Width.}$$

$$\pm \frac{\text{Start Trigger Jitter Error}}{\sqrt{N}}$$

$$\pm \frac{\text{Stop Trigger Jitter Error}}{\sqrt{N}}$$

+ (Stop Slew Rate Error–Start Slew Rate Error) ± 10 ns.

TOTALIZE

Frequency Range – DC Coupled: > 0 Hz to 10 MHz. AC Coupled: 10 Hz to 10 MHz. Overflows above 999,999. Display update Run/Hold will hold display while counter continues to advance. Releasing Run/Hold will update display to new value.

TIME BASE

Frequency (At Calibration) – 10 MHz ±1 x 10^{-7}

Temperature Stability – ±5x10 – 6 (±5 ppm), 0 to + 50°C.

Adjustment Resolution – ±5x10^{-8}

Aging Rate – ≤1x10-6/year (≤1 ppm/year).

EXTERNAL TIME BASE INPUT

10 MHz. Must drive 1 LSTTL load. VIH = 2.0 V/20 µA VIL = 0.8 V/400 µA.

RESOLUTION AND ACCURACY DEFINITIONS

Same as DC 503A except DC 504A has 100 MHz bandwidth and input hysteresis =30 mV p-p typical.

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, at tenuator, and coupling mode controls. Eight measurement functions are available with the DC 503A, and an averaging feature allows averaging of 1 to 10 occurrences of the signal of interest. Signals to be counted or timed can be applied to channels A and B via front-panel BNC connectors or through rear-interface connections. The DC 503A features an easy-access front panel and an LSI-based design for increased instrument reliability.

The DC 503A is equipped with a temperature-controlled 10 MHz crystal oscillator to obtain a highly stable and precise internal time base.

CHARACTERISTICS

Display – Eight digit LED; indicators for units, gate open, and overflow.

Display Time – ≈0.2 s to 5 s and hold.

CHANNEL A AND B INPUT

Frequency Range – 0 to ≥ MHz, dc coupled. 10 Hz to ≥125 MHz, ac coupled.

Sensitivity – 20 mV RMS sinewave to 100 MHz. 60 mV p-p at minimum pulse width (of 5 ns to 100 MHz). 35 mV RMS sinewave to 125 MHz. 100 mV p-p (minimum pulse width of 4 ns to 125 MHz).

Attenuation – Selectable 1X, 5X.

Impedance – 1 M Ω paralleled by ≈27 pF.

Dynamic Range – V p-p ≤ 3 V x attenuation.

Trigger Level Range – Adjustable ±3.5 V x attenuation

Trigger Level Output Accuracy – ±0.5% of reading for a dc input V, ±20 mV.

Independent Controls – Slope ±, Attenuation 1X/5X, Coupled ac/dc, Source Internal/ External.

Maximum Input Voltage – IX: ≤ 200 V peak; ≤ 400 V p–p from dc to 50 kHz, derate to ≤ 15 V p-p from 1.33 to 125 MHz.

5X: ≤ 200 V peak; ≤ 400 V p-p from dc to 5 MHz, derate to ≤ 20 V p-p from 100 to 125 MHz.

Shaped Out – Shaped replica of signal being measured, aids proper triggering on complex waveforms. ≤ 200 mV p-p from 50 Ω.

FREQUENCY A

Range – 0 to 125 MHz.

Resolution – 0.1 Hz to 10 MHz in decade steps.

Accuracy – ±1 count ± Time Base Error.

PERIOD B (SINGLE SHOT)

Range – 100 ns to 10^9 s.

Resolution – 100 ns to 10 s in decade steps.

Accuracy – ±count ± Time Base Error x Period B ±1.4 x Channel B Trigger Jitter Error.

Frequency Range – 125 MHz.

PERIOD B (AVERAGE)

Range – 8 ns to 10 s.

Resolution – 1 fs (10^{-15}) to 100 in decade steps.

Events Averaged (N) – 1 to 10^8.

Accuracy –

$$\pm \frac{100\text{ ns}}{N} \pm \text{Time Base Error}$$

$$\pm \frac{1.4 \times \text{Channel B Trigger Jitter Error}}{N}$$

Frequency Range – 0 to ≤ 125 MHz.

RATIO A/B

Averaged over 1 to 108 cycles of Channel B signal.

Frequency Range – 0 to ≤ 125 MHz (both Channel A and Channel B).

Accuracy –

$$\pm \frac{\text{Frequency B}}{\text{Frequency A} \times N}$$

$$\pm \frac{1.4 \times \text{Channel B Trig Jitter Error} \times \text{Freq A}}{N}$$

$$\pm \frac{\text{Frequency A}}{0.3 \times 10^8}$$

TIME A → B (SINGLE SHOT)

Range – 100 ns to 10^9 s.

Resolution – 100 ns to 10 s in decade steps.

Accuracy – ±1 count ± Time Base Error x Time AB ± Channel A Trigger Jitter Error ± Channel B Trigger Jitter Error ± (Channel B stop Trigger Slew Error – Channel A start Trigger Slew Error) ±4 ns.

TIME A → B (AVERAGE)

Range – 12.5 ns to 10 s.

Minimum Dead Time – 12.5 ns (stop-to-start).

Resolution –

$$\frac{100\text{ ns}}{\sqrt{N}}$$

Events Averaged (N) – 1 to 10^8 in decade steps.

Accuracy –

$$\pm \frac{100\text{ ns}}{\sqrt{N}} \pm \text{Time Base Error} \times \text{Time A} \rightarrow \text{B}$$

$$\pm \frac{\text{Channel A Trigger Jitter Error}}{\sqrt{N}}$$

$$\pm \frac{\text{Channel B Trigger Jitter Error}}{\sqrt{N}}$$

EVENTS A DURING B (AVERAGE)

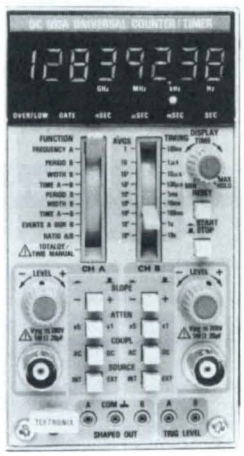
Maximum A Frequency – ≤ 125 MHz.

Minimum B Pulse Width – 5 ns

Events Averaged (N) – 1 to 10^8 in decade steps.

DC 503A

- ***125 MHz Both A and B Channels***
- ***10–ps Resolution in Time–Interval Average with 108 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***

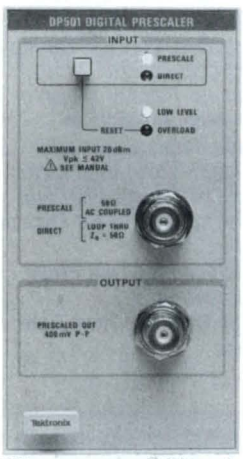


ORDERING INFORMATION

DC 503A Universal Counter/Timer **$1,725**
Includes: Instruction manual (070-2971-00).

DP 501

- *Extends Frequency-Measurement Capability to 1.3 GHz*
- *Compatible with Most TM 500 and TM 5000 Counters*
- *AGC•Low-Level Indicator*
- *GPIB Programmability w/DC 5009 and DC 5010*



GPIB programmability when used with DC 5009 and DC 5010.

ORDERING INFORMATION

DP 501 Digital Prescaler $725
Includes: Instruction manual (070-4332-00).

UTILITY SOFTWARE
See Test & Measurement Software section for description.

CONVERSION KITS
IEEE Standard 488 Capability –
DC 510 Order 040-1023-05 $340
DC 509 Order 040-0957-04 $340
DC 504A Order 040-1255-00 *1
*1 *Contact your local sales represenatative.*

OPTIONAL COUNTER ACCESSORIES
Power Divider GR, 50 Ω..
Order 017-0082-00 $825
Adapters –
(GR to BNC female)
Order 017-0067-00 $75
(GR to BNC male)
Order 017-0064-00 $105
Cable Adapters –
(BNC to tip jack)
DC 503, DC 509, DC 5009
Order 175-3765-01 $48
(BNC to RF) DC 510, DC 5010.
Order 012-0532-00 $48

RECOMMENDED PROBES
P6125 – 5X Passive $90
P6101A – 1X, dc to 34 MHz $60
P6106A – 10X, dc to 300 MHz $150
P6201 – FET, dc to 900 MHz $1,350
P6230 – Bias/Offset, dc to 1.5 GHz $475

Accuracy –

$$\pm \frac{\text{Period A}}{\text{Width B} \times \sqrt{N}}$$

$$\pm \frac{\text{Channel B start Trigger Jitter Error}}{\sqrt{N}}$$

$$\pm \frac{\text{Channel B stop Trigger Jitter Error}}{\sqrt{N}}$$

WIDTH B (SINGLE SHOT)
Range – 100 ns to 10^9 s.
Resolution – 100 ns to 10 s in decade steps.
Accuracy – ±1 count ± Time Base Error x Width B ± Channel B start Trigger Jitter Error ± Channel B stop Trigger Jitter Error ± (Channel B stop Slew Rate Error–Channel B start Slew Rate Error).

WIDTH B (AVERAGE)
Range – 5 ns to 10 s.
Resolution –

$$\frac{100 \text{ ns}}{\sqrt{N}}$$

Events Averaged (M) – 1 to 10^8 in decade steps.
Accuracy –
± 1 Count ± B Trig. Jit. Error (rising edge)
± B Trig. Error (falling edge) ± Time Base Error

Frequency Range – 0 to 100 MHz.

TIME MANUAL
Electronic stopwatch, accumulates and displays time between activation of front panel start/stop button or rear interface signal line. Clock rates selectable from 100 ns to 10 s in decade steps. Range 100 ns to 10^9 s.

TOTALIZE A
1 count to 99,999,999 counts at maximum rate of 125 MHz. Start, stop and reset controlled by front panel pushbuttons or rear interface signal lines.

RESOLUTION AND ACCURACY DEFINITIONS
Time Base Error is the sum of all errors specified for the time base used.

N is the number of periods averaged in Period B (AVGS) mode, the number of intervals averaged in the Time A–B (AVGS) mode, the number of widths of B averaged in Width B (AVGS) and Events A During B modes, and the number of periods of B in the Ratio A/B mode.

Trigger Jitter Error (in μs) –

$$\frac{\sqrt{(en_1)^2 + (en_2)^2}\ (V)}{\text{Input Slew Rate at Trigger Point (V/μs)}}$$

Where: e_{n1} = 100 μV RMS typical internal noise
e_{n2} = RMS noise of signal input at trigger point for a 125 MHz bandwidth

Trigger Slew Rate Error (in μs) –

$$\frac{\text{Input Hysteresis (V)/2}}{\text{Input Slew Rate at set Trigger Point (V/μs)}}$$

Where: Input hysterisis = 20 mV p-p typical.

OTHER CHARACTERISTICS
HIGH STABILITY STANDARD TIME BASE
Crystal Frequency – 10 MHz.
Temperature Stability – < ±2 x 10^{-7} after warm-up, 0 to + 50°C.
Warmup Time – Within 2 x 10^{-7} of final frequency in < 10 minutes when cold started at 25°C.
Aging Rate – 1 x 10^{-8}/day at time of shipment 4 x 10^{-9}/week after 30 days of continuous operation, 1x 10^{-6}/year after 60 days of continuous operation.
Setability – Adjustable to within 2 x 10^{-8}

REAR INTERFACE
Inputs – Direct count input to 50 MHz, (50 Ω) impedance, resistor may be removed for 1 MΩ impedance, remote start/stop, reset; external time base.
Outputs – BCD serial-by-digit, decimal point overflow, scan clock; trigger level; time base reference.

DP 501

The DP 501 Digital Prescaler adds 1.3 GHz frequency-counting capability to most counters, though it was designed specifically for use with the DC 503A, DC 509/DC 5009, and the DC 5010/DC 510 Universal Counter/Timers.

The DP 501 is placed in the signal line between the source and the counter's signal input and can be operated in either the Direct or the Prescale mode. The ÷16 prescaling function can be activated manually, with a front panel pushbutton, or via the GPIB when used with the DC 5009 or DC 5010.

Input sensitivity in the Prescale mode is 20-mV RMS to 1 GHz and 30-mV RMS to 1.3 GHz. A Low-Level indicator alerts the user if the input signal amplitude is too low for error-free counting. An automatic gain-control circuit provides optimum immunity to signal noise in the Prescale mode.

The DP 501 and DC 509/DC 5009 or DC 510/DC 5010 can be used with the Tektronix 7L14 Spectrum Analyzer and TR 502 Tracking Generator to provide counter-accuracy measurements of swept-frequency signals from100 kHz to 1.3 GHz.

CHARACTERISTICS

Prescale Mode Input – Frequency range is ≤ 100 MHz to ≥ 1.3 GHz.

Sensitivity – 100 MHz to 1 GHz is ≤ 20 mV RMS (-21 dBm). 1 to 1.3 GHz is ≤ 30 mV RMS (–17 dBm).

Impedance – 50 Ω, ac coupled; vswr ≤ 2.2:1.

Output – Amplitude into 50 Ω is ≤ 200 mV, p-p. Unterminated is 2X terminated value.

Direct Mode Input – Connected directly to output.

Frequency Range – 0 to > 350 MHz.

Impedance – Loop through characteristic impedance is 50 Ω; nonterminated capacitance ≈20 pF (no connection to output).

Output – Connected directly to input. < 1 dB insertion loss up to 350 MHz. Powers up in direct mode.

Overload Protection – Prescale: Input disconnects when input signal exceeds + 20 dBm + 5 dBm for a period of ≈ 0.5 s or more.

Damage Level – Prescale: Input may be damaged if signal level exceeds + 25 dBm. Direct: 42 V peak maximum. Maximum current is 250 mA.

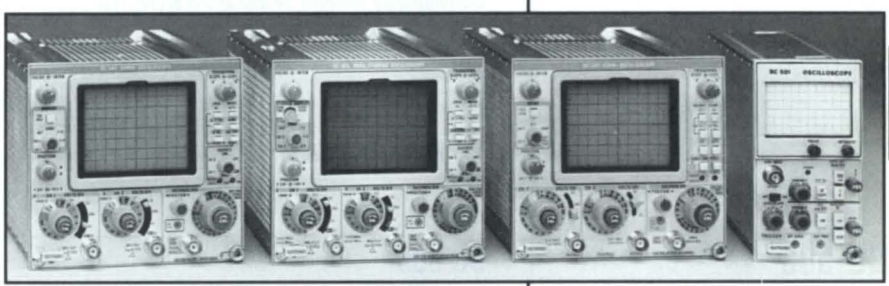
Input Attenuation – Automatic: Up to 40 dB range.

Low Level Indicator – Lights when input signal is below that required for error-free counting.

Tracking-Generator Compatibility – Outputs will drive two standard TTL loads. Inputs represent two standard TTL loads. Requires arming input to associated counter.

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 503 is an analog storage oscilloscope for viewing non-repetitive or low-repetitive signals. The SC family provides an ideal, size-conscious solution to your signal viewing needs whether mounted in a rack or on an engineering bench.



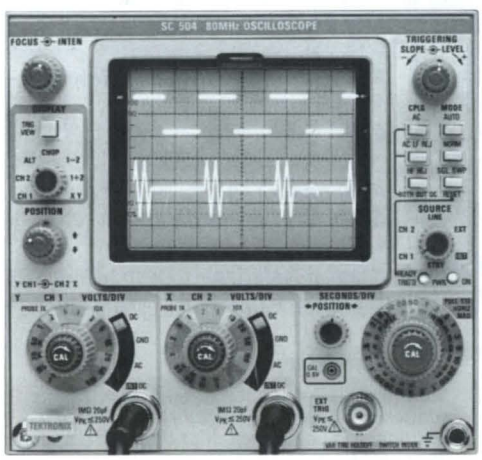
OSCILLOSCOPE SELECTION GUIDE

Application/Feature	SC 504	SC 503	SC 502	SC 501
Bandwidth (MHz)*[1]	80	10	15	5
Number of Channels	2	2	2	1
Sensitivity (mV/div)	5	1	1	10
Vertical Accuracy	±2%	±3%	±2%	±3%
Max Input Voltage: V dc peak ac)	250	350	350	350
(V p-p #1 kHz)	500	700	700	
Sweep Rate (ns/div)	50 ns to .2 s	500 ns to 2 s	200 ns to .5 s	1 µs to 100 ms
With x10 Mag	5 ns	50 ns	20 ns	NA
	21 Steps	21 Steps	20 Steps	
	1-2-5 Sequence	1-2-5 Sequence	1-2-5 Sequence	Decade Steps
Compartment Size Mainframe	2 Wide	2 Wide	2 Wide	1 Wide
Recommended Probes	1X, P6106A; 10X, P6102A; 1X/10X, P6062B			
Page	277	278	279	279
Price	$4,695	$4,495	$2,995	$1,995

*[1] *Optimum bandwidth, rise time, aberrations, and deflection-factor accuracy. Expect reduced performance for other temperature ranges and attenuator settings.*

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.

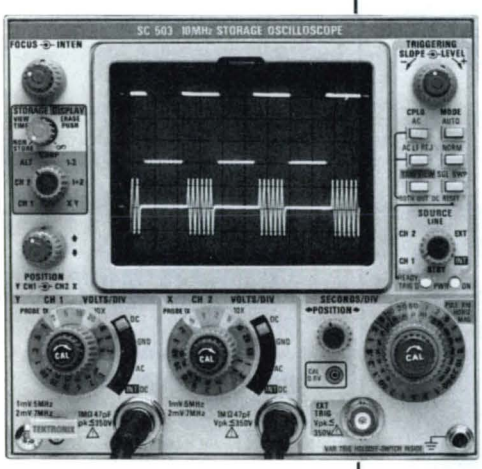


SC 504

- *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*

SC 503

- *10-MHz Bandwidth, Dual Trace*
- *50-ns/Div Maximum Calibrated Sweep Rate*
- *1-mV/Div Maximum Sensitivity*
- *Bistable Storage Autoerase*
- *Trigger View, Variable Trigger Holdoff*
- *Switchable Front/Rear X and Y Inputs*
- *Rear Z-Axis Input*
- *True X-Y Capability*



CHARACTERISTICS

VERTICAL DEFLECTION

Rise Time – 4.4 ns

Step Response Aberrations – ±4%

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

CMRR (CH 1 minus CH 2) – > 50:1 at 1 MHz

Calibrator – 0.6 V ±1%, ≈ 1 kHz

HORIZONTAL DEFLECTION

Continuously Variable Sweep to 0.5 s/div

Sweep Accuracy**2 – 15 to 35 deg C
±3%, 0.2 s/div to .50 ms/div;
±2%, 20 ms/div to 0.2 µs/div;
±3%, 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	Triged 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.

SC 503

The SC 503 is a nondelayed-sweep, general-purpose analog storage oscilloscope that can be used to store and display waveforms after the input signal is removed.

Important storage applications of the SC 503 include measurement of signals in computer peripherals, communication terminals, and industrial control systems.

The SC 503 also features an autoerase mode that erases the stored signal and automatically retriggers the oscilloscope, and X-Y capability. The X-Y capability allows creation of Lissajous patterns in many cause-and-effect testing relationships including: acoustic-speech testing, nerve-potential testing, and optical-stimulus-response testing.

CHARACTERISTICS

VERTICAL DEFLECTION

Rise Time – 35 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

CMRR (CH 1 minus CH 2) – > 30:1 at 1 MHz

Channel Isolation – ≤ 2% to 10 MHz

Displayed Noise – ≤ 0.2 mV p-p at 1 mV/div

Calibrator – 0.6 V ±1%, ≈ 1 kHz

**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.*

HORIZONTAL DEFLECTION

Continuously Variable Sweep to 0.5 s/div

Sweep Accuracy**1 – 15° to 35°C
±4%, 2 s/div to .5 s/div;
±3%, 0.2 s/div to 5 µs/div;
±4%, 2 µs/div to 0.5 µs/div

X-Y Mode Bandwidth – DC to 500 kHz

TRIGGERING

Coupling – DC, AC, AC LF REJ

Trigger Sensitivity (min p-p signal) DC Coupling

Source	≤ 5 MHz	5 MHz to 10 MHz
Ch 1 and Ch 2	0.4 div.	1 div
Ext. Rear Int.	35 mV to 60 mV	80 mV to 150 mV

Triggering Level Range – V Ext ≥ 1.2 V, Int ≥ 6 div.

AVAILABLE REAR CONNECTIONS

Z Axis In	Ch 1 Trig Out
Ch 1 & Ch 2 In	Triged Gate Out
Trig In	Ramp Out
Ext Gate In	Sweep Gate Out
Gate Select In	Light Out
Intensity In	Hold Off Out
Reset In	Erase Function

CRT

Phosphor – GX (P44)

Accelerating Potential – 2 kV

Graticule – 8X10 div (0.25 in / div) internal graticule lines

STORAGE SYSTEM

Stored Writing Speed (Center 68 Divisions) – At least 80 div/ms (50 cm/ms).

Erase Time – 400 to 600 ms.

Autoerase Viewing Time – Continuously variable from 0.5 to 5 s.

Maximum Recommended Storage Time – 4 hrs.

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 SC 502 is intended to be a powerful tool in the field servicing of digital equipment. The CRT of the SC 502 offers a high writing speed as an advantage in the display of digital information, while stable, clean triggering is assured by incorporating well-proven circuits. Thus, the SC 502 offers a unique combination of performance, compactness, and systems capability.

The rear-interfacing capability of the SC 502 and all TM 500/TM 5000 instrumentation suggests exceptional applicability to systems of built-in test equipment or rackmounted installations. The TM 515 Traveler mainframe with the SC 502, forms a nucleus for sophisticated, compact field-service "packages."

CHARACTERISTICS

VERTICAL DEFLECTION

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

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

Continuously Variable Sweep to 0.5 s/div

***Sweep Accuracy**1* – 15° to 35° C
±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	≤ 5 MHz	5 MHz to 15 MHz
Ch 1 and Ch 2	0.4 div.	1 div
Ext. Rear Int.	60 mV	150 mV

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	Other Optional Inputs

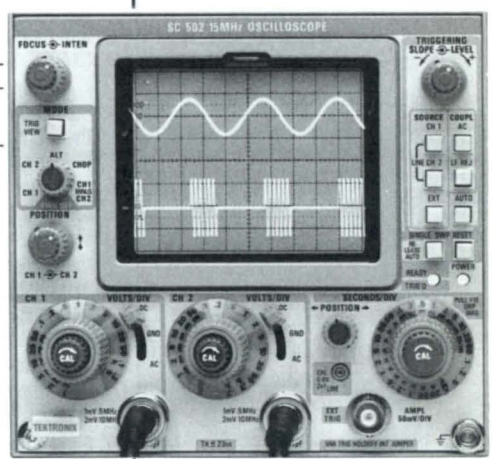
CRT

Phosphor – GH (P31)

Accelerating Potential – 12 kV

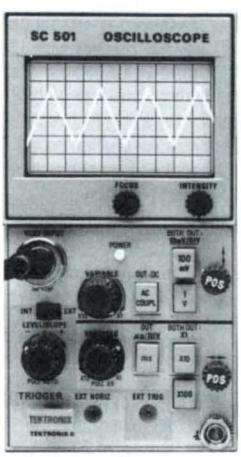
Graticule – 8X10 div (0.25 in/div) internal graticule lines

**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*



SC 501

The SC 501 is a single-channel, 5-MHz plug-in-unit oscilloscope with a 2.5-inch CRT display that occupies a single TM 500/TM 5000 series plug-in compartment.

Since the SC 501 fits any TM 500 or TM 5000 mainframe, it can be used on the bench, in a rack, or on the road.

Calibrated sweep rates are selected by pushbutton logic in decade steps from 1 s/div to 100 ms/div. A variable control extends the slowest sweep rate to at least 1 s/div and a fixed magnifier extends the fastest sweep rate to 200 ns/div.

A 0- to 10-V ramp for all sweep rates (excluding the X5 magnification) is provided at a rear-interface connector.

CHARACTERISTICS

VERTICAL DEFLECTION:

AC Coupled Low-Frequency Response – ≤ 2 Hz

Deflection Factors – 10 mV/div, 100 V/div, and 1 V/div continuously variable.

AVAILABLE REAR CONNECTIONS

Ramp out
Vert in (Optionally customer connected)
Ext Trig (Optionally customer connected)
Ext Horiz (Optionally customer connected)

CRT

Phosphor – GH (P31)

Accelerating Potential – 1 kV

Graticule – 6X10 div (0.2 in/div)

SC 501

- *5-MHz Bandwidth*
- *Single Compartment Size*
- *6.4-cm (2.5 in.) CRT*

ORDERING INFORMATION

SC 504 80 MHz Oscilloscope (070-2296-00).	**$4,695**
For Floating Measurements, order A6902B Isolator. See page 421 for complete description.	**$2,070**
SC 503 10-MHz Storage Oscilloscope Includes: Instruction manual (070-3438-00).	**$4,495**
SC 502 15-MHz Oscilloscope Includes: Instruction manual (070-1878-01).	**$2,995**
SC 501 5-MHz Oscilloscope Includes: Instruction manual (070-1700-01).	**$1,995**

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).

Most of these measurements are stimulus/response measurements; that is, a suitable stimulus is applied to the input of the device under test and the measurement is then made at the output. Some of these are single measurements (power, noise level, distortion), some are the ratio of two single-point measurements (gain/loss, signal-to-noise ratio, crosstalk/separation/isolation), and many are sets of single point measurements (frequency response, THD vs frequency, IMD vs level, power vs frequency, crosstalk vs frequency, etc.). It is very common to graph the results of the sets of measurements for further intepretation and analysis. With GPIB instruments this can be done relatively automatically.

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. SMPTE, DIN, and CCIF intermodulation distortion measurements are described in the Tekronix Application Note 75 AX-4485.

Level (amplitude) measurements are typically made with an ac voltmeter. A digital multimeter (Dmm) is built into the AA 5001/AA 501A, removing the need for a separate voltmeter.

Important considerations include bandwidth (must be at least 20 Hz to 20 kHz and preferably extends to several hundred kHz), detector response type (RMS preferred, but many older and less expensive instruments use average-responding-RMS calibrated), sensitivity (must extend down toward the microvolt region for noise measurements on state-of-the-art devices), input circuitry (must be true differential – balanced for rejection of common-mode noise, so that you can use that sensitivity), and the human factors considerations of display type – analog meter vs digital numeric readout, manual vs autoranging, etc. The availability of filters to control the instrument's bandwidth, or sensitivity through the bandwidth, is important for rejection of extraneous noise and to provide noise measurements which correlate well with human perceptions of noise.

Vocabulary

Much of the special vocabulary used by audio and communication workers relates to the dB (decibel). Since level measurements are common from several tens of volts on down to microvolts, the industry long ago standardized on using dB to express both absolute levels and ratios of signals. Frequency response is always "±X dB" from the midband level; signal-to-noise ratio is "minus X dB" or "X dB down". In the broadcasting, recording, and satellite/microwave/telephone industries, absolute levels are also referred to in dB rather than volts or watts. The most common reference is one milliwatt. Levels referred to one milliwatt are expressed in dBm. Watts are clearly a power unit, but most level measuring instruments are voltmeters (not wattmeters) and are not sensitive to circuit impedance. They must be calibrated for some particular value of impedance if they are to display dBm (power) even though they really measure voltage, and 600 ohms is the most common circuit impedance in broadcasting/recording (150 ohms is also frequently used).

Our AA 501A and AA 5001 work this way in dBm mode; they assume they are connected across a 600 ohm 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 ohms, so there is no difference between dBm and dBu if you are connected across a 600 ohm circuit.

Most of the other special vocabulary you're likely to encounter, will be in the area of standard industry specifications. SMPTE is the Society of Motion Picture and Television Engineers; DIN is the Deutsches Institut Für Normalung, a German-based standards organization. CCIF and CCIR are the initials of the French names for Swiss-based standards groups in the communication fields. IEC is the International Electrotechnical Commission, also European. CCITT is another set of French initials for a standards group in the telephone industry in Europe. IHF is the Institute of High Fidelity Manufacturers, dealing with consumer audio products. 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/verifiying 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.

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; Option 01 Required for AA 501A).*

AA 5001/AA 501A DISTORTION ANALYZERS

The AA 5001/AA 501A Distortion Analyzers provide fully automated measurement of level, total harmonic distortion plus noise (THD+N), and intermodulation distortion (Option 01 for the AA 501A). The AA 5001 adds GPIB compatibility plus programmability.

FULLY AUTOMATIC

Automatic measurement means that once the mode is selected and the test signal is applied, the operator simply reads the accurate result on the 3-digit display. Functions such as level setting, tuning, and nulling are fully automatic.

The AA 501A Option 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 ohms) or to a selected applied signal. The 0 dB reference memory stores the selected level, and all subsequent measurements are referenced to it. The user can choose true RMS or average response. While true RMS is generally more accurate, the averaging feature is convenient for comparison of new data with data taken on older instruments where averaging was the only mode available.

The fundamental frequency range is 10 Hz to 100 kHz, with harmonic measurements to 300 kHz. Any one of four built-in frequency-weighting filters can be switched into the signal paths for input signal preconditioning. External filters can be simply connected for special applications such as stereo pilot tone rejection, rejection of continuous tone squelch signals in mobile radio systems, or for selection of individual harmonics instead of total harmonic distortion measurements.

An Input-Monitor connector and a Function-Output connector permit oscilloscope display of the input signal or the filtered signal input used in THD+N measurement.

TM 5000/TM 500 COMPATIBILITY AND CONFIGURABILITY

As members of the TM 5000/TM 500 series, the AA 5001/AA 501A distortion analyzers are designed to be used together with the SG 5010/SG 505 Oscillators respectively as the nuclei of state-of-the-art audio analysis systems. The AA 5001/SG 5010 setup provides the heart of a programmable automated audio testing system, while the AA 501A/SG 505 setup can be rack mounted for ease of use at the plant for manual operations or can be easily removed and placed in a portable mainframe for use in the field.

CHARACTERISTICS

HARMONIC DISTORTION FUNCTION

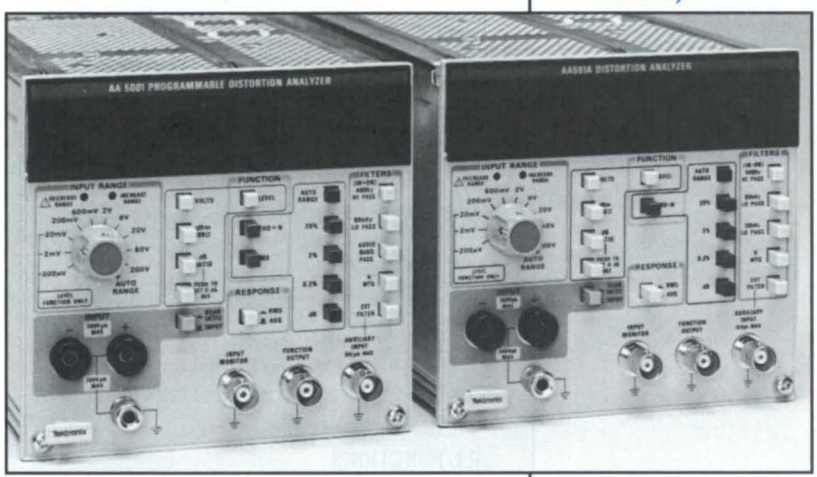
Fundamental Frequency Range – 10 Hz to 100 kHz, automatically tuned to input frequency.

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 ≥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.

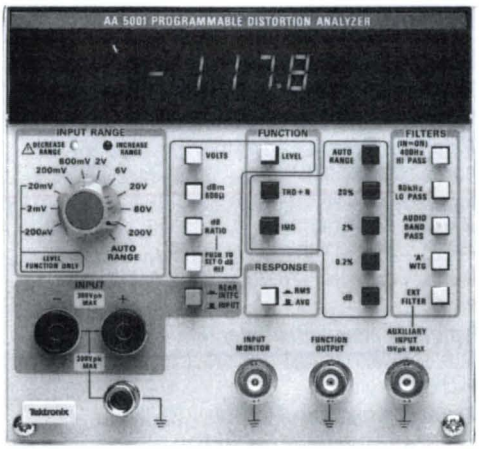
Residual Noise – ≤ 3 μV (-108 dBm) with 80 kHz and 400 Hz filters, RMS response; (AA 5001, AA 501A and AA 501A Option 01) ≤1.5 μV (-114 dBm) with "A" weighting filter, RMS response (standard instruments only); ≤ 5 μV (-104 dBm) with CCIR weighting filter, quasi-peak response (Option 02 instruments only).

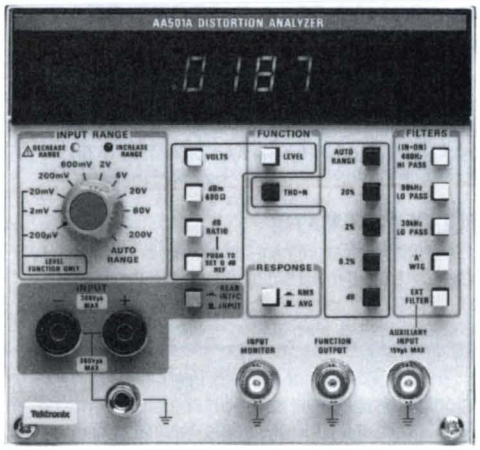
GPIB IEEE-488 *

** The AA 5001 complies with IEEE Standard 488.1-1987, and Tektronix Standard Codes and Formats*

ORDERING INFORMATION

AA 5001 Programmable Distortion Analyzer Includes: Instruction manual (070-4598-01); Instrument Interface Guide (070-4788-00); Reference Guide (070-4597-00).	**$3,550**
Opt. 02 – CCIR/DIN (includes Intermodulation Distortion)	**+$410**
AA 501A Distortion Analyzer Includes: Instruction Manual (070-2958-00).	**$2,600**
Opt. 01 – Intermodulation Distortion.	**+$750**
Opt. 02 – CCIR/DIN (includes Intermodulation Distortion)	**+$1,150**





INTERMODULATION DISTORTION FUNCTION

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 (AA 5001) – 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. Option 02 replaces average detector with quasi-peak detector complying with CCIR Recommendation 468-2 and DIN 45405.

Filters – 400 Hz High Pass: –3 dB at 400 Hz ±5%; 18 dB/octave slope, at least 40 dB rejection at 60 Hz.

80 kHz Low Pass: –3 dB at 80 kHz ±5%; 18 dB/octave slope.

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). Option 02 replaces "A" weighting filter with CCIR weighting filter complying with CCIR Recommendation 468-2 and DIN 45405.

Ext – Allows connection of external filters.

Input Type – Balanced (full differential).

Input Impedance – 100 kΩ ±2%, each side to ground.

Maximum Input – 300 V peak, 200 V RMS either side to ground or differentially. Fully protected on all ranges.

Common-Mode Rejection – ≥50 dB at 50 or 60 Hz. Typically ≥40 dB to 300 kHz.

PROGRAMMABILITY (AA 5001 ONLY)

Function – (Level or THD or IMD). Level Mode (Volts or dBm). Input Level and Distortion Ranges (Auto-range or default to range selected by front-panel switches).

Detector Type – (RMS or AVG; or RMS or Q-PK on Option 02).

Filter Selection – (400 Hz Hi Pass, 80 kHz Low Pass, 22.4 Hz to 22.4 kHz Band-Pass, "A" Weight (or CCIR WTG on Option 02, Ext Filter).

GPIB Interface Function Subsets Implemented – SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0 , C0.

FRONT-PANEL SIGNALS

Input Monitor – Provides constant-amplitude version of signal applied to input. Output Voltage: 1 V RMS ±10% for input signals >50 mV. Source Impedance: 1 kΩ ±5%.

Function Output – Provides a scaled sample of selected function signal. Output Voltage: 1 V RMS ±3% for 1000 count display. Source Impedance: 1 kΩ ±5%.

Auxiliary Input – Provides input to detector circuit when Ext Filter button is depressed. Sensitivity: 1 V RMS ±3%=1000 count display. Impedance: 100 kΩ ±5%, ac coupled.

REAR-INTERFACE SIGNALS

Duplicates of all front-panel inputs and outputs are provided to allow external filter connections or oscilloscope monitoring within same mainframe without exposed cables. Detector outputs with specified scale factors also available to drive analog chart recorders, storage oscilloscopes, or similar devices.

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 Option 02)*
- *Selectable Source Impedance (SG 505 Option 02)*
- *Intermodulation Test Signal (Options 01 and 02)*

LOW-DISTORTION OSCILLATORS

SG 5010 /SG 505 OPTION 01 AND OPTION 02

The SG 5010 and SG 505 Oscillators generate an ultra-low distortion sine wave from 10 Hz to 163.8 kHz (SG 505 to 100 kHz) with less than 0.0008% and 0.0032% THD respectively. The THD is typically less than 0.0003% in the 20 Hz to 20 kHz range.

The SG 5010 offers the full benefits of TM 5000 configurability, GPIB compatibility, and compliance with Tektronix Standard Codes and Formats. It generates five waveforms: sine wave, square wave, SMPTE/DIN intermodulation test signal, CCIF intermodulation test signal, and sine wave burst. All of these signals may 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 ohm load.

On the SG 505 a FREQUENCY Hz dial provides frequency adjustment within each band. A FREQ VERNIER control permits extremely fine frequency adjustment (to Z ±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 ohm load, selects eight level steps at the OUTPUT. The SYNC OUT connector provides approximately 200 mV RMS fixed amplitude and ground-referenced sine wave signal at the same frequency as the OUTPUT.

The SG 505 Option 01 adds an intermodulation test function. The Intermodulation Test Signal pushbutton mixes an internally selectable 60 or 250 Hz sine wave with the normally selected frequency in a 4:1 amplitude ratio. The composite peak-to-peak amplitude is calibrated to be identical with the peak-to-peak amplitude of the OUTPUT signal in the normal oscillator mode.

The SG 505 Option 02 adds the Option 01 (intermod) and changes the SG 505 to have a balanced output with an amplitude range of + 22 dBm to – 68 dBm; the variable attenuator provides a continuous adjustment from CAL. A front panel control selects a source resistance of 600, 150, or 50 ohms.

CHARACTERISTICS (SG 5010)

AVAILABLE FUNCTIONS

Sine wave, square wave, SMPTE/DIN 4:1, SMPTE DIN 1:1, CCIF, Sine-Wave Burst, IHF Burst (±20 dB or OFF between bursts), External Input (Amplifier Mode).

FREQUENCY RANGE AND ACCURACY

Sine Wave, Sine-Wave Burst – SMPTE/DIN: 10 Hz to 163.80 kHz ±0.01%. CCIF Center Frequency: 2.500 to 163.80 kHz ±0.01%. Square Wave: 10 Hz to 16.380 kHz ±0.01%.

Resolution in Above Functions – 10.00 to 163.80 Hz: 0.01 Hz; 163.9 Hz to 1.6380 kHz: 0.1 Hz; 1.639 to 16.380 kHz: 1.0 Hz; 16.39 to 163.80 kHz: 10.0 Hz.

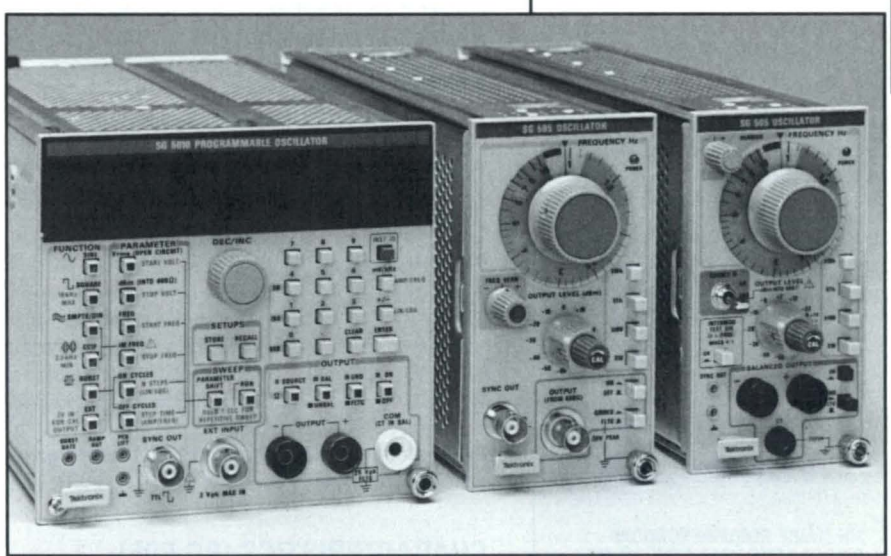
SMPTE Lower Tone, CCIF Offset From Center Frequency – Selectable From: 40, 50, 60, 80, 100, 125, 250, 500 Hz, all ±2%.

Sine Distortion (Load 600 Ω THD Including 2nd Through 5th Harmonics) –
20 Hz to 20 kHz: 0.001% (– 100 dB).
20 to 50 kHz: 0.0032% (– 90 dB).
10 to 20 Hz and 50 to 100 kHz: 0.01% (– 80 dB).
100 to 163.8 kHz: 0.032% (– 70 dB) any individual harmonic.

Sine Flatness – 20 Hz to 20 kHz: 0.05 dB; 10 Hz to 163.8 kHz: 0.2 dB.

Square-Wave Rise Time – 1.5 µs ±10%.

Burst Range – 1 to 65535 cycles On. 1 to 65535 cycles Off. Off Level either 20 dB or zero. All switching at sine-wave zero crossing. Triggered, gated, or free-running burst modes available.



OUTPUT LEVEL RANGE AND ACCURACY

Balanced – Into Open Circuit: 200 µV to 21.2 V RMS. Into 600 Ω: –72.45 to + 28.05 dBm.[*1]

Unbalanced – Into Open Circuit: 200 µV to 21.2 V RMS. Into 600 Ω: –72.45 to + 22.05 dBm.[*1]

Resolution – 0.05 dB in dBm mode, 0.25% or better in volts mode.

Level Accuracy (Sine Wave) – 20 Hz to 20 kHz ±2 % (0.2 dB). 10 Hz to 163.8 kHz ±3% (0.3 dB).

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.

*[*1] R_s = 50 Ω. For R_s=150 Ω, subtract 1.25 dBm; for R_s = 600 Ω, subtract 5.35 dBm.*

GPIB IEEE-488 *

** The SG 5010 complies with IEEE Standard 488.1-1987, and Tektronix Standard Codes and Formats*

ORDERING INFORMATION

SG 5010 Programmable Oscillator. **$4,320**
Includes: Instruction manual (070-4331-00), Instrument Interface Guide (070-4790-00), Reference Guide (070-4330-00).

SG 505 Oscillator **$950**
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**

SOFTWARE RECOMMENDATIONS

EZ-TEST PC – Order S45F030 **$1,795**

IBM BASICA Programs Available with GURU II Package: AUDIODEM BAS, TPG.BAS. Order S3FG100.

SYNC OUTPUT

A ground referenced TTL-compatible signal is provided that allows stable oscilloscope display of all functions. In sine and square wave modes, the output is at the signal frequency. In the IM modes, the sync output is at the lower or offset frequency. In both burst modes, the sync signal follows the burst envelope.

SWEEP MODE

Linear or logarithmic sweep of amplitude or frequency in any function. Sweep is composed of discrete steps. The following sweep functions are programmable via GPIB or from the front panel: swept parameter (frequency or amplitude), linear or log sweep, number of steps up to 99, time per step from 0.1 to 25 s, start frequency or voltage, and stop frequency or voltage. Start and stop frequencies or voltages can be anywhere within the range of the generator, and sweep direction can be upward or downward. Pen lift and ramp outputs are available for interface to an analog plotter.

STORED SETUPS

Ten different complete front-panel setups can be stored in the nonvolatile internal memory and recalled from front-panel pushbuttons or via the GPIB. Additionally, the front-panel settings at power down are retained and used at power up.

PROGRAMMABILITY

All functions, parameters, and modes can be controlled over the GPIB using simple English-like commands. All settings can be interrogated, with the resulting response usable as a command to return the instrument to that setting (Learn mode). The GPIB address can be displayed and changed from the front panel.

GPIB Interface Function Subsets Implemented – SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0.

CHARACTERISTICS (SG 505)

MAIN OUTPUT

The following characteristics are common to the standard SG 505 and Option 01.

Frequency Range – 10 Hz to 100 kHz in four overlapping bands. Accurate within 3% of dual setting (with Vernier at center). Vernier Range is at least ±1% of frequency setting.

Calibrated Output – Selectable from +10 to – 60 dBm into 600 Ω in eight 10 dB steps. Accurate to within 0.2 dB at 10 dBm and 1 kHz. Step accuracy is 0.1 dB/10 dB step. An uncalibrated control provides continuous variation from at least +2.2 dB to <-10 dB from calibrated positon.

Amplitude Response – Level flatness ± 0.1 dB from 10 Hz to 20 kHz (1 kHz ref); within 0.2 dB from 20 to 100 kHz (excluding > – 60 dB output-level range).

Harmonic Distortion – < 0.0008% (–102 dB) THD from 20 Hz to 20 kHz (typically 0.0003%); 0.0018% (– 95 dB) THD from 10 to 20 Hz, and from 20 to 50 kHz 0.0032% (– 90 dB) THD from 50 to 100 kHz ($R_L \geq 600\ \Omega$).

Output Impedance – 600 Ω ± 2%; floating or grounded through ≈30 Ω. Output impedance does not change with Output On/Off selection. Maximum floating voltage ± 30 V peak.

Maximum Output Voltage – At least 6 V RMS open circuit; 3.16 V RMS (+10 dBV or +12.2 dBm) into 600 Ω.

SYNC OUTPUT Signal – 200 mV RMS ±20% sine wave to 20 kHz, at least 120 mV RMS at 100 kHz.

Frequency – Same as main output.

Impedance – Nominally 1 kΩ, ground referenced and isolated from main output.

REAR INTERFACE SIGNALS

Buffered Main Output – Buffered version of actual output signals from front-panel connector. ≈600 Ω output impedance.

Sync Output – Same as front-panel Sync Output except output impedance is ≈ 50 Ω.

(SG 505) OPTION 01 IM TEST SIGNAL

Selecting the IM Test Signal causes an LF sine wave to be mixed with the normal oscillator signal in a 4:1 amplitude ratio.

LF Frequency – Internally selectable 60 Hz (±1 Hz) or 250 Hz (±3 Hz).

Main Output – Composite p-p output within 0.2 dB of normal oscillator mode output.

Residual IMD – <0.0005% from 2.5 to 10 kHz.

Sync Output – LF signal component only, 200 mV RMS ±20%.

(SG 505) OPTION 02 OSCILLATOR

MAIN OUTPUT

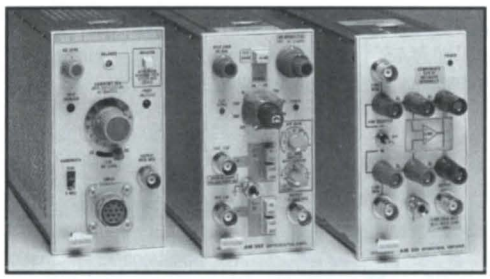
Calibrated Output – Selectable from + 22 to – 68 dBm into 600 Ω in ten 10 dB steps. Accurate to within 0.2 dB at +22 dBm and 1 kHz. Step accuracy is ± 0.1 dB/10 dB step or 20 dB step change. An uncalibrated control provides continuous variation from < – 10 to + 0.3 dB from calibrated position.

Harmonic Distortion – <0.0008% (– 102 dB) THD from 20 Hz to 20 kHz (typically 0.0003%); 0.0018% (– 95 dB) THD from 10 to 20 Hz, and from 20 to 50 kHz; 0.0056% (– 85 dB) THD from 50 to 100 kHz ($R_L \leq 600\ \Omega$)

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.

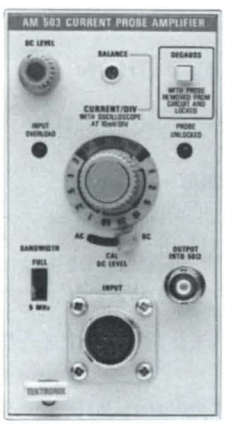


SIGNAL CONDITIONERS

TM 500 Signal Conditioners offer unique capabilities for solving electrical measurement and analysis problems. The compact portability and plug-in flexibility of these modules are applicable to a broad range of measurement needs including: preamplification of low-level signals, addition or removal of dc offset, integration, differentiation, filtering, summing of multiple signals, impedance transformation, or level conversion (to 80 V peak-to-peak).

AM 503/AM 503S CURRENT PROBE AMPLIFIER

The AM 503 Current-Probe Amplifier allows 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 100 MHz bandwidth. The amplifier attenuator has 12 calibrated steps in a 1-2-5 sequence, and the knob-skirt is illuminated to indicate current/division. See page 424 for detailed information.



AM503 Amplifier

The AM 503/A6302 and AM 503/A6303 Current Probe Systems have a wide variety of applications from SCR and power-supply measurements to medical applications. These probes use inductive coupling to minimize interference with the circuit under test. By combining an oscilloscope, such as the SC 504, with the AM 503/A6303 Current Probe Amplifier in a TM 500/TM 5000 mainframe, you will have a convenient and compact high-current amplification/measurement system.

A current probe package is available (AM 503S) that includes the AM 503, A6302 (and/or A6303), and the 016-0362-02 Tool Box Module for probe storage, all in a TM 502A Power Module.

CHARACTERISTICS

(When used with the A6302 or A6303 Current Probes.)

Maximum Input Current – 20 A (dc + peak ac) for A6302. 100 A (dc + peak ac) for A6303.

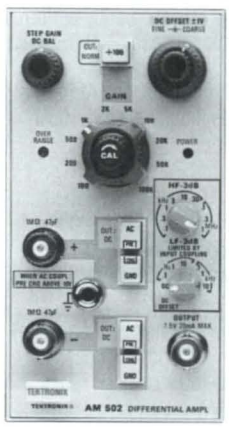
Bandwidth (–3 dB) – DC to ≥50 MHz with A6302. DC to ≥15 MHz with A6303.

Rise Time (Full Bandwidth) – ≤7 ns with A6302. ≤23 ns with A6303.

Deflection Factor – 1 mA/div to 5 A/div for A6302. 20 mA/div to 50 A/div for A6303. In 1-2-5 sequence for both probes.

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. Matched differential probe pairs such as the P6055 are recommended as the signal path from the desired test points.

AM 503/AM 503S

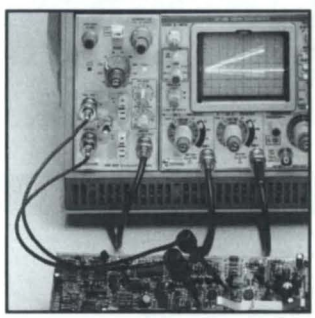
Current Probe Amplifier

- *Displays Current Signals on an Oscilloscope*
- *Dc to 50 MHz bandwidth*

AM 502

Differential Amplifier

- *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*

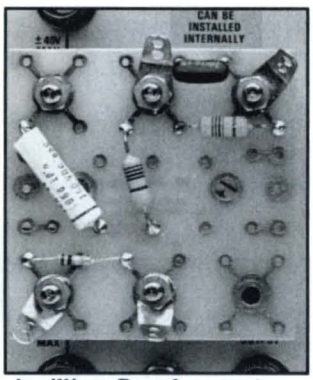


AM 502 provides differential comparator capability to scopes with single-ended inputs.

AM 501

Configurable Amplifier

- *± 40 V, 50-mA Output*
- *Open-Loop Gain 10,000*
- *50 V/µs Slew Rate*
- *Symmetrical Differential Design*
- *Optional Circuit Board to Customize Function*



Auxilliary Board

ORDERING INFORMATION

AM 503 Current-Probe Amplifier. See page 285 for further information.	**$1,330**
AM 503S Current Probe System Includes: AM 503, A6302 (calibrated to AM 503), Tool Box, TM 502A. See page 285 for further information.	**$2,200**
AM 502 Differential Amplifier Includes: Instruction manual (070-1582-01).	**$1,495**
AM 501 Operational Amplifier Includes: Instruction manual (070-1616-01).	**$895**
AM 501 Auxiliary Circuit Board Kit Order 013-0146-00	**$27**

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

Gain – 100 to 100,000 in Normal Mode, 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 50 k gain; 250 kHz at 100 k 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 ±1V. Equivalent to ± 100 V in +100 Mode.

Common-Mode Rejection Ratio – Normal Mode: 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 in Normal mode.

Maximum Noise – ≤ 25 µV (tangentially measured) referred to input in Normal mode.

Common Mode Voltage Range – Normal Mode: ±5V, +100 Mode: ±50V.

Maximum Safe Input Voltage – Normal Mode dc coupled: 15 V (dc + peak ac). +100 Mode dc coupled: 350 V (dc + peak ac). AC coupled: 350 V (dc + peak ac) with coupling capacitor precharged.

Input R and C – 1 MΩ paralleled by ≈ 47 pF. Input impedance can be increased to a FET input via a simple internal jumper change.

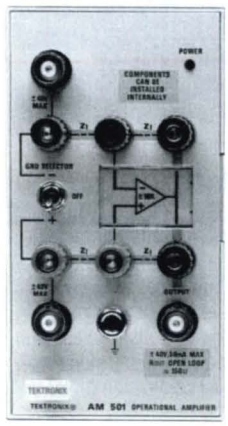
Maximum Output – ±5 V, ±20 mA, output resistance is 5 Ω or less.

Minimum Load Impedance – 250 Ω.

Over-Range – Front-panel lamp indicates most over-range conditions.

AM 501 OPERATIONAL AMPLIFIER

The AM 501 Operational Amplifier features high input impedance (FET), high slew rate, a wide range of input and output voltage, and high output current. The output (40 V and 50 mA across 800 Ω loads) can drive many electronic and electro-mechanical applications. This high-output unit has front-panel connectors that let you change configurations by selecting feedback components. The AM 501 is easily set up for differentiation, integration, summing, offsetting, and impedance-transformation problems.



The AM 501 is ideal for quickly prototyping circuits using the versatility of high-gain operational amplifier blocks. The AM 501's V+ and V- power is supplied by any TM 500 or TM 5000 mainframe eliminating the task of securing or dedicating a dual-output power supply. When used with the accessory board described below, the AM 501 permits rapid performance comparisons of different circuit topologies.

CHARACTERISTICS

Open Loop Gain – At least 10,000 at 60 Hz into 800 Ω load.

Unity Gain Bandwidth – At least 5 MHz into 800 Ω load.

Common-Mode Rejection Ratio – Typically >20,000:1 at 60 Hz for common-mode signals up to ±40 V.

Slew Rate – At least 50 V/µs into an 800 Ω load.

Input Bias Current – Typically < 500 pA at 25°C, < 2 nA at 50°C.

Drift – <100 µV/°C.

Noise – <10 µV rms.

Maximum Differential Input Voltage – 80 V.

Voltage Range – At least ±40 V into 2 kΩ.

Current Limit – At least ±50 mA.

Open Loop Output R – ≈150 Ω.

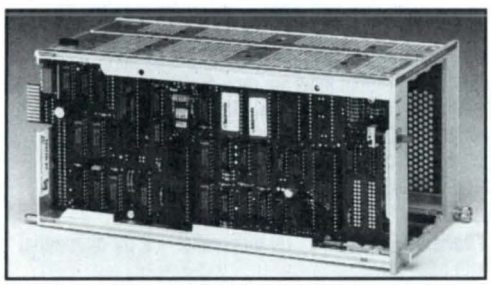
AM 501 AUXILIARY CIRCUIT BOARD KIT

The Auxiliary Circuit Board Kit attaches to the input and output terminals on the front of the AM 501 Amplifier. The pc board has six terminal studs that attach to the amplifier's banana jacks and is approximately 2.5-inches square. The designer can configure a network of components for use in conjunction with the AM 501's input, output, or feedback circuits.

INTERFACE TOOLS

MI 5010/MX 5010

The Multifunction Interface System consists of the MI 5010 Multifunction Interface, the MX 5010 Multifunction Interface Extender, and seven different function cards. These cards are capable of a variety of functions typically required in evaluation and functional test-system interfacing, data acquisition and generation, and process control.



MI 5010 shown with side panel removed. In addition to providing power to function cards, MI 5010 has sequencing capability, time of day clock, command buffer, and self diagnostics.

The MI 5010 and MX 5010 each house up to three function cards, in any combination. The MI 5010 provides the communication between cards and the system controller such as the Tektronix PEP 301 or the 2402 TekMate. The MX 5010 extends the MI 5010's control to six function cards at one GPIB address.

Simple English-like commands sent to the MI 5010 control card operation. For example, "VOLT 1.25" sent to the 50M20 Programmable Voltage Source card generates 1.25 Volts across the 50M20's output pair. Similarly, "VOLT?" sent to the 50M10 Analog Measurement card queries the 50M10 for the value of the last measurement.

In addition to providing the interface between the function cards and the system controller, the MI 5010 has a built-in command buffer. This buffer is capable of storing up to 300 system commands and executing them in sequence, paced by the on-board time-of-day and pacing clock or by signals from the system under test. It requires no interference from the system controller, thus freeing the controller to direct activity elsewhere in the system. For example, with an active 50M20 voltage source card, the following sequence of commands sent to the MI 5010 buffer:

```
BUFFER ON
VOLT 1.25
WAIT 0.4
VOLT – 1.25
WAIT 0.6
EXECUTE 100
```

would generate 100 cycles of a signal toggling between 1.25 and -1.25 Volts with a duty cycle of about 40% and a period of about 1 second.

The MI 5010 system also supports tightly coupled test sequencing to optimize measurement throughput. TTL compatible "Ready" and "Done" handshaking signals can be enabled to step test sequences with minimal dead time and without time consuming controller intervention in multi-instrument configurations.

IEEE Standard 488.1-1987 Interface Function Subsets Implemented – SH1, AH1, T6, L4, SR1, RL0, PP0, DC1, DT1, C0.

50M10 ANALOG MEASUREMENT CARD

Four voltage ranges are provided, selectable by on-board jumpers with least significant bit resolutions of 50 µV (±100 mV range) to 50 mV (±100 V range). The analog inputs (high and low) can be elevated to + 340 volts (dc plus peak ac). Unlike traditional integrating digital multimeters, the 50M10's short 400 nsec aperture time enables the measurement of voltages which hold their value for short intervals. A Guard signal at the input connector can drive guard conductors adjacent to the input signal conductor. TTL compatible front-panel control lines permit the 50M10 conversions to be triggered or gated (continuous conversions).

Amplifier Settling Time – 100 mV Range: ≤ 150 µs. 1 V Range: ≤ 25 µs. 10 V Range: ≤ 10 µs. 100 V Range: ≤ 30 µs.

Maximum Aperture Time – 400 ns.

Input Impedance – 100 mV, 1 V and 10 V Ranges: $\geq 10^{10}\ \Omega$. 100 V Range: Typically 1 MΩ ±1%.

Digital-Data Transfer Format – 12-bit word transferred in two bytes.

Common Mode Rejection Ratio:

	@ 60 Hz	@ 1 MHz
1 Ω in low lead	100 dB	60 dB
1 kΩ in low lead	80 dB	50 dB

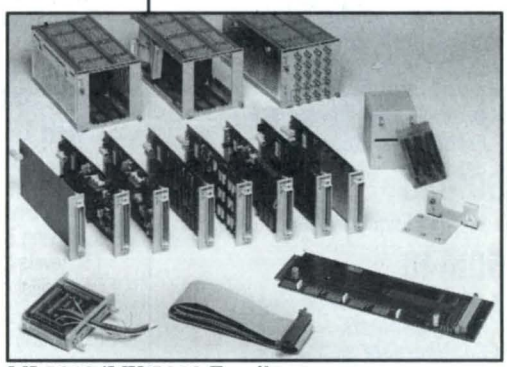
Guard Output Resistance – Typically 870 Ω.

50M20 PROGRAMMABLE VOLTAGE/ CURRENT SOURCE

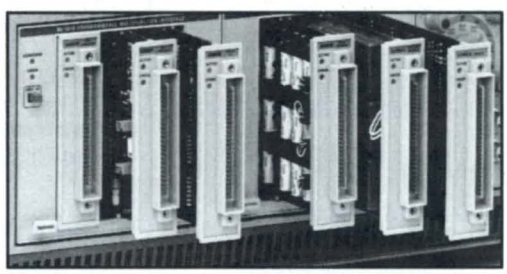
The 50M20 converts digital data to ground isolated analog voltage or current selectable via an on-board switch. The floating output pair can set voltage or current bias points or simulate switching thresholds in precision analog circuits. TTL compatible lines at the front-panel connector are provided to control conversion timing with an external system.

MI 5010/MX 5010

- *Programmable Stimulus and Measurement System*
- *Controller-Free Test Sequencing using Internal Command Buffer*
- *Analog and Digital Input/ Output*
- *Single-Ended and Guarded-Differential Signal Scanning*
- *Word Acquisition and Generation*
- *Customized Programmable Instrumentation*



MI 5010/MX 5010 Family



Cards rapidly slide in and out of the MI 5010 system for a fast flexible approach to test. Alternatively, for dedicated applications, card configuration can be secured in the MI 5010 with rear locking screws.

GPIB IEEE-488 *

**The MI 5010 and MX 5010 comply with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

50M10
- *12-Bit Resolution to 50 µV*
- *Up to 100 dB CMRR @ 60 Hz*
- *250 V RMS Isolation*
- *Built-in Track-and-Hold Amplifier*
- *32 µs Conversion Time*
- *Conversion Results Available over GPIB or Front-Panel Connector*

50M20
- *12-Bit Resolution*
- *250 V RMS Isolation*
- *± 10 V Voltage Mode*
- *± 20 mA Current Mode*
- *Data Transfer via GPIB or Front-Panel Connector*

50M30
- *16 Input and 16 Output Lines*

50M40
- *16 Mercury-Wetted Reed Relay Contacts*
- *Configurable as 1, 2, or 4 Independent Groups*

50M41
- *10 Differential Contact Pairs Plus Guard*
- *<1 µV Thermal Offset in Each Channel*

50M50
- *16K-byte Segmentable Digital Input/Output*
- *TTL Pattern Generation or Acquisition*
- *Repeat Mode For Continuous Output*
- *Single 16-Bit or Dual 8-Bit Channels*

50M70
- *32 Data I/O Ports*
- *Simple Interface to GPIB*
- *Vector Board Development Area*
- *+5V and Dual Analog Supplies*
- *1 MHz crystal Clock Signal*

Total Conversion Time (Maximum) – 20 µs.
Digital-Data Transfer Format – 12-bit word transferred in two bytes.

VOLTAGE MODE
Range – -10.240 to + 10.235 V; (LSB = 5 mV)
Accuracy – ±10.0 mV (+ 20° to +30° C).
Output Current Range – 0 to ±5 mA.

CURRENT MODE
Range – 20.48 to +20.47 mA; (LSB=10 µA)
Accuracy – ±20 µA (+ 20° to + 30° C).
Compliance Voltage – ±11 V.

50M30 PROGRAMMABLE DIGITAL INPUT/OUTPUT CARD

The 50M30 provides 16 digital input and 16 digital output lines. The inputs accept data from switches, contact closures, and digital devices capable of supplying TTL output levels. The digital outputs provide TTL levels to control instruments, relays, indicators, etc.. The digital outputs can be configured for open-collector outputs by positioning internal jumpers. TTL compatible handshake lines at the front-panel connector allow synchronization of data-transfers.

Data Outputs – 16 open-collector TTL (type 7406) with 2 kΩ pullups to internal +5 V or user supplied supply (15 V maximum). Logical "0" sink current up to 40 mA for output of ≤ 0.7 V.
Data Inputs Buffers – 16 LSTTL Schmitt triggers (type 74LS14).

50M40 PROGRAMMABLE RELAY SCANNER CARD

The 50M40 provides 16 independent, normally open relay contacts. The relay contacts can be used as switch closures to supply power to several external points from one source, or scan several sources and supply various inputs to a single measurement device.

The desired relay configuration is set by internal jumpers. Three possible configurations include:

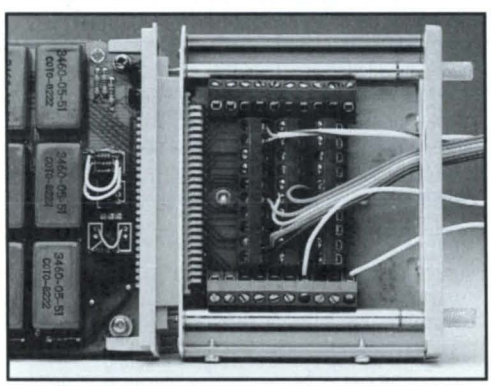
4 groups:	1 of 4 relays each
2 groups:	1 of 8 relays each
1 group:	1 of 16 relays

The relay-scanning sequence, open and close operations, and triggering events are programmed thru the MI 5010's GPIB interface. TTL compatible logic signals on the front-panel connector are provided for externally controlling the 50M40.
Insertion Loss – typically < 0.3 dB to 1 MHz.
Pull In and Release Time – 3 ms nominal.
Maximum Applied Voltage – 40 V dc plus peak ac.
Maximum Carry Current – 1 A.
Breakdown Voltage – 100 V dc plus peak ac.
Contact Resistance – 0.15 Ω nominal (end of life).

50M41 PROGRAMMABLE LOW-LEVEL SCANNER CARD

The 50M41 provides ten pairs of guarded, normally open relay contacts. Each differential pair of contacts is accompanied by a third contact to switch the shield or guard connection. The relays can be configured as two groups of five individual relays with two commons, or as one group of ten individual relays with one common. The desired pattern is configured by internal jumpers. A tree relay can be included in the 1 of 10 configuration to reduce capacitive loading and potential noise problems when using more than one 50M41 in a system. TTL compatible signal lines are provided for externally controlling the 50M41. A + 5 Vdc supply and a ground isolated ±15 Vdc power supply is available (15 mA maximum load) at the card edge for applications requiring external signal conditioning circuitry.

Thermal Offset – <1 µV differential; < 2 µV differential with tree relay.
Series Resistance – 100 Ω nominal. Factory installed 100 Ω series resistors are removable.
Contact Resistance – Typically ≤0.3 Ω.
Insertion Loss – Typically 0.1 dB at 30 kHz.
Maximum Scan Rate – ≥ 200 cycles/s.
Maximum Applied Voltage (High, Low or Guard of Any Channel to Chassis) – 350 V (dc + peak ac)
Maximum Switched Voltage – 150 V (dc + peak ac) (not to exceed VA rating).
Maximum Carry Current – 250 mA.
Maximum Switched Current – 10 mA.
Maximum Switched VA – 0.15



The one wide interfacing adapter shown attached to the 50M41 low level scanner card. Allows routing of switched signals and access to + 5 V and isolated ± 15 V supply for external signal conditioning circuitry.

50M50 PROGRAMMABLE WORD GENERATION AND ACQUISITION CARD

This 16K-byte digital input/output buffer can be configured, under program control, as a single 16-bit input/output port or as two 8-bit input/output ports. The buffer can be segmented to allow rapid switching between buffers relieving the controller of loading or dumping the buffer between test steps.

The 50M50 is intended to be used as a digital-word generator and/or as a digital-data acquisition buffer. For example, digital initialization sequences are often required to place a unit under test into a known operating mode. Different sequences including required control and strobe lines can be embedded in different memory segments. Once the different patterns are loaded, the controller can jump between required output sequences without time-consuming reloading operations.

When driven by an external clock the 50M50 can simulate state sequencing in a digital subsystem. As a word generator, it can be used with a D/A converter (50M20) to function as a waveform generator. Conversely, it can be used with an A/D converter (50M10) to function as a waveform digitizer.

The 50M50 can transfer data on its two channels simultaneously. TTL compatible handshake lines permit synchronization with the user's system.

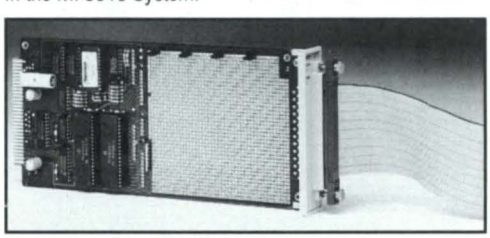
Data Outputs – 8 or 16 LSTTL (type 74LS646) lines. Logical "1": > 2 V at 10 mA source current. Logical "0": ≤ 0.5 V at 20 mA sink current.

Data Inputs – 8 or 16 LSTTL (type 74LS646) lines.

Maximum Data-Transfer Rate – 8-Bit Transfers: ≈200 kHz. 16-Bit Transfers: ≥120 kHz.

50M70 PROGRAMMABLE DEVELOPMENT CARD

The 50M70 provides the means of developing a unique circuit and interfacing it to the GPIB without the need for designing the GPIB interface. With the 50M70, the user can create a specialized function card to be used in the MI 5010 System.



50M70 development card shown with 50-conductor ribbon cable attached. Ribbon cable is supplied with each function card.

The 50M70 contains two 16-bit interface-logic registers (type 68B21 PIAs) with a high level language interface into the MI 5010 GPIB system. A 4x4 inch breadboard area with power supplies permits circuit development.

Typical 50M70 applications include analog and digital signal processors, timing, triggering and protocol generators, and keyboard and display emulators. The 50M70 is an ideal tool for evaluating a new component. The digital I/O port can emulate switch closures to load control or mode registers to sequence the component through various operations.

Simple GPIB control commands configuration and I/O. Byte-wide outputs are made with "DATA <num>" commands. Inputs are made with "DATA? " queries.

DC Voltage Sources Available on the Card – + 26 V and –26 V ±9%, 100 mA maximum; + 8 V ±5%, 600 mA maximum; + 5 V ±5%, 1.5 A maximum. Total Combined Power Limit: 7.5 W.

MI 5010 ACCESSORIES

Single-Width Interfacing Adapter

Mates with any single function card to permit customized interface wiring between cards or to external system under test. The adapter accommodates up to five screw-terminal blocks described below.

Triple-Width Interfacing Adapter

Mates with up to three function cards in an MI 5010 or MX 5010 to permit interface wiring among cards or to external system under test. The adapter includes two screw-terminal blocks described below.

Screw-Terminal Block

Mounts in interfacing adapters to permit wiring changes without soldering (ten terminals per block).

Interfacing Cable

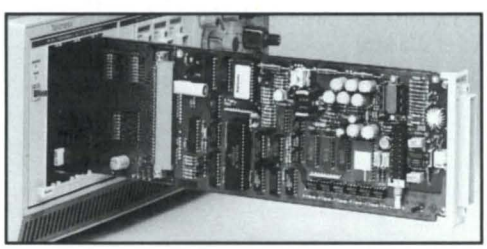
50-conductor flat ribbon cable with connector to mate with front-panel edge connector of any Multifunction Interface System function card. Other end of the 48-inch cable terminates in bare tinned leads. (This cable is a standard accessory with function cards.)

Card Extender

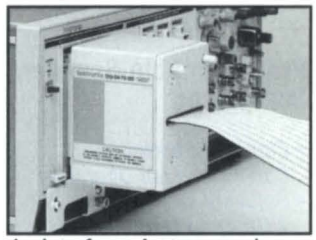
Permits operation of a function card while extended from the front of an MI 5010 or MX 5010.

Function Card Access Shield

Dummy function card of insulating material to protect against possible electrical shock or damage in partially filled MI 5010 or MX 5010.



The extender card allows access to all function cards such as when debugging prototype circuitry on a 50M70 development card or calibrating function card circuitry.



An interface adapter organizes the often complex interconnection to the unit under test. Signals to and from up to three function cards and the unit under test can be neatly combined.

ORDERING INFORMATION

MI 5010 Multifunction Controller **$1,760**
Includes: Instruction manual (070-3712-00); Instrument interfacing guide (070-5187-00); Reference guide (070-3882-00).

MX 5010 Extender **$740**
Includes: Same as MI 5010.

50M10 A/D Converter Card **$895**
Includes: Interfacing cable (015-0430-00); Instruction manual (070-4495-00); Reference guide.

50M20 D/A Converter Card **$910**
Includes: Interfacing cable (015-0430-00); Instruction manual (070-3724-01); Reference guide.

50M30 Digital I/O Card **$495**
Includes: Interfacing cable (015-0430-00); Instruction manual (070-3722-00); Reference guide.

50M40 Relay Scanner Card **$695**
Includes: Interfacing cable (015-0430-00); Instruction manual (070-3723-00); Reference guide.

50M41 Low-Level Scanner Card **$995**
Includes: Interfacing cable (015-0430-00); Instruction manual (070-4557-00); Reference guide.

50M50 Memory Card **$995**
Includes: Interfacing cable (015-0430-00); Instruction manual (070-4555-00); Reference guide.

50M70 Development Card **$40**
Includes: Interfacing cable (015-0430-00); Instruction manual (070-3725-00); Reference guide.

MI 5010 ACCESSORIES

Interfacing Cable
Order 015-0430-00 **$45**

Single-Width Interfacing Adapter
Order 015-0466-00 **$240**

Triple-Width Interfacing Adapter
Order 015-0473-00 **$265**

Screw-Terminal Block
Order 131-3083-00 **$10.25**

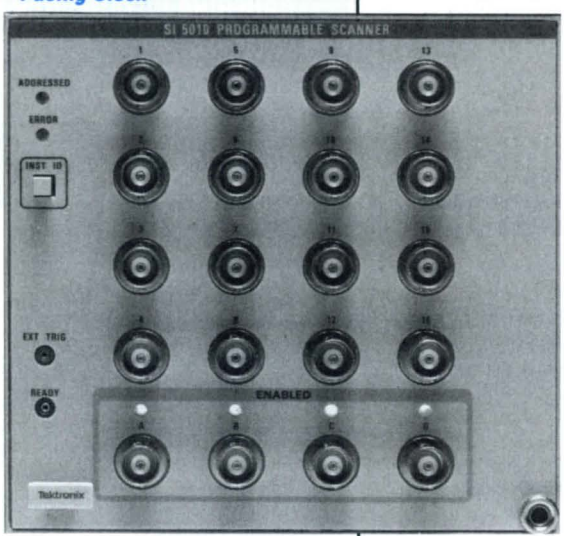
Card Extender
Order 067-1066-00 **$265**

Function Card Access Shield
Order 020-0836-00 **$65**

SI 5010

Programmable Scanner/ Multiplexer

- *Command Buffer for Controller-Free Operation*
- *Software configurable as:*
  1 Group of 16 Channels
  2 Groups of 8 Channels
  4 Groups of 4 Channels
- *350 MHz Bandwidth in 4-Channel Configuration*
- *External Handshake Lines*
- *Built-In Time-of-Day and Pacing Clock*



GPIB IEEE-488 *

ORDERING INFORMATION

SI 5010 Programmable Scanner **$2,350**
Includes: Instruction manual (070-3721-00); Instrument interface guide; Reference guide.

RECOMMENDED PROBES

P6056 – 10X Passive	**$240**
P6057 – 100X Passive	**$225**
P6202A – FET	**$780**
P6230 – Bias/Offset	**$475**

* *The SI 5010 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

SI 5010 PROGRAMMABLE SCANNER/MULTPLEXER

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.

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.

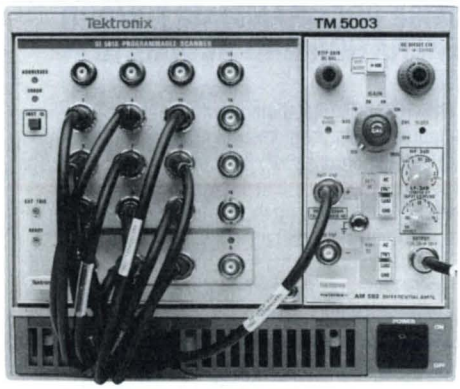
Frequency Response – Any 1 Group of 4:3 dB at 350 MHz, decreasing to 6 dB at 500 MHz or greater. Any 1 Group of 8: 3 dB at 175 MHz or greater. Any 1 Group of 16:3 dB at 80 MHz or greater.

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.



SI 5010 shown switching inputs to an AM 502 differential comparator.

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.

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: at 100 MHz. 2:1 at 225 MHz.

Insertion Loss – 1 dB at 100 MHz.

Channel Delay Matching – Any Group of 4: 50 ps Any Group of 8: 110 ps. Any Group of 16: 310 ps.

Type of Relays – 16 Form A, EAC 05Y21A1 40 BAB, or equivalent. 4 Form "C", TO-5, Teledyne 712-6, or equivalent. Pull-In Time: 3 ms. Release Time: 3 ms. Breakdown Voltage: 350 V (dc + peak ac). Series Path Resistance (End of Life): 0.5Ω

Peak Carry Voltage – Unterminated: 40 V maximum. 50Ω 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.

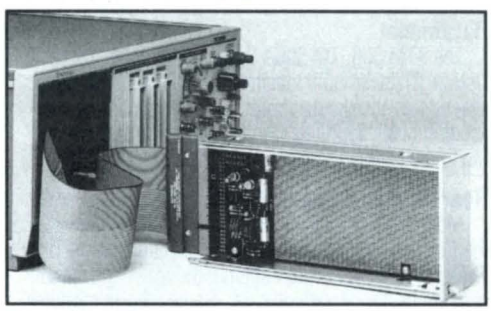
CUSTOM PLUG-IN KITS

THE MISSING LINK

Test engineers often require custom interfaces such as specialized signal or timing generators, amplifiers or converters, and signal routers to complete a test system. Design engineers frequently need to prototype a component manufacturer's "suggested circuit" or integrate an evaluation board when selecting a new component. Educators need sturdy demonstration aids and circuit construction tools for senior lab projects that do not tie up power supplies and valuable bench space. Instrument and equipment manufacturers in focused applications require a platform that does not require the development of new electrical and mechanical packages. This is why the modular instruments line includes custom plug-in kits. The kits provide a mechanical package and development boards that allow rapid construction and wiring of circuits. The plug-ins are compatible with both TM 500 and TM 5000 mainframe power modules.

POWER WHERE IT'S NEEDED

Each 56-conductor slot connector (up to 6 in a TM 506A or TM 5006 mainframe) supplies a wide assortment of dc voltages and isolated ac voltages to generate +5 V supplies, dual analog supplies, and other specialized sources. In addition each mainframe slot has a dedicated pair of series pass NPN and PNP power transistors internal to the mainframe to simplify power supply design. Approximately 10 Watts can be dissipated per slot of a TM 500 mainframe (15 Watts for a TM 5000 mainframe). Specific technical information on power sources is available in power module mainframe instruction manuals. See page 296 for information.



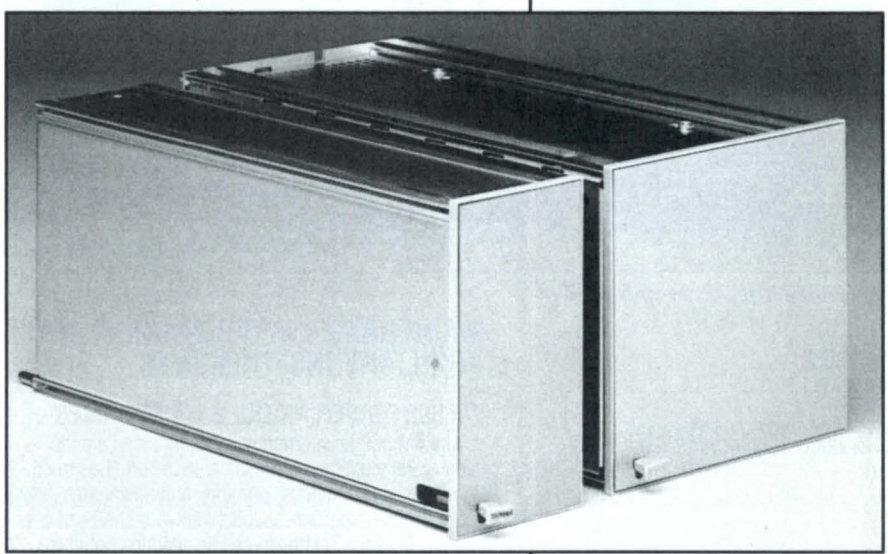
Assembled Single Compartment Kit shown on Extender cable.

SIGNALS TO GO

In addition to delivering power to the plug-ins, each 56-conductor slot edge-connector includes uncommitted conductors to transfer signals to and from other slots, or to and from the rear panel of power module mainframes (with Option 02). A Rear Interface Data Book (070-2088-04) describes the rear-interface system in greater detail and lists rear interface signals for existing instruments. An Extender Cable (067-0645-00) for the 56-conductor edge connector is available to extend the plug-in kit outside of the mainframe housing. A series of construction notes provides direction for building custom circuits.

SINGLE COMPARTMENT WITH POWER SUPPLY BOARD

This 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" grid perforated board with plated holes for circuit development.



Single and Dual compartment plug-in kits.

SINGLE COMPARTMENT WITH DEVELOPMENT BOARD

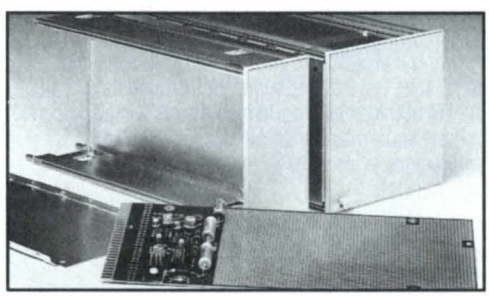
This kit comes without the power supply components or the pre-etched power supply circuit. The board includes the edge-connector interface and has about 35 square inches of board development area.

SINGLE COMPARTMENT WITHOUT BOARD

This kit comes without a board for applications where custom circuit boards are fabricated.

DUAL COMPARTMENT WITH DEVELOPMENT BOARDS

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.



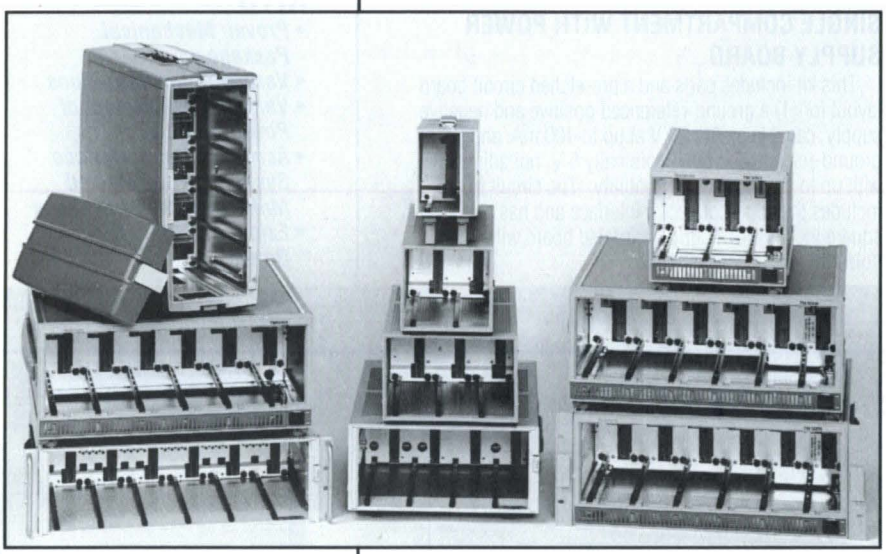
Development Board with Power Supply (shown assembled).

CUSTOM PLUG-IN KITS

- *Proven Mechanical Package*
- *Variety of Configurations*
- *Versatile Assortment of Power Sources*
- *Access to Rear Interface System for Customized Multi-Instrument Systems*
- *Extender Cables for Debugging*

ORDERING INFORMATION

Single Compartment with Power Supply Board – Order 040-0803-02	**$135**
Single Compartment with Uncommitted Board – Order 040-0652-05	**$135**
Single Compartment Without Board – Order 040-0821-03	**$70**
Double Compartment with Two Boards – Order 040-0754-07	**$210**
Rear-Interface Data Book – Order 070-2088-04	**$22**
Flexible Extender Cable – Order 067-0645-02	**$400**



TM 5000/TM 500 Mainframes

GPIB IEEE-488 *

**The TM 5003/TM 5006 comply with IEEE Standard 488.1-1987*

MAINFRAMES, ACCESSORIES, AND AUXILIARY INSTRUMENTS

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 over 50 plug-ins from Tektronix, can be used to configure hundreds of multifunction or application specific packages.

PLUG-IN COMPATIBILITY

The TM 500 plug-in instruments operate in any of nine mainframes that accept instruments in combinations of up to six single-wide plug-ins. One single-wide plug-in instrument can be accommodated by the TM 501A, or up to six instruments can be accommodated in the TM 500 bench-top (TM 506A) and rackmount mainframes (RTM 506). Two, three, and four-wide mainframes are also available as well as a five-wide Traveler mainframe which provides for applications that require instrument portability.

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 5006 accepts up to six instruments at one time. These two TM 5000 mainframes were designed specifically for use with the Tektronix TM 5000 line of programmable, IEEE-488 compatible test and measurement instruments, but all of the TM 500 manual plug-in instruments will also operate in these same mainframes allowing manual and programmable instruments to be mounted together in adjacent slots.

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 seven benchtop mainframes are the TM 501A, TM 502A, TM 503A, TM 504, TM 506A, TM 5003 and TM 5006. The TM 502A and TM 5003 are the most compact of the multiple instrument units. The TM 504, TM 506A, and TM 5006 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 5006 incorporate a quiet fan for optimum cooling. All operate from 110 or 220 V ac.

Portability

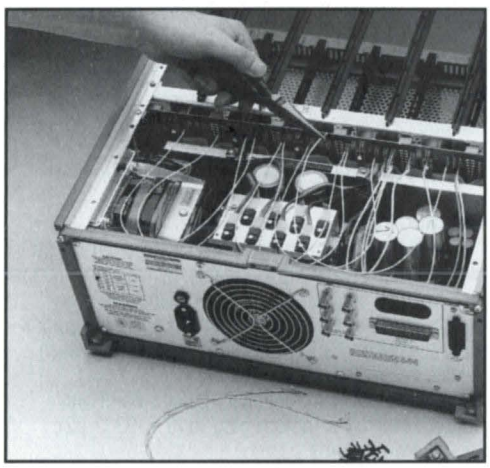
All benchtop models have carry handles and optional protective covers for portable applications. The TM 515 Traveler Mainframe, however, was designed for superior, multi-instrument portability. It is extremely moisture and dust resistant and is designed to withstand the rigors of transport. Once at a destination, its rear cover is popped off to access the power cord and power switch and allow airflow for the built-in fan. Removing the front cover exposes up to five TM 500 plug-in instruments to reveal an operational electronics lab traveling as a suitcase. The TM 515 also comes with a locking bar for plug-in security.

Rackmount

The RTM 506, TM 506A Option 10, and the TM 5006 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. For example, the trigger output of a signal source can be interconnected to the rear input of a counter for instant frequency checks at the touch of a front-panel switch. Or, a digital multimeter and power supply may be interconnected to speed up precise voltage setups without any need to move test leads. Any module can be internally connected through the mainframe and also can be externally interfaced out the rear panel.



The mainframes can be interfaced in a variety of ways. A user can solder together the appropriate connector pins on a standard mainframe, or can order the mainframe with Option 02. 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.

The TM 515 Traveler Mainframe is available with the Option 05 interface which includes everything in the Option 02 except the rear panel multi-pin connector, the mating cable connector, and the BNC connector.

Economy

TM 500 and TM 5000 mainframes represent a most economical approach in test and measurement instrumentation. 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. Because of its modularity, expandability, and versatility, the modular concept represented by TM 5000/TM 500 may provide the lowest cost-per-test/measurement when you are considering multi-function usage.

The ability to upgrade to a higher-performance system without replacing the entire investment is made possible by the compatibility between the TM 500 and TM 5000 lines. 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 unprecedented economy for test and measurement.

MAINFRAME (ALL) 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 jumber or rear panel.

Line Frequency Range – See chart

Power Consumption – See chart for max. V, A.

(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.

Altitude Range – Operating: Sea level to 4,500 m (15,000 ft). Nonoperating: Sea level to 15,200 m (50,000 ft).TM 5006

The TM 5006 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.

Cabinet-to-rackmount conversion kit, equipped with slide out assemble, required to convert a TM 5006 to rackmount capability. Order 040-0982-00.

Rackmount-to-cabinet conversion kit, equipped to convert a TM 5006 with rackmount configuration to cabinet style. Order 040-0983-00.

TM 506A

The TM 506A mainframe accepts up to six different TM 500 plug-ins, providing a complete test station with one power cord. 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.

Available options: Option 02 Rear Interface, A1 - A5 power cords.

Cabinet-to-rackmount conversion kit, equipped with slide out assemble, required to convert a TM 506A to rackmount capability. Order 040-0982-00.

Rackmount-to-cabinet conversion kit, equipped to convert a TM 5006 with rackmount configuration to cabinet style. Order 040-0983-00.

TM 5006

POWER MODULE

- *Six Compartment Mainframe*
- *High Power Compartment*
- *Switching dc Power Supply*
- *Forced Air Cooling*
- *Rear Panel Interface Connections with Option 02*
- *Rackmounting Capability with Option 10*
- *IEEE 488.1–1987 Compatibility*
- *UL 1244 Listed*

GPIB IEEE-488 *

TM 506A

POWER MODULE

- *Six Compartment Mainframe*
- *High Power Compartment*
- *Forced Air Cooling*
- *Interface Connection on Rear Panel Via Option 02*

RTM 506

POWER MODULE

- *Six Compartment Mainframe*
- *Designed for a Standard 19 inch Rack*
- *High Power Compartment*
- *Forced Air Cooling*
- *Interface Connections on Rear Panel Via Option 02*

**The TM 5006 complies with IEEE Standard 488.1-1987*

CHARACTERISTICS

Dimensions	TM 5006		TM 5003		TM 515		TM 506		RTM 506		TM 504		TM 503A		TM 502A		TM 501A	
Width	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**
	445	17.5	230	9	381	15	483	19	305	12	305	12	214	8.4	145	5.7	96.7	3.87
Height	194	7.6	194	7.6	173	6.8	133	5.3	152	6	168	6	140	5.5	140	5.5	156	6.25
Depth	488	19.2	488	19.2	508	20	480	18.9	508	20	508	20	452	17.8	407	16.6	416	16.6
Weight ≈	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**
Net	14.5	32	8.6	19	10.2	22.5	14.4	32	8.4	18.5	8.4	18.5	4.7	10.3	4.0	8.75	239	5.4
Shipping	20.9	46	12	26.5	13.6	30	21	46	11.8	26	11.2	24.5	7.45	16.3	6.75	14.75	5.22	11.4
Line Frequency Hz	48 to 66		48 to 66		48 to 66		-		48 to 66		-		48 to 400		48 to 400		48 to 440	
Power Consumption VA maximum	≈650VA		≈300VA		≈240VA		≈320VA		≈320VA		≈320VA		≈120VA		≈120VA		≈120VA	

(Actual power consumption depends on plug-in selection and operating modes)

TM 515

TRAVELER POWER MODULE

- *Five Compartment Portable Mainframe*
- *Forced Air Cooling*
- *Interface Connections on Rear Panel Via Option 05*
- *Line Frequency to 400 Hz with Option 06*

TM 5003

GPIB IEEE-488 *

POWER MODULE

- *Three Compartment Mainframe*
- *Switching dc Power Supply*
- *Forced-Air Cooling*
- *Interface Connections on Rear Panel Via Option 02*
- *IEEE Standard 488 Compatibility*
- *UL 1244 Listed*

TM 503A

POWER MODULE

- *Three Compartment Mainframe*
- *Interface Connections on Rear Panel Via Option 02*

TM 504

POWER MODULE

- *Four Compartment Mainframe*
- *High Power Compartment*
- *Interface Connections on Rear Panel with Option 02*

TM 502A

POWER MODULE

- *Two Compartment Mainframe*
- *Internal Interface Connections Only*

TM 501A

POWER MODULE

- *Single Compartment Mainframe*
- *Three Rear Interface BNC's Only*

**The TM 5003 Power Module complies with IEEE Standard 488.1-1987*

RTM 506

The RTM 506 is a 5 1/2 inch height rackmount mainframe compatible with TM 500 plug-ins. It adds front panel handles and rackmount rails for built-in, configurable test stations.

Available options: Option 02 Rear Interface.

TM 515 TRAVELER POWER MODULE

The TM 515 Traveler Mainframe accepts up to five single width TM 500 plug-ins and is specially designed to protect them during transportation to and from the work site. Included with this rugged mainframe are pop-off front and back covers that protect the instruments and also store accessories. The Traveler Mainframe will slide easily under an airline seat when traveling and comes equipped with a heavy duty handle and tilt bail. A locking bar provides plug-in security.

Available options: Option 05 Rear Interface., Option 06 - 48 to 400 Hz Fan.

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, A1 - A5 power cords.

TM 503A

The TM 503A 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. An optional Toolbox plug-in (Option 13) is available as is an option which deletes the bail/handle (Option 11).

Available options: Option 02 Rear Interface, Option 11 Deletes Bail/handle, Option 13 Includes Toolbox plug-in (016-0362-02).

TM 504

The TM 504 mainframe accepts up to four single width TM 500 plug-ins. Each TM 504 comes equipped with front panel switch, tilt bail, and a handle. An optional carrying case is available to protect the TM 504 during transportation.

Available options: Option 02 Rear Interface.

TM 502A

The 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 (Option 13) is available as is an option which deletes the bail/handle (Option 11).

Available options: Option 11 Deletes Bail/Handle, Option 13 Includes Toolbox plug-in (016-0362-02). A1 - A5 Power Cords.

TM 501A

The TM 501A is designed for use with one single width TM 500 plug-in. TM 500 Series instruments are interchangeable in seconds, so you can use one type plug-in instrument for one test, then use another for a completely different application.

Available options: A1 - A5 Power Cords.

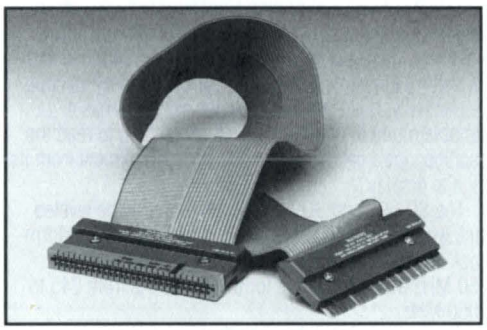
ORDERING INFORMATION

TM 5006 Power Module	**$995**
Mainframe Includes: Instruction manual (070-2950-00)	
Opt. 02 – Rear Interface.	**+$190**
Opt. 10 – Rackmount. Includes high-power fan.	**+$100**
Opt. 12 – Combination Opt. 02 and Opt. 10	**+$290**
A1-A5 Power Cord Options	**NC**
TM 506A Power Module Mainframe	**$695**
Includes: Instruction manual (070-6929-00).	
Opt. 02 – Rear Interface.	**+$150**
Opt. 10 – Rackmount. Includes high-power fan.	**+$100**
Opt. 12 – Combination Opt. 02 and Opt. 10.	**+$250**
A1-A5 Power Cord Options	**NC**
RTM 506 Rackmount Power Module Mainframe	**$995**
Includes: Instruction manual (070-1786-02).	
Opt. 02 – Rear Interface.	**+$180**
TM 515 Power Module Mainframe	☎ **$895**
Includes: Instruction manual (070-2020-02).	
Opt. 05 – Rear Interface.	**+$90**
Opt. 06 – 48 to 440 Hz Fan.	**+$170**
A1-A5 Power Cord Options	**NC**
TM 5003 Power Module Mainframe	**$875**
Includes: Instruction manual (070-2955-00).	
Opt. 02 – Rear Interface.	**+$100**
A1-A5 Power Cord Options	**NC**
TM 503A Power Module Mainframe	☎ **$395**
Includes: Instruction manual (070-6568-00).	
Opt. 02 – Rear Interface.	**+$75**
Opt. 11 – Deletes Bail/Handle.	**–$10**
Opt. 13 – Includes Plug-in Toolbox.	**+$75**
A1-A5 Power Cord Options	**NC**
TM 504 Power Module Mainframe	☎ **$495**
Includes: Instruction manual (070-1716-01).	
Opt. 02 – Rear Interface.	**+$120**
TM 502A Power Module Mainframe	**$295**
Includes: Instruction manual (070-6502-00).	
Opt. 11 – Deletes Bail/Handle.	**–$10**
Opt. 13 – Includes Plug-in Toolbox.	**+$75**
A1-A5 Power Cord Options	**NC**
TM 501A Power Module Mainframe	**$525**
Includes: Instruction manual (070-7613-00).	
A1-A5 Power Cord Options	**NC**

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

AUXILARY INSTRUMENTS ACCESSORIES AND FLEXIBLE PLUG-IN EXTENDER CABLES



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.

Standard Extender Cable (shown) 067-0645-02.
GPIB Extender Cable 067-0996-00.

1105 BATTERY POWER SUPPLY

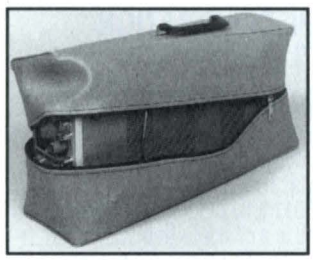
The Battery Power Supply is designed for use when suitable ac line power is unavailable. Operating time is dependent on the number and type of plug-ins being powered and their operating mode. The following table shows estimated operating time for a full mainframe in a typical situation.

TM 501A	5.0 hours
TM 502A	2.5 hours
TM 503A	1.7 hours
TM 504	1.3 hours
TM 506A	0.9 hours
TM 515	1 hour

TM 500 CARRYING CASE

These luggage-type carrying cases available for the TM 503A, TM 504, and TM515 are molded of high-strength glass-epoxy. They are 610 mm long; 216 mm thick; 445 mm high, (24 in. long by 8.5 in. thick by 17.5 in. high) and weighs ≈ 14 pounds empty.

TM 503A and TM 504 - 016-0565-01
TM 515 - 016-0643-00.



RAIN COVERS

These soft, weather-proof vinyl-coated Rain Covers come in sizes for TM 503A, TM 504, and the TM 5000 monolitic packages (016-0621-00).

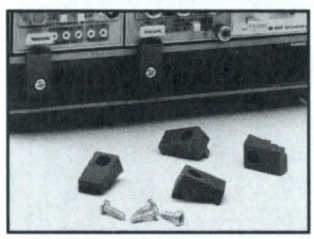
PROTECTIVE FRONT COVER

A snap-on front cover, molded of high-impact plastic, is available for the TM 502A, TM 503A TM 504, and TM 506A mainframes.

TM 506	200-1728-00	TM502A	200-2576-00
TM503A	200-3554-00	TM5003	200-3252-00

MAINFRAME PLUG-IN RETAINERS

A mainframe Retainer Bar Kit is available for the TM 504 or RTM 506 to secure plug-ins; each has a separate kit, 020-0548-00 and 020-0549-00 respectively. 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. The TM 515 comes standard with the retainer bar. The TM 506A, TM 5003, and TM 5006 use Retainer Clips (354-1085-01).



ACCESSORY POUCH

Made for carrying probes, cables, or other accessories, this soft vinyl pouch snaps on to the carying handle of any TM 5000 / TM 500 mainframe or Tektronix oscilloscope, or the straps can be snapped together to form a carrying handle. Dimensions are approximately 91/4 in. long X 53/4 in. wide X 2 in. high, 016-0351-00.

LAB INSTRUMENTS CARTS

The Lab Instrument Carts accept all TM 5000/TM 500 mainframes that are up to four plug-ins wide, or an oscilloscope. See page 399 for additional information.

BLANK PLUG-IN PANEL

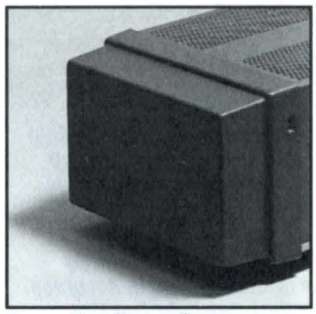
When operating TM 500/TM 5000 instruments with less than the full complement of plug-ins, the blank plug-in panel can be used to cover unused compartments (016-0195-03).

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 inches).

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 (070-2088-04).

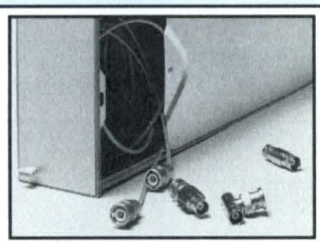


Protective Front Cover

ORDERING INFORMATION

Extender Cable – for TM 500 / TM 5000 mainframes. Order 067-0645-02	**$400**
GPIB Extender Cable – for TM 5000 mainframes. Order 067-0996-00	**$160**
1105 Battery Pack	
Opt. 01 – 230 V Operation.	**+$2,690**
Front - Panel Cover-	
(TM 502A) Order 200-3576-00	*1
(TM 503A) Order 200-3554-00	**$26**
(TM 504) Order 200-1727-00	**$20**
(TM 506) Order 200-1728-00	**$21**
(TM 5003) Order 200-3252-00	**$11.25**
Mainframe Retainer Bar Kit –	
(TM 504) Order 020-0548-00	**$55**
(RTM 506) Order 020-0549-00	**$60**
(TM 506A / TM 5003/TM 5006)	*1
Retainer Clips – Order 343-1085-01	**$2.00**
Accessory Pouch – Order 016-0351-00	**$32**
K213 Lab Instrument Cart –	**$660**
Opt. 05 – Delete Power Strip.	**NC**
Opt. 10 – 7854 keyboard drawer	**+$195**
Opt. 12 – 5000/7000 Series plug-in storage cabinet	**+140**
Option 22 – Combines Opt. 10 and 12	**$295**
Additional Lower Shelf – Order 436-0132-01.	**$70**
Safety Belt – to secure oscilloscopes or TM 5000/TM 500 to top tray or lower shelves (not needed for Series or 7000 Series on Top Tray). Order 346-0136-01.	**$39**
Blank Plug–in Panel. Order 016-0195-03.	**$35**
Plug–in Toolbox. Order 016-0362-02.	**$80**
GPIB Interconnecting Cables–	
(0.5)– Order 012-1015-00	**$85**
(2m)– Order 012-0630-01	**$105**
(2m) Double Shielded – Order 012-0630-03	**$110**
Rear Interface Data Book – 070-2088-04.	**$22**

*1 *Contact your local sales representative.*



Plug-In Toolbox

OSCILLOSCOPE CALIBRATION INSTRUMENTS

CG 5010
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*

OSCILLOSCOPE CALIBRATION INSTRUMENTS

PRODUCT SUMMARY

The TM 5000/TM 500 line of modular Scope Calibration Instruments provides the solution to all of your scope calibration needs.

The CG 5010/CG 5011 fully programmable calibration generators can be used in a computerized system for calibration and verification of all major oscilloscope parameters. The CG 5010 is designed primarily for analog oscilloscope calibration, however, it can also be used for digital oscilloscope calibration and verification up to 500 MHz. The CG 5011 is designed to cover both analog and digital requirements up to 2 GHz. Both are ideally suited for environments where multiple scopes are maintained, and both are complemented by a complete set of manual calibration products.

In addition to the CG 5010/CG 5011 Calibration Generators, TM 500 offers a complete set of manual calibration instruments that can be configured into a portable test set for in-field oscilloscope service and calibration. These TM 500 Oscilloscope Calibration instruments offer the widest range of standard amplitude square waves, fastest risetimes, lowest aberrations, fastest time marks and widest frequency range of leveled sine waves available in one package.

OSCILLOSCOPE CALIBRATION INSTRUMENT SELECTION GUIDE

Instrument	Primary Functions	Secondary Functions
CG 5010 / CG 5011 Programmable Calibration Generator	Amplitude Calibration (CG 5010) Time Base Calibration (CG 5011)	Testing risetime and transient response, attenuator compensation, oscilloscope non-linearity
PG 506A Calibration Generator	Amplitude Calibration	Testing risetime and transient response, attenuator compensation
TG 501A Time Mark Generator	Time Base Calibration	Testing oscilloscope nonlieariy
SG 502 Signal Generator	LF Response & Triggering	Low distortion leveled signal source
SG 503 Signal Generator	Bandwidth Calibration	General leveled RF signal source
SG 504 Signal Generator	Bandwidth Calibration	General leveled RF signal source with frequency modulation capability

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. Like the TG 501A, the PG 506A has a variable mode of operation which allows you to read the oscilloscope's calibration error directly in percent from its digitial 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.

CG 5010/CG 5011

The Tektronix CG 5010/CG 5011 Programmable Oscilloscope Calibration Generators can be used as a part of a computerized system for the calibration and verification of major oscilloscope parameters.

The CG 5010/CG 5011 are three-wide TM 5000 compatible plugins which feature 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. Subsequent use of the resulting program requires a minimum of operator skill and makes data logging an automatic operation.

A CG 5010/CG 5011 computer-based test and calibration system can provide step by step instructions to the operator and archiveable documentation, significantly reducing the skill level and/or time required for scope maintenance.

The CG 5010/CG 5011 can be used in conjunction with the optional Comparator Head to calibrate built-in oscilloscope calibrators. Both the oscilloscope calibrator and the CG 5010/CG 5011 signals are applied to the Comparator Head and simultaneously displayed on the scope's CRT. The CG 5010/CG 5011 signals are then varied to obtain congruent displays. Errors are automatically displayed on the readout.

The Remote Variable option, the Units/Div, Variable-Fixed button, the Continue push-button, and the VAR allow remote operation of the system.

The CG 5010/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.

NEW

CHARACTERISTICS

VOLTAGE (AMPLITUDE MODE)

The standard voltage is 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 mV 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)

The standard current is used to calibrate current probes.

Range – 1 mA to 100 mA (1-2-5 sequence).

Multipliers – 1, 2, 3, 4, 5, 6, 8, or 10.

Aberrations – Less 5% of period and less than ±15% ±100 µA of Amplitute.

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 (AMPLITUDE)

The Low Distortion Pulse obtained in this mode is used to test oscilloscope input amplifier and attenuator compensation.

Range – 20 mV to 1 V p-p (50 Ω load only) (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.

Risetime/Falltime – ≤1.3 ns.

Long Term Flatness – ±0.5% after first 10 ns.

Frequency – 10 Hz to 1 MHz (decade steps).

Variable Amplitude Range – ≥ ±9.9% from nominal.

HIGH EDGE (AMPLITUDE MODE)

The Low Distortion Pulse obtained in this mode is used to test oscilloscope input amplifier and attenuator compensation.

Range – 1.2 V to 100 V p-p 1 MΩ load (1-2-5 steps with multipliers).

Multipliers – 1, 2, 3, 4, 5, 6, 8, or 10.

Polarity – Positive transition only (negative voltage rising to ground).

Risetime – <100 nS

Aberrations – ±2% of square wave amplitude.

Long Term Flatness – ±0.5% after first 500 ns.

Frequency – 10 Hz to 100 kHz (decade steps).

Variable Amplitude Range – ≥ ±9.9% from nominal.

MARKERS (TIMING MODE)

The markers obtained in this mode are used to calibrate oscilloscope time bases.

Range – 10 ns to 5 s (CG 5010 only); 0.5 ns to 5 s (CG 5011 only) (1-2-5 steps).

X10 Magnifier – Increases marker rate by a factor of ten (0.1 µs to 5 s range only).

Accuracy – TXCO ±0.0003. (+15° C to + 50° C).

Amplitude (CG 5010) – 1 V minimum into 50 Ω.

(CG 5011) – 1 V minimum 5 s to 2 ns, 350 mV minimum: 1 ns, 100 mV minimum: 0.5 ns.

Variable Range – ±9.9.%

SLEWED EDGE (TIMING MODE – CG 5010 ONLY)

Slewed Edges are used to calibrate the very fastest ranges found on analog oscilloscope time bases.

Ranges – 0.4 ns and .5 ns to 100 ns (1-2-5 steps).

X10 Magnifier – Increases Slewed Edge rate by a factor of ten (5 ns to 100 ns range only).

Accuracy – TCXO ±0.0003%

Edge Position Uncertainty – ±40 ps.

Amplitude – 1 V into 50 Ω

Variable Range – ±9.9.%

TRIGGER OUTPUT

The oscilloscope under test is normally triggered externally from this source.

Output Amplitude – 1 V minimum into 50 Ω.

Trigger Rate (Marker Mode) – Normal: Slaved to marker rate from 100 ns to 5 s; remains at 10 ns for faster markers. Divided by 10: Reduces normal trigger rate by a factor of ten. Divided by 100: Reduces normal trigger rate by a factor of one hundred.

Slewed Edge Mode – One trigger per slewed edge.

All Other Modes – Normal: Slaved to output frequency. Divided by 10: One-tenth output frequency. Divided by 100: One-hundredth output frequency.

REFERENCE FREQUENCY

Output Frequency – 1 MHz with internal time base accuracy.

Output Amplitude – TTL compatible.

Input Frequency – Any integral multiple of 1 MHz up to 5 MHz.

Input Amplitude – 1 V to 10 V RMS displayed via EXT REF indicator on front panel.

Required Accuracy – ±0.001%.

Input Amplitude – 1 V to 10 V RMS.

Input Resistance – 10 KΩ (nominal).

GPIB INDICATORS AND FUNCTION SUBSETS

The subsets that apply to the CG 5010/CG 5011 are: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, and C0.

FAST EDGE (AMPLITUDE MODE)

The Pulse Head is used to generate fast rise, low-distortion pulses for testing higher bandwidth vertical amplifiers.

Polarity – Positive or negative transitions from ground.

Risetime – ≤ 200 ps.

Aberrations – ±3% of pulse amplitude; not to exceed 4% p-p for adjacent peaks.

Frequency – 100 Hz to 100 kHz (decade steps).

Amplitude – 1.1 V peak ±5% into 50 Ω.

Variable Range – ±10.%

ORDERING INFORMATION

CG 5010 Programmable Calibration Generator **$14,495**
Includes: Output cable assembly (012-0884-00); Pulse head (015-0311-01); Instrument interface guide (070-7747-00); Instruction manual (070-7745-00). Programmer's Reference Manual (070-7748-00); Service Manual (070-7746-00):

CG5011 Programmable Calibration Generator. **$15,995**
Includes: Same as above

Opt. 01 – Adds Time Base High Stabilizer **+$650**

Opt. 02 – Deletes Pulse Head **–$1,100**

MAINFRAME COMPATIBILITY

CG 5010/CG 5011 requires either a TM 5003 or TM 5006. The CG 5010/CG 5011 is not compatible with TM 500 power module mainframes.

OPTIONAL ACCESSORIES

Comparator Head – Used to calibrate built-in oscilloscope calibrators against the signals available from the CG 5010/CG 5011. Both the oscilloscope calibrator and CG 5010/CG 5011 standard amplitude signals are applied to the Comparator Head and simulataneously displayed on the oscilloscope CRT. The CG 5010/CG 5011 signals are then varied to obtain congruent displays. Errors are then displayed on the CG 5010/CG 5011 readout. Order 015-0310-01. **$710**

Test Program Generator Software – SCOPEVER.BAS available with GURU II software package. *1

Remote Variable – Permits remote operation of the following front panel controls: Units/Div, Variable-Fixed Button, Continue Pushbutton and the VAR. Order 015-309-01. **$490**

Pulse Head – (When purchased separately.) Order 015-0311-01. **$1,550**

Rigid Circuit Board Extender – Order 067-0975-00. **$140**

Flexible Circuit Board Extender – Trouble Shooting Aid – Order 067-0974-00. **$470**

*1 *Contact your local sales representative.*

PHYSICAL CHARACTERISTICS*1

Dimensions	mm	in
Width	203	8.0
Height	124	4.9
Depth	305	12.0
Weights	**kg**	**lb**
Standard	3.9	8.5
Option 02	4.0	8.7

*1 *Maximum Overall Dimensions (triple compartment plug-in)*

OSCILLOSCOPE CALIBRATION INSTRUMENTS

PG 506A

CALIBRATION GENERATOR

- *Three Square-Wave Output Modes*
- *10 Hz to 1 MHz*
- *Direct Readout of Oscilloscope Deflection Error*

ORDERING INFORMATION

PG506A Calibration Generator **$3,140**
Includes: Instruction manual (070-6687-00).

OPTIONAL ACCESSORIES

Precision Voltage Divider –
Order 015-0265-00. **$240**

Tunnel-Diode Pulser –
Order 067-0681-01. **$275**

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.

An optional Tunnel-Diode Pulser provides a clean, fast-rise pulse for adjusting the transient response of high frequency oscilloscopes and other instruments. It can be driven by the PG 506A at repetition rates exceeding 50 Hz. Output amplitude of the pulse is approximately 250 mV into 50 ohms, while rise time is less than or equal 125 ps; aberrations are less than 1% in a 1 GHz system.

The optional Precision Voltage Divider is designed for use with the PG 506A in the Standard Amplitude mode. This .4 divider allows your oscilloscope to display a constant four divisions when checking amplitude calibration from 20 µV/div through 1 V/div. It also allows more convenient use of the PG 506A with oscilloscopes that cannot display five divisions of amplitude. The input limit on the instrument is 5 V RMS. The output is 0.4 X the PG 506A amplitude with a voltage accuracy of 0.4%. The input capacitance requirement is 50 ohms with an output load greater than or equal to 100 kohms.

CHARACTERISTICS

AMPLITUDE-CALIBRATOR MODE

Period – Fixed at ≈1 ms or dc.

Ampitude – 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.

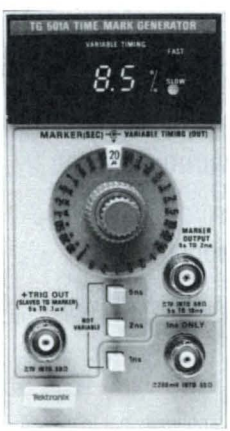
NEW TG 501A

TIME MARK GENERATOR

- *Marker Outputs, 1 ns to 5 s*
- *Direct Readout of Oscilloscope Timing Error*
- *External Trigger Output*

ORDERING INFORMATION

TG 501A Time Mark Generator **$2,750**
Includes: Instruction manual (070-1576-02).



TG 501A TIME MARK GENERATOR

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.

Markers – 1 ns through 5 s in a 1-2-5 sequence.

Marker Amplitude – ≥ 1 V peak into 50 Ω on 5 s through 10 ns markers. ≥ 750 mV p-p into 50 Ω on 5 ns and 2 ns markers. ≥ 200 mV p-p into 50 Ω on 1 ns markers.

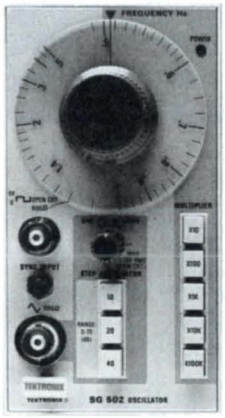
Trigger Output Signal – Slaved to marker output from 5 s through 100 ns. Remains at 100 ns for all faster markers.

Internal Time Base – Crystal Frequency 5 MHz; Stability (0 to 50°C within 5 parts in 107 after 1/2 hour; Long-Term Drift 1 part or less in 107 per month; Setability adjustable to within 5 parts in 108.

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).



SG 502 OSCILLATOR

The SG 502 Oscillator features a wide frequency range of 5 Hz to 500 kHz with low distortion (0.035% between 20 Hz and 50 kHz) and is desirable for general test purposes. Other SG 502 features include 70 dB amplitude control plus a simultaneous fixed-amplitude square wave.

CHARACTERISTICS

Frequency Range – 5 Hz to 500 kHz in 5-decade steps. Accurate within 5% of dial set ting 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

Frequency Range and Accuracy – Same as sine wave. The square wave switches on the 0° phase of sine out.

Rise Time and Fall Time – 50 ns or less.

Amplitude – + 5 V, fixed, open circuit.

Output Impedance – 600 Ω, grounded.

SYNC INPUT

Oscillator can be synchronized to external signal. Sync range, the difference between sync frequency and set frequency, is a linear function of sync voltage.

Input Impedance – 10 kΩ.

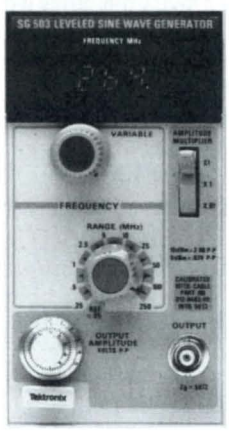
SG 502

OSCILLATOR

- *5 Hz to 500-kHz Sine Waves and Square Waves*
- *Low-Distortion Sine Wave*
- *5 V RMS Open Circuit – 600 Ω Source*
- *0 to 40 dB Output Variable Plus 0 to 70 dB in 10-dB Steps*

ORDERING INFORMATION

SG 502 Oscillator **$1,345**
Includes: Instruction manual (070-1430-01).



SG 503

The SG 503 Signal Generator provides a leveled output that is variable in frequency from 250 kHz to 250 MHz. The selected frequency is indicated by a built-in autoranging frequency counter with a three-digit LED readout on the front panel. Accurately calibrated output voltage is variable from 5 mV to 5.5 V peak-to-peak into 50 Ω.

CHARACTERISTICS

Frequency Range – 250 kHz to 250 MHz, plus 50 kHz reference frequency.

Frequency Accuracy – Within ±0.7 of one count of the least significant digit of indicated frequency.

Amplitude Range – 5 mV to 5.5 V p-p into 50 Ω termination in three decade ranges.

Amplitude Accuracy (50 kHz Reference) – Within 3% of indicated amplitude on (X1) range, 4% on (X.1) range, and 5% on (X.01) range.

Flatness (P-P) – From 250 kHz to 100 MHz, output amplitude will not vary more than 1% of the value at 50 kHz except that up to +1.5%, –1% variation may occur between 50 and 100 MHz on amplitude multiplier X.1 and X.01 ranges only. From 100 to 250 MHz, amplitude variation is within 3% of the value at 50 kHz.

Harmonic Content – Second Harmonic: At least 35 dB down. Third Harmonic and All Higher Harmonics: At least 40 dB down.

Rear Interface – Addresses the leveling circuit.

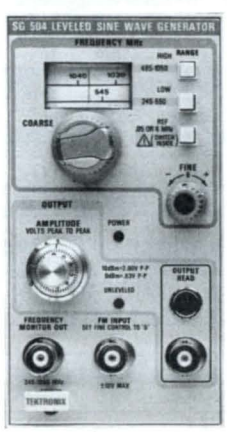
SG 503

SIGNAL GENERATOR

- *250 kHz to 250 MHz*
- *Leveled, Variable Output*
- *Digital Readout of Frequency*

ORDERING INFORMATION

SG 503 Signal Generator **$2,995**
Includes: Three-foot precision 50 cable (012-0482-00); Instruction manual (070-6770-00).



SG 504

The SG 504 Signal Generator provides leveled output amplitude and is variable from 245 to 1050 MHz in two bands via its compact output leveling head. Frequency is indicated by a high-resolution tape dial that expands each band over 28 inches. The accurately calibrated output voltage is variable from 0.5 V to at least 4.0 V p-p into 50 Ω.

CHARACTERISTICS

Frequency Range – Low Band: 245 to 550 MHz. High Band: 495 to 1050 MHz, plus 50 kHz or 6 MHz reference frequency (internally selected).

Frequency Accuracy – ±2% of dial indication.

Amplitude Range – 0.5 V to at least 4.0 V p-p.

Amplitude Accuracy (At Reference) – Within 3% of indicated amplitude.

Flatness – ±4% of amplitude at reference frequency.

Harmonic Content – Second Harmonic: At least 25 dB down. Third Harmonic and All Higher Harmonics: At least 40 dB down.

FM Input – Frequency Range: DC to 100 kHz. Deviation Sensitivity: ±9 V produces from 0.05% to 0.5% deviation of carrier, depending on output frequency.

Frequency Monitor Output – ≥ 0.3 V p-p into a 50 Ω load from 245 to 1050 MHz.

Rear Interface – Address FM input, frequency-monitor output, and amplitude control.

SG 504

SIGNAL GENERATOR

- *245 to 1050 MHz*
- *Leveled, Variable Output*
- *Frequency-Modulation Capability*
- *Internal Peak Detection*

ORDERING INFORMATION

SG 504 Signal Generator **$4,175**
Includes: Instruction manual (070-1632-01); Leveling head (012-0282-01).

Four tough yet affordable test and training aids from TEK

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*
- *UL Listed, CSA Certified*

CFG250

Function Generator

- *Square, Triangle and Sine Waves; TTL Output*
- *20 dB Attenuator*
- *Internal or External Frequency Sweep*
- *Variable Duty Cycle*
- *One Year Warranty*
- *UL Listed, CSA Certified*

CFC250

Frequency Counter

- *5 Hz to 100 MHz (1Hz Res.)*
- *8 Digit Display*
- *Switchable Input Sensitivity*
- *Overrange Indicator*
- *100 kHz Lowpass Filter*
- *UL Listed, CSA Certified*

CDM250

Digital Multimeter

- *AC/DC Volts (500 V Range)*
- *Ohms (20 MΩ Range)*
- *Current (10 A Range)*
- *Overload Protection*
- *UL Listed, CSA Certified*

ECONOMICAL INSTRUMENTS FOR THE BENCH

Now you can have genuine TEK instrumentation, even if you're on a budget. Here are four low-cost solutions built specifically to handle the unique requirements of teaching or basic test applications.

Educator courseware is available which covers basic skills to advanced analysis. It comes with video tapes, primers, and workbooks (see education section for details).

CPS250

The CPS250 Triple Output Power Supply is a versatile instrument with two variable and one fixed output to meet the needs of semiconductor and digital lab experiments, which can be performed easily and with minimal training. Three sets of test leads are included.

CHARACTERISTICS

Outputs – Two 0 V 20 V, 0.5 A max; One 5 V fixed, 2.0 A max.

Load/Line Regulation – 0 to 20 V: 0.01% + 3mV; 5 V fixed: 0.1% + 5 mV.

Ripple/Noise – 2 mV rms (5 Hz to 1 MHz).

Tracking Error – ±0.2 ±20 mV.

Indicators – Analog type meters
Voltage Range: 0 - 25 V dc ±2.5% of full scale.
Current Range: 0 - 600 mA ±2.5% of full scale.

CFG250

The CFG250 2 MHz Function Generator produces sine, square and triangle waves, and TTL signals for testing amplifiers, filters and digital circuits. Its sweep function can be controlled internally or with an external signal level. Duty cycle, DC offset, sweep rate, sweep width and amplitude are all operator controlled.

CHARACTERISTICS

Waveform Outputs – Sine, Square, Triangle, TTL pulse.

Symmetry – 20% to 80% variable.

Frequency Range – 0.2 Hz to 2.0 MHz, seven ranges.

Frequency Multiplier – Variable from 0.2 to 2.0 times the selected frequency range.

Amplitude – Open: 100 mV p-p to 20 V p-p; 10 mV p-p to 2 V p-p. 50 Ω load: 50 mV p-p to 10 V p-p; 5 mV p-p to 1 V p-p.

Accuracy – ±5% of full scale.

DC Offset – + 10 V to −10 V dc continuously variable.

Output Impedance – 50 Ω ±10%.

Sine Wave Distortion – 10 Hz to 100 kHz: < 1%.

Square Wave Response – ≤ 100 ns rise/fall time, with maximum output to 50 Ω.

Triangle Linearity – 20 Hz to 200 kHz: ≥ 99%, 200 kHz to 2 MHz: ≥ 97%.

Pulse Output Amplitude – 3 V p-p (open); Rise Time: 25 ns.

Seep Rate – 0,5 Hz to 50 Hz continuously variable.

Sweep Width – Variable from 1:1 to 100:1.

TM250 CHARACTERISTICS

	CPS250		CFG250		CFC250		CDM250	
Dimensions	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**
Height	100	3.94	64	2.5	64	2.5	64	2.5
Width	240	9.46	240	9,46	240	9.46	240	9.46
Depth	190	7.49	190	7.49	190	7.49	190	7.49
Weight	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**
Net Weight	4.8	10.5	1.6	3.6	1.9	4.2	1.6	3.6
Power Requirements								
Max. Power Usage	165 VA, 131 W		20 VA, 17 W		16 VA, 13 W		8 VA, 7 W	
Line Volt Ranges (at 50 Hz to 60 Hz)	90 V to 110 V ac		108 V to 132 V ac		180 V to 220 V ac		216 V to 250 V ac	
Environmental								
Operating Temp.	0°C to +50°C at 75% relative humidity.							
Nonoperating Temp.	−20°C to +60°C at 80% relative humidity.							

CFC250

The CFC250 Frequency Counter counts the signal frequency of sine, square and triangle waves from 5 Hz to 100 MHz at input levels from 30 mV to 42 V peak. Applications include the adjustment, testing and repair of itmes including audio instruments, AM/FM radios, televisions, CB radios, computer clocks, amateur radios and musical instruments.

CHARACTERISTICS

Frequency Range – AC coupled: 5 Hz to 100 MHz.

Sensitivity – 5 Hz to 30 MHz; 30 mV rms; 30 MHz to 70 MHz: 50 mV rms; 70 MHz to 100 MHz: 80 mV rms.

Attenuation – Selectable Range: 3 V to 42 V range or 80 mV to 5 V range.

Impedance – 1.0 MΩ paralleled by 40 pF.

Dynamic Range (V p-p) – < 1 V times attenuation.

Maximum Input Voltage – 5 Hz to 100 kHz: 42 V peak; 100 kHz to 10 MHz: 13.8 V peak; 10 MHz to 100 MHz: 5.4 V peak.

Resolution – 1 Hz.

Accuracy – ±1 count ±time base accuracy.

Gate Time – 1 second.

TIME BASE ACCURACY

Crystal Frequency – 3.579545 MHz.

Temperature Stability – ±10 ppm, 0°C to 50°C.

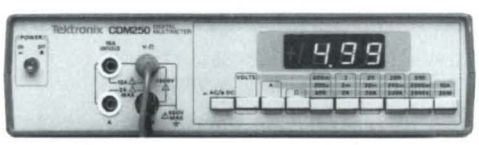
Aging Rate – ±10 ppm per year.

OTHER CHARACTERISTICS

Sampling Rate – 2.5 Samples/second.

Display – 8 digit LED.

Overflow Indicator – Flashing LED.



CDM250

The CDM250 Digital Multimeter displays measurements in digital form on a 3 1/2-digit LED display. Sine wave alternating voltages and currents are displayed in RMS values. Test Leads are included.

CHARACTERISTICS

AC/DC VOLTS		AC/DC CURRENT	
Range	Resolution	Range	Resolution
200 mV	100 mV	200 µA	0.1 µA*1
2 V	1 mV	2 mA	1 µA*1
20 V	10 m V	20 mA	10 µA*1
200 V	100 m V	200 mA	100 µA*1
500 V	1 V	2 A	1 mA*2
		10 A	10 mA*1

*1 *DC Accuracy: ± 1.0% of reading ± 1 count (18°C to 28°C)*

*2 *DC Accuracy: ± 1.0% of reading ± 3 counts (18°C to 28°C)*

AC Accuracy: ± 1.5% of reading ± 4 counts (18°C to 28°C)

AC/DC CURRENT

Response Time – dc: 3 seconds; ac: 5 seconds (200 Ω to 2 MΩ), 15 seconds (20 MΩ).

Input Impedance – Varies with range from 1 KΩ to 0.01 KΩ.

Maximum Input Current – 2 A fused; 10 A unfused.

AC/DC VOLTS

Accuracy – dc: ±0.5% of reading ±count (18°C to 28°C); ac: ±1.0% of reading (18°C to 28°C).

Response Time – dc: 3 seconds; ac: 8 seconds.

Input Impedance – 10 MΩ.

Max Input Voltage – 500 V dc or 350 v ac rms

CMRR – dc: > 100 dB (50/60Hz); ac: > 60 dB (50/60 Hz)

NMRR – > 50dB (50/60Hz).

RESISTANCE

Ohm Range	Resolution	Maximum Test Current
220 Ω	0.1 Ω	2.5 mA*1
2 kΩ	1 Ω	250 µA*2
20 kΩ	10 Ω	50 µA*2
200 kΩ	100 Ω	5 µA*2
1 MΩ	1 kΩ	500 nA*2
20 MΩ	10 kΩ	50 nA*3

*1 *Accuracy: ± 0.75% of reading ± 4 counts (18°C to 28° C).*

*2 *Accuracy: ± 0.75% of reading ± 1 count (18°C to 28° C).*

*3 *Accuracy: ± 1.5% of reading ± 5counts (18°C to 28° C).*

Response Time – 5 seconds (200 Ω to 2 MΩ); 15 seconds (20MΩ).

Open Circuit Voltage – 3.2 V max (200 Ω); 0.6 V max. (2 kΩ to 20 MΩ).

OTHER CHARACTERISTICS

Sampling Range – 2.5 samples/second.

Overrange Indicator – Leftmost digit is "1" and all other digits are blank.

ORDERING INFORMATION

CPS250
Triple Output Power Supply **$410**
Includes: Power Supply Test Leads (3 pairs, Black/Red) (106-3201-00); Operator's Manual (070-6740-00); 1 Year Warranty; U.S. Power Cord.

CFG250
2 MHz Function Generator **$340**
Includes: Operator's Manual (070-6738-00); 1 Year Warranty; U.S. Power Cord.

CFC250
100 MHz Frequency Counter **$305**
Includes: Operator's Manual (070-6741-00); 1 Year Warranty; U.S. Power Cord.

CDM250
Digital Multimeter **$320**
Includes: DMM Test Leads (1 pair Black/Red) (196-3200-00); Operator's Manual (070-6736-00); 1 Year Warranty; U.S. Power Cord.

***WARRANTY-PLUS* SERVICE OPTIONS**

Opt. M1 – 2 years service plus 2 calibrations.

CPS250	+$123
CFG250	+$124
CFC250	+$101
CDM250	+$105

Opt. M9 – 2 years service

CPS250	+$81
CFG250	+$66
CFC250	+$59
CDM250	+$63

OPTIONAL ACCESSORIES

Service Manuals –

CPS250 (070-6739-00)	$25
CFG250 (070-6737-00)	$25
CFC250 (070-6741-00)	$28
CDM250 (070-6735-00)	$28

INTERNATIONAL POWER PLUG OPTIONS

Standard – U.S. power Cord **NC**
120 V, 60 Hz

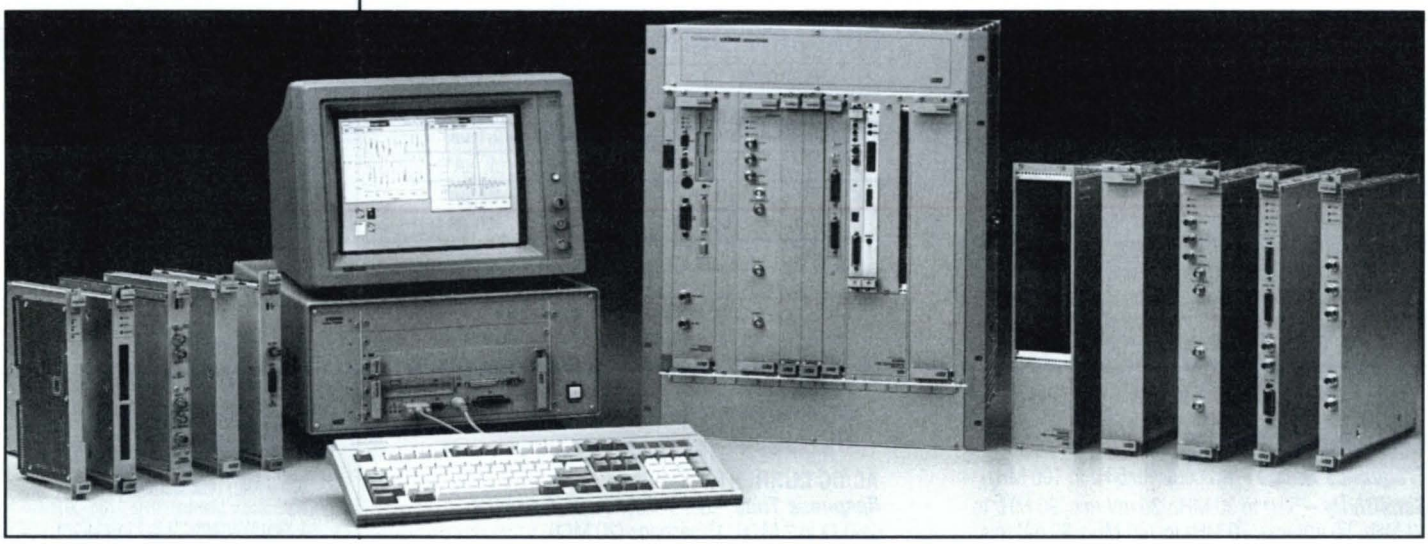
Opt. A1 – Universal Euro **NC**
220 V, 50 Hz (020-0859-00)

Opt. A2 – United Kingdom **NC**
240 V, 50 Hz (020-0861-00)

Opt. A3 – Australian **NC**
240 V, 50 Hz (020-0861-00)

Opt. A4– North American **NC**
240 V, 60 Hz (020-0862-00)

Opt. A5 – Switzerland **NC**
220 V, 50 Hz (020-0863-00)



C and D size VXI Instrumentation Family

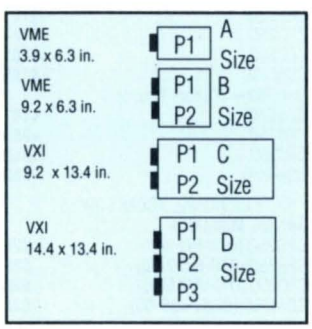


Figure 1.

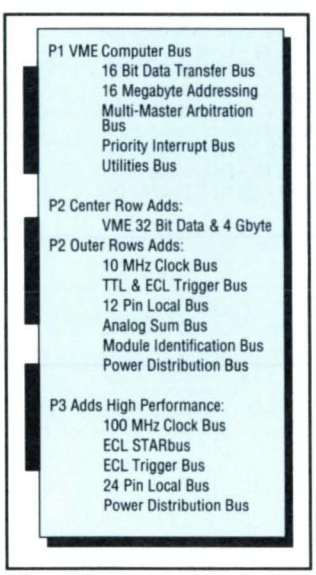


Figure 2.

WHAT IS VXIbus

The VXIbus standard establishes the basis for the next generation of automated test systems. VXIbus (VMEbus Extensions for Instrumentation) is a completely open, nonproprietary architecture for modular electronic test instruments that fully incorporates the open VMEbus standard. VXIbus is the long-awaited standard that makes possible the evolution of ATE to instruments-on-a-card.

Developed by a consortium of major test equipment manufacturers, of which Tektronix is a founding member, VXIbus allows a wide range of instruments, interfaces, and computers from different manufacturers to coexist as fully compatible modules within the same card chassis. It provides the foundation for downsized, interchangeable, and standardized electronic test equipment.

A TRUE SYSTEMS APPROACH

The VXIbus Specification addresses not only electrical and mechanical interfacing, but also provides communication protocols to ensure interdevice communication within the VXI mainframe. Devices designed within the VXIbus specification must support a standard set of register definitions, as well as configuration and communication protocols.

A VXI system automatically identifies each device, its type, model, manufacturer, and any memory requirements upon powerup. You no longer need to physically configure an instrument's address (as with GPIB instrumentation).

Both analog and digital multiple channel acquisition and stimulus instruments can be tightly time coordinated to a single reference point, either with the VXI defined 10 or 100 MHz clocks, or any compatible user clock input. These time coupled measurements greatly enhance data analysis capabilities. Local Bus and STARbus lines provide a network of connections between system components which reduces cable clutter and increases measurement repeatablity.

VXIbus REDUCES SOFTWARE REQUIREMENTS

Because the VXIbus standard ensures multivendor interoperability of all VXI modules, users will have access to generic software packages such as TekTMS on page 346. Standardized software will improve the quality of testing by reducing development errors and making troubleshooting easier.

Virtual software can be used to select front panel settings. Programmable operator interfacing lets you establish the degree of operator involvement that fits your application.

THE VXIbus STANDARD

The VXIbus standard defines three connectors: P1, P2, and P3 and four VXI module sizes A, B, C, or D as shown in Figure 1. The VXIbus standard retains the VMEbus pin configuration on P1 and the center row of P2, but adds optional higher performance features via the outer rows of P2 and all of P3 (Figure 2). The VXIbus Specification contains details about electrical, mechanical, electromagnetic compatibility, system power, device operation, communication protocols, system resources, command and event formats, and IEEE 488 to VXI interface implementation into a VXIbus system.

Resource Manager and Slot 0 Devices

The VXIbus architecture requires some system related functions to be performed by a Resource Manager such as identification of all VXI devices in the mainframe, allocating shared system resources, system self test and diagnostics, etc. In addition, a Slot 0 device provides the 10 MHz clock on P2, 100 MHz clock on P3, and signal distribution.

VXIbus Electrical Definition

Computer Bus

The VME computer bus is a multi-master computer bus with an 8, 16, or 32 bit data bus and 64 KBytes, 16 MBytes, or 4 GBytes of address space.

Clock Bus

The clock bus provides two clocks which use differential ECL signals. The 10 MHz clock is located on P2 and the 100 MHz clock and a synchronization signal (SYNC100) are located on P3. Tek's D-size VXI instruments use the SYNC100 signal and 100 MHz clock for precise timing accuracy.

Trigger Bus and Trigger Protocols

The trigger bus can be subdivided into 8 TTL trigger lines and 6 ECL trigger lines. The trigger bus is used for intermodule communication. Any module, including Slot 0, may drive and receive information on these lines. They are general purpose logic lines used for triggering, handshaking, clocking, or data transmission. Several trigger protocols defined in the VXIbus Specification, are aimed at various system applications and are suggested ways to utilize the VXI trigger lines as a means to promote multivendor interoperability of instruments.

Local Bus

Extended high-speed data transfer, control, and analysis is possible using the local bus lines. Short, well matched propagation delays and very tight time coordination allow data transfer rates of up to 250 MBytes/s for C-Size instruments using the 12 local bus lines on P2 and data tranfer rates up to 1 GByte/s for D-size instruments using all 36 local bus lines. This high-speed data transfer can occur between several modules simultaneously, allowing private communications between modules, without occupying the global resources of the system and freeing other VXI busses to be utilized for other tasks.

STARbus

The STARbus, available on P3, provides two bidirectional differential ECL lines connected between each module slot and Slot 0. Slot 0 can be viewed as the center of a 12 point star with a module slot at each of 12 points. Each module connected over the STARbus is electrically equidistant from Slot 0. The maximum timing skew between any two module slot's receipt of a Star signal is 2 ns. The maximum timing skew between Slot 0 and any module slot is 5 ns. This allows very precisely matched trigger timing between modules regardless of their location in a D-Size mainframe.

Analog Sum Bus

The analog sum bus is a summing node that is bussed across the VXIbus backplane. Any module could drive or receive signals onto or off of this bus.

Module Identification Bus

The module identification (MODID) lines on P2 allow the Slot 0/Resource Manager to identify the presence and slot number of each of the modules in the mainframe. The Slot 0/Resource Manager detects a module when the MODID line is pulled to ground. This allows the Slot 0/Resource Manager to detect a module even if it has failed or lost power.

Power Distribution Bus

The power distribution bus can provide up to 268 watts of power on a single D-size module. Power is delivered from the backplane as seven different regulated voltages. Cooling requirements per slot are not defined in the VXIbus Specification, but adequate cooling is an important part of the VXI system operation.

VXI Communication Protocols

Two communication protocols are defined in VXI for Message Based Devices: Word Serial Protocol (WSP) and Shared Memory Protocol (SMP). The other type of communication possible in VXI is low level, binary data transfers which is defined for Register Based Device communication. Communication in a VXIbus system has a hierarchical commander/servant structure which is established by the system Resource Manager when the system powers up. A commander is any device with one or more lower level devices (servants). The commander initiates communication with its servants. A servant is a device which operates under the control of a commander. All Message Based Devices must respond to WSP, but can also respond to the more advanced communication Shared Memory Protocol. With WSP, the required communication is 16 bit words transferred serially by reading or writing to one of the communication registers resident on a servant device. There is a WSP command set defined extensively in the VXIbus Specification.

SMP defines the operation of a shared memory channel established between two communicating devices with shared memory space. A channel can be asynchronous or synchronous. Asynchronous channels are used for high priority communciations such as warnings, events, and commands which must be immediately executed. The data transfer is accomplished over the ComputerBus in large data blocks. SMP is an efficient method of transferring large amounts of data in a VXI system whether the information is command strings or results obtained from performing a test.

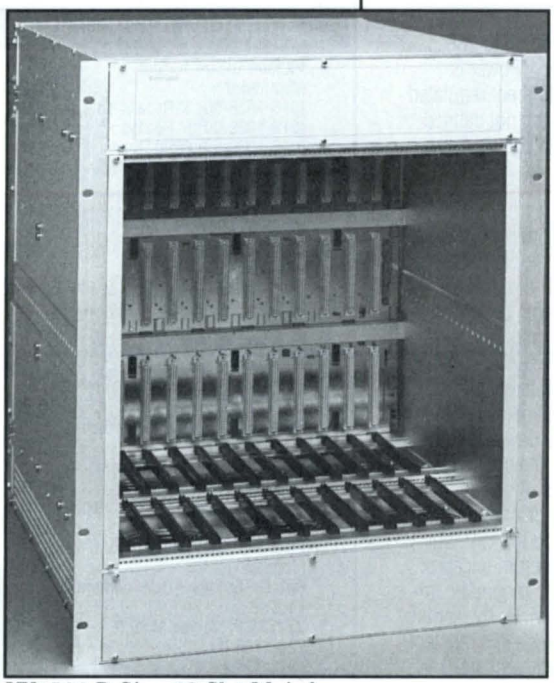
Tektronix VXI Instrumentation

Tektronix provides a wide range of VXI instrumentation and components including the key system elements of most automatic test equipment. These basic system components include: mainframes, system controllers, interface devices, stimulus and acquisition instrumentation, scanners and switches, and UUT probes and contacts. Tek has chosen to apply the VXI resources according to the system performance and functionality needed by the product, therefore Tek offers both C- and D-size VXIbus products and support for generic VME cards. By providing consistent software and hardware tool sets to all levels of VXIbus implementation, Tektronix confirms our commitment to the VXIbus system architecture.

ORDERING INFORMATION

VX1500 D-Size 13 Slot Mainframe	**$9,995**
(016-1028-00) 3" Recess Kit	**$195**
(016-1029-00) 5" Recess Kit	**$195**
(016-1030-00) Front Door	**$250**
(014-0070-00) C Card Adapter	**$195**
VX1505 D-Size 6 Slot Mainframe	*1
VX1400 C-Size 13 Slot Mainframe	*1
VX1405 C-Size 5 Slot Mainframe	**$3,600**
Opt. 1R – VX1405 Rackmount Version	**+$275**
VX1510 VME Conversion Module	**$2,995**
VX1321 B-Size Development Module	**$1,950**
Opt. 5 – Software Development Tool Kit	**+$950**
VX1421 C-Size Development Module	**$2,150**
Opt. 5 – Software Development Tool Kit	**+$950**
VX1521 D-Size Development Module	**$2,250**
Opt. 5 – Software Development Tool Kit	**+$950**
VX1520 Prototype Module	**$1,395**
020-1785-00 D-Size, Singlewide Mech Wrap	**$450**
671-0838-00 D-Size, Perforated Circuit Board	**$350**
VX5520 D-Size Slot 0/Resource Manager	**$3,995**
VX4530 C-Size 16 MHz System Controller	**$11,750**
VX4535 C-Size 20 MHz System Controller	**$17,500**
VX5530 D-Size 16 MHz System Controller	**$17,900**
Opt. 1 – Delete Advance Trigger Functions	**–$3,000**
VX5535 D-Size 20 MHz System Controller	**$23,900**
Opt. 1 – Delete AdvanceTrigger Funtions	**–$3,000**
VX5260 D-Size Waveform Digitizer	**$10,950**
Opt. 1 – 128K Equivalent Time	**+$2,000**
Opt. 2 – 128K Waveform Memory	**+$2,250**
VX5790 D-Size Arbitrary Waveform Generator	**$7,995**
VX4236 C-Size Digital Multimeter	**$3,750**
VX4223 C-Size Counter/Timer	**$3,500**
Opt. 1 – Channel C 1.3 GHz	**+$595**
VX4440 C-Size Scanner Master	**$3,250**

*1 *Contact your VXI System Specialist at your local field office.*



VX1500 D-Size, 13 Slot Mainframe

VX1500
D-Size 13 Slot Mainframe
- *Supports All P1, P2 and P3 Functionality*
- *Also Accommodates A, B, and C VXIbus Modules*
- *Over 900 Watts of Power*
- *Over 100 Watts of Cooling per Slot*

NEW VX1505
D-Size 6 Slot Mainframe
- *Supports All P1, P2 and P3 Functionality*
- *600 Watt Power Supply*
- *100 Watts of Cooling per Slot*

NEW VX1400
C-Size 13 Slot Mainframe
- *Supports All P1 and P2 Functionality*
- *600 Watt Power Supply*
- *50 Watts of Cooling per Slot*

NEW VX1405
C-Size 5 Slot Mainframe
- *Supports All P1 and P2 Functionality*
- *400 Watt Power Supply*
- *45 Watts of Cooling per Slot*

All of Tek's VXI Mainframes provide the full implementation of the high performance VXI features for their size, C or D. These mainframes, like the rest of the VXI family of products from Tektronix, contain features drawn from years of ATE and manufacturing experience. Each mainframe fits in a standard 19 inch rack. The 13 slot mainframes fit in the rack with the modules sliding in vertically and the 5 and 6 slot mainframes fit in the rack with the modules sliding in horizontally. For ordering information on any of these mainframes refer to page 303.

VX1500

The VX1500 D-Size, 13 Slot Mainframe is a high performance VXI Mainframe supporting the full implementation of VXIbus Specification, 1.3. The VX1500 provides access to all three 96-pin connectors per slot and gives you the ability to implement your VXI system using all the VXI resources. The mainframe's power supply has been designed specifically for VXIbus and provides over 900 Watts to the VXI power bus. 100 Watts of cooling per slot is provided by directed forced air drawn in from any combination of the bottom, sides, back, or front and exits at the rear of the mainframe. This mainframe can accommodate all four VXI card sizes. Adapters are available from Tek which allow A-, B- and C-size modules to be integrated while maintaining the necessary air flow. Tek's VX1510 VME Conversion module accommodates A- and B-size VXI modules (page 305) while C-size modules can be implemented with the C Card Adapter (014-0070-00). Incorporated in the design of the mainframe are lift handles and hinged power supply compartment. A set of mounting options are available including a 3 inch (016-0028-00) and a 5 inch (016-0029-00) recess kit and full frame locking door (016-0030-00).

VX1505

The VX1505 D-size, 6 Slot Mainframe provides the same high performance VXI features as the VX1500. Providing fewer slots decreases the size and cost of the VX1505 for those who have strict space and cost considerations.

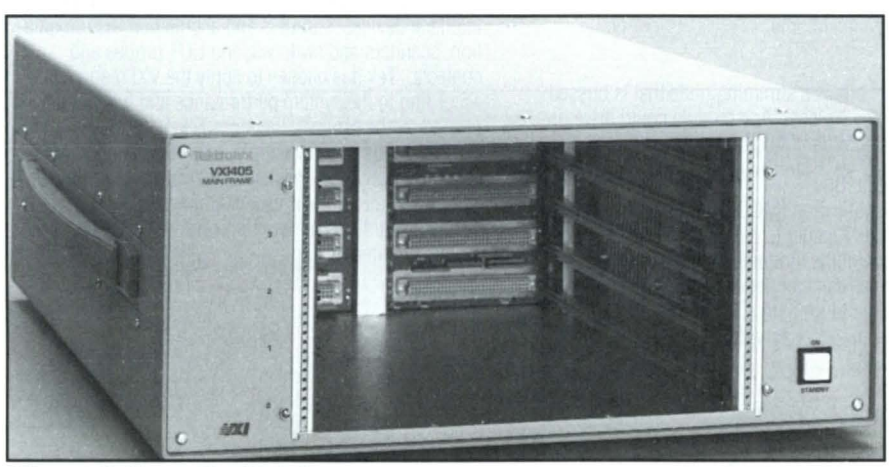
VX1400

The VX1400 C-Size, 13 Slot Mainframe supports all the VXI resources provided on the P1 and P2 connectors as defined in the VXIbus Specification 1.3. This mainframe's 600 Watt power supply has been designed to provide the best distribution of power to the VXI power bus for your system configurations. 50 Watts of cooling per slot will maintain the critical system performance you require in your C-size VXI system.

VX1405

The VX1405 C-Size, 5 Slot Mainframe provides the VXI development engineer a small desktop VXI environment for designing C-size instruments or software. This portable C-size mainframe can also be used in the field for troubleshooting system problems in a remote area or by itself as a small VXI system.

The VX1405 has a 400 Watt power supply and 45 Watts of cooling per slot to provide all the power and cooling required for 5 slots of VXI C-Size instruments.



VX1405 C–Size, 5 Slot Mainframe

VX1510

The VX1510, Tek's D-size, VME Conversion Module (VCM) converts 3 VXI slots into 4 VME slots allowing you to combine current VME solutions to the VXI environment. Not only can you accommodate any VME controller, but any VME instrument card as well. The VCM provides a physical extension of the VXIbus buffering all VMEbus signals to the J1 and J2 connectors on the VCM backplane.

The outer rows of the VME J2 connector are local to the VCM and remain user definable. The VCM is slot independent and utilizes the forced air cooling provided by Tek's D-size mainframes.

VX1321/1421/1521

Tek's offering of message based development modules are available in B (VX1321), C (VX1421), and D (VX1521) Size single-wide modules. These modules allow you to take advantage of Tek's VXI expertise, therefore reducing your VXI instrument development cycle. Tek's Development Modules take care of the VXI communication protocols so you can focus on your hardware functionality. The steps to your custom VXI instrument are first, to attach your hardware to the 68000 microprocessor on a development module via the 34 pin connectors. Then, using the host computer and operating system of your choice, create your VXI instrument's command set and program. Compile your program using OASYS' Green Hills Cross Assembler into a 68000 machine code. Link this code to the Tek I/O Utilities provided in the Software Development Tool Kit. Then, download the program from your host computer into the 68000 microprocessor via the Serial I/O Card also provided in the Software Development Tool Kit. A debugging tool and diagnostics are provided in ROM on the Serial I/O Card.

VX1520

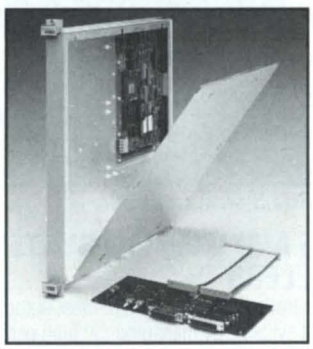
The VX1520, Prototype Module, is a double wide D-size module with 125 inches of Vector/Vero board with interlayer shielding for electrical components or installing wire-wrap pins. 25 inches of board space is provided without shielding to provide easy cutouts for mechanical component mounting.

To assist in prototype development Tek provides a D-size, single-wide mechanical wrap (020-1785-00) and a D-size perforated circuit board (671-0838-00).

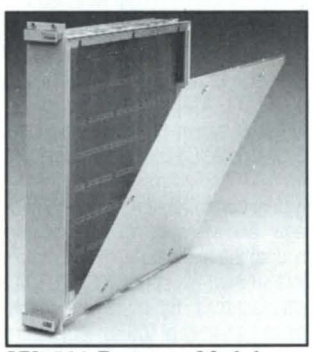
VX5520

The VX5520 is a multi-purpose device combining VXI Slot 0/Resource Manager functions with a GPIB Talker/Listener Interface. This module also supports VMEbus Master functions, VXI signal support, and VXI commander functions like system clock, and SYSFAIL. The VX5520 has a 10 and 100 MHz clock and provides signal distribution as required of a Slot 0 device. Resource manager functions: system self test, diagnostics, system memory configuration (dynamic and static), and address mapping functions are all handled by the VX5520. Additionally, Tek's VX5520 provides message manager functions which handle the VXIbus overhead required to move information to and from VXI devices.

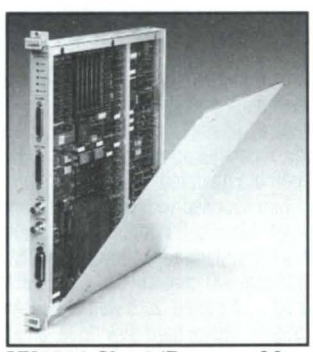
VX1510 VME Conversion Module



VX1521 Development Module with Serial I/O Card



VX1520 Prototype Module



VX5520 Slot 0/Resource Manager

VX1510
VME Conversion Module (VCM)

- *Converts 3 VXIbus Slots into 4 VMEbus Slots*
- *VMEbus J2 Outer Rows Are User Definable*
- *Meets VME Specification C.1*

VX1321/1421/1521
Development Modules

- *Intelligent 68000 Message Based Interface Devices*
- *Supports Word Serial and Shared Memory Protocols*
- *Software Development Tool Kit Option*
- *Debugger and Diagnostics*

VX1520
Prototype Module

- *Install Electrical or Mechanical Components or Wire-Wrap Pins*
- *Module Shielding and a Blank Front Panel*

VX5520
Slot 0/Resource Manager

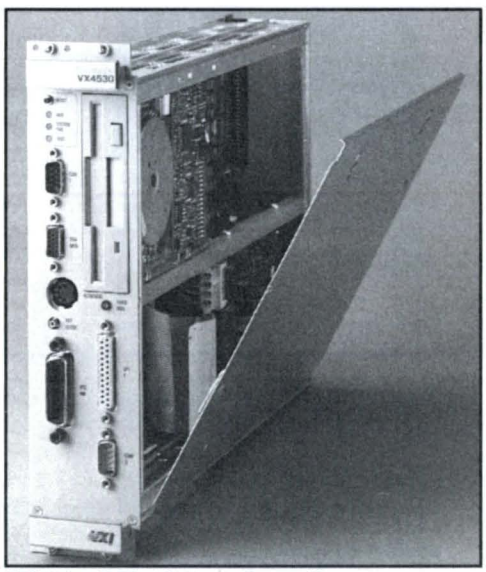
- *Supports All VXI Slot 0 Functions*
- *Supports All VXI Resource Manager Functions*
- *VXIbus Commander and Servant, VMEbus Master and Slave*
- *IEEE-488 Talker/Listener Interface*

VX4530
C-Size, 16 MHz
- *16 MHz, 2 MBytes RAM, 40 MByte Hard Drive, 3.5" Floppy*
- *Slot 0/Resource and Message Manager Functions*
- *VGA Color Monitor, Serial Mouse, Keyboard*
- *Software: DOS 4.01, Microsoft Windows386, C and Basic Compilers, Tek's I/O System, EPConnect + TekTMS*

VX4535
C-Size, 20 MHz
- *20 MHz, 8 MBytes RAM, Math Co-processor, 40 MByte Hard Drive, 3.5" Floppy*
- *Slot 0/Resource and Message Manager Functions*
- *VGA Color Monitor, Serial Mouse, Keyboard*
- *Software: DOS 4.01, Microsoft Windows386, C and Basic Compilers, Tek's I/O System, EPConnect + TekTMS*

VX5530
D-Size, 16 MHz
- *16 MHz, 2 MBytes RAM, 40 MByte Hard Drive, 3.5" Floppy*
- *Slot 0/Resource and Message Manager Functions*
- *VGA Color Monitor, Serial Mouse, Keyboard*
- *Software: DOS 4.01, Microsoft Windows386, C and Basic Compilers, Tek's I/O System, EPConnect + TekTMS*
- *Advanced Trigger Functions*
- *Option 1: Delete Advanced Trigger Functions*

VX5535
D-Size, 20 MHz
- *20 MHz, 8 MBytes RAM, Math Co-processor, 40 MByte Hard Drive, 3.5" Floppy*
- *Slot 0/Resource and Message Manager Functions*
- *VGA Color Monitor, Serial Mouse, Keyboard*
- *Software: DOS 4.01, Microsoft Windows386, C and Basic Compilers, Tek's I/O System, EPConnect + TekTMS*
- *Advanced Trigger Functions*
- *Option 1: Delete Advanced Trigger Functions*



VX4530 C-Size System Controller

VX4530/5 AND VX5530/5 SYSTEM CONTROLLERS

The VXI controller forms the core of most automatic test equipment systems by managing the high performance VXI resources and controlling the VXI instrumentation. Tektronix VX4530/5 (C-size) and VX5530/5 (D-size) controllers link Intel's 80386 processor and the PC/AT architecture to the VXIbus creating a family of controllers which utilize generic PC software, all of the advanced instrumentation resources of the VXIbus, and address the full A32/D32 VMEbus memory space. Additionally, these VXI system controllers provide GPIB Commander-In-Charge (CIC) and Talker/Listener capabilities.

These VXI system controllers implement Slot 0, Resource Manager, and Message Manager functions. In addition to providing the mandatory P3 signals. Tek's D-size controllers support the optional SYNC100 and STARbus system resources. By implementing the full VXI specification in its family of VXI system controllers, Tektronix assures compatibility with VXI devices from all other vendors even as more complex implementations become available. This translates to easier system integration.

Each Tektronix VXI system controller is provided with a PC/AT style keyboard, a VGA Color Monitor, a serial mouse and software. In addition to keyboard, monitor and mouse ports, a parallel printer port, second RS232 port and GPIB port are mounted on the controller's front panel. The software supplied with each of the controllers includes DOS 4.01, Microsoft Windows386, C and Basic Compilers, Tek's I/O system, EPConnect + TekTMS.

The VX4530 C-size VXI controller has a 16 MHz CPU, 2 MBytes of 32 bit dual ported, zero wait-state RAM for system memory, a 40 MByte hard disk drive, and a 3.5" 1.4 MByte floppy disk in addition to the features listed above.

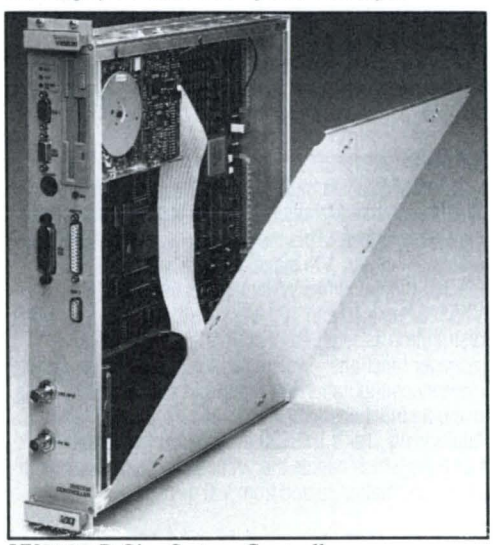
The VX4535 C-size VXI controller has a 20 MHz CPU, a math co-processor, 8 MBytes of 32 bit dual ported, zero wait-state RAM for system memory, an 80 MByte hard disk drive, and a 3.5" 1.4 MByte floppy disk in addition to the features listed above. The C-size controllers have an external clock reference included on their front panels.

The VX5530 D-size VXI controller has a 16 MHz CPU, 2 MBytes of 32 bit dual ported, zero wait-state RAM for system memory, a 40 MByte hard disk drive, and a 3.5" 1.4 MByte floppy disk in addition to the features listed above.

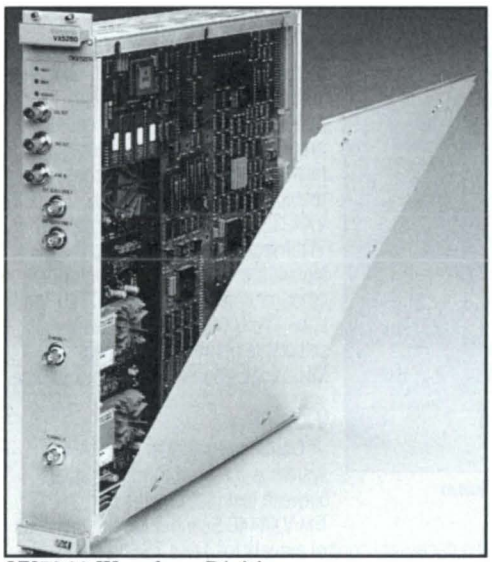
The VX5535 D-size VXI controller has a 20 MHz CPU, a math co-processor, 8 MBytes of 32 bit dual ported, zero wait-state RAM for system memory, an 80 MByte hard disk drive, and a 3.5" 1.4 MByte floppy disk in addition to the features listed above.

An optional connector supporting a high speed data communication link for use in multi-rack VXI systems or network communications is available on the D-size controllers. In addition, the D-size controllers have four BNC connectors providing two channels of input and output.

Both the VX5530 and VX5535 include Tektronix Advanced Trigger Functions (ATF), a superset of the Slot 0 resources, which provide real time links between multiple VXI subsystems, control internal and external signal phase relationships, and the ability to trigger on complex events. The ATF are accomplished through custom ECL gate arrays which provide three advanced system features: trigger logic, programmable linear delay units and STARbus support. The Logic Unit performs logical functions: AND, NAND, OR, NOR, EXOR, EXNOR, and INVERT, allowing a trigger event to be related to a complex set of criteria. Two programmable linear delay units are used for deskewing signals into and out of the mainframe as well as altering the phase relationships of signals within the mainframe. The STARbus support enables routing and broadcasting of asynchronous signals with very tight time coordination. Tektronix commitment to the VXIbus architecture resulted in the development on the Advanced Trigger Functions which make high performance ATE systems a reality in VXI.



VX5530 D-Size System Controller



VX5260 Waveform Digitizer

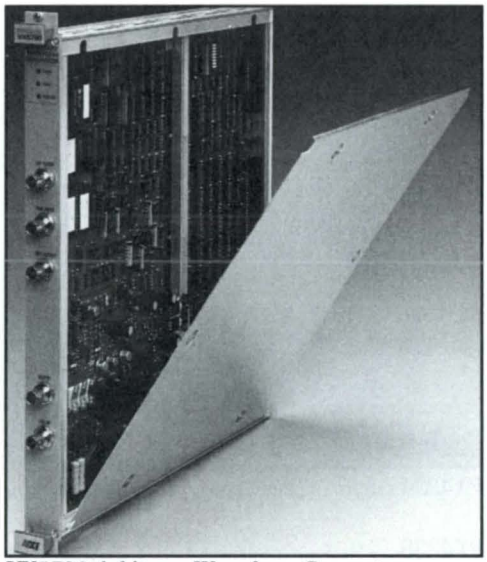
VX5260

The VX5260 is a compact, high performance, message based, dual channel waveform digitizer designed to utilize the instrumentation resources of the VXIbus. The 200 MS/s real time acquisition rate and 8 bit vertical resolution give accurate time measurements on transient events as well as rapid capture of multiple events. The equivalent time option and signal averaging feature increase the time and amplitude resolution for repetitive signal analysis.

A waveform memory option increases the standard 16K memory per channel to 128K (if long record lengths are required). This flexible waveform memory permits the storage of long duration events acquired at high sampling rates or the storage of many shorter events.

The trigger system provides flexibility for synchronizing the VX5260 with the Device Under Test (DUT) as well as other instruments in the test system. VXIbus STAR, SYNC100, trigger lines and the ESTST protocol can be used to synchronize multiple digitizers and other VXI instruments. This provides timing accuracy and high throughput for VXI ATE systems.

Internal signal analysis commands are available to provide answers rather than just waveform data. Five recording modes emphasize the versatility and power of the VX5260 for both manufacturing ATE and high speed data acquisition applications. A real time A to D places data from the A to D directly on the Local Bus, thus providing continuous real time digital waveform data. The signal averaging mode permits 2 to 256 waveforms to be averaged reducing random noise and improves the signal to noise ratio on repetitive signals yielding increased vertical resolution. The envelope capture mode can be used to efficiently analyze signal drift and jitter. The envelope comparison mode can provide go/no-go verification of waveform data within the specified upper and lower boundaries. Auto-Advance mode provides rapid capture of multiple events by automatically arming and waiting for a trigger event before capturing the next waveform.



VX5790 Arbitrary Waveform Generator

VX5790

The VX5790 Arbitrary Waveform Generator (AWG) permits complex signals to be generated for use as DUT stimulus. These waveforms can be sine, triangle or square or more arbitrary such as waveforms derived from complex mathematical functions. The VX5790 can also recreate waveforms downloaded from a digitizer.

The VX5790 features 10 bit vertical resolution, a maximum clockrate of 100 MHz, extensive signal conditioning and waveform memory capabilities. The maximum output amplitude from the VX5790 is 20 V peak-to-peak into an open circuit or 10 V peak-to-peak into 50 Ω. Three selectable filters are located within the instrument with 3 dB points of 390 kHz, 25 MHz, and 3.1 MHz to assist with the removal of aliased components and to smooth the output waveform. Waveform packet size is selectable from 24 up to 2048 data points in increments of 8. The packets can be combined in any order to define a sequence. Additionally, each packet within the sequence can be scanned from 1 to 256 times before moving on to the next.

The VX5790 is a single channel, single wide D-size instrument. Multi-channel VX5790's can be implemented by adding additional AWG modules and using the VXI trigger protocols to synchronize operation. Three operating modes can be selected for optimal performance. Auto-Advance executes the next waveform packet without delay. Packed Advance requires a valid trigger before advancing which allows synchronization between different waveforms and external events. Continuous mode permits the VX5790 to function as a free running signal source.

Both the Waveform Digitizer and AWG are specifically designed as VXI system instruments offering several modes of operation and advanced triggering capabilities. ATE system performance will be significantly advanced when implementing the full extent of Tek's high performance VXI instruments.

VX5260
Waveform Digitizer

- *200 MS/s Acquisition Rate*
- *8 Bit Vertical Resolution*
- *Dual Channel Acquisition*
- *128K Record Length per Channel Options*
- *5 Operating Modes: Real Time A to D, Auto-Advance, Envelope Capture and Comparison, and Signal Averaging*
- *Signal Analysis: Arithmetic Functions, Waveform Parametrics, and Signal Processing*
- *Selectable Input Coupling: 50 Ω or 1 MΩ*
- *Equivalent Time Sampling*
- *Double Wide, D-Size Module*

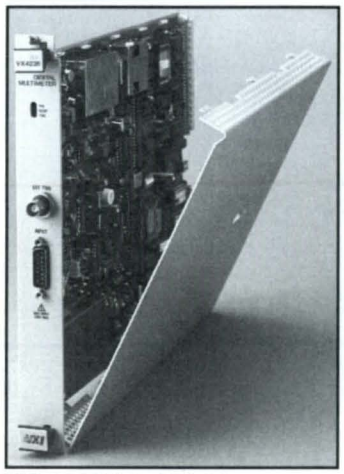
VX5790
Arbitrary Waveform Generator

- *10 Bit Amplitude Resolution*
- *Maximum Clock Rate of 100 MHz*
- *128K Data Points of Waveform Memory*
- *3 Operating Modes: Auto-Advance, Packed Advance, and Continuous*
- *Packetized Waveform Generation: 24 to 2048 10 Bit Packets Executed in Any Order 1 to 256 Times*
- *Single-Wide, D-Size Module*

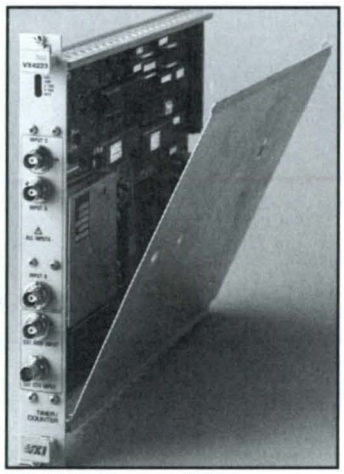
VX4236
Digital Multimeter
- *6.5 Digit Resolution*
- *DC Voltage Measurements 100 nV to 300 V*
- *AC Voltage Measurements 1 MicroV to 300 V*
- *Resistance Measurements 100 Micro Ω to 20 M Ω.*
- *Fully Programmable*
- *External Trigger Capability*

VX4223
Counter/Timer
- *DC to 1.3 GHz Frequency Measurements*
- *1 ns Single Shot Resolution*
- *Signal Conditioning*
- *External Arming Capabilities*
- *Automatic Phase Measurement*

VX4440
Scanner Master
- *Controls Six Ports*
- *32 Bit Bidirectional TTL Lines per Port*
- *500 Step per Port Sequence Buffer*
- *Three Operating Modes: Immediate, Stored or Sequenced*
- *Emulates TSS40 Cards: TSS40 Switch, TSS45 RF Scanner, TSS46 Microwave Scanner*
- *Powers 12 P651x Spring Contact Probes or P650x Microprobes*



VX4236 Digital Multimeter



VX4223 Counter/Timer

VX4236

The VX4236 is a C-size, single wide, message based 6.5 digit full function Digital Multimeter providing DC Volt, AC Volt and resistance measurement capability. Up to 1000 measurements can be stored in this DMM's buffer before the information is transmitted to the system controller. The VX4236 provides full external calibration of all ranges and functions via the VXIbus, so no physical adjustments are necessary. High isolation of sensitive input circuits can be accomplished due to an extremely low noise DC to DC converter technique providing excellent noise rejection. The VX4236 has a CMRR >130 dB and a NMRR of 76 dB at line frequency for DC Voltage measurements.

100 mV to 300 V DC Volts measurements can be made with 6.5 digit resolution and 1 mV to 300 V AC Voltage measurements can be made with 5.5 digit resolution. Resistance measurements are made from 100 Ω to 10 MΩ with 5.5 digit resolution. The VX4236 has selectable measurement resolution from 4.5 to 6.5 digits to offer matching between the speed and resolution of a measurement to the application's needs. Measurements are fully programmable and can be triggered externally.

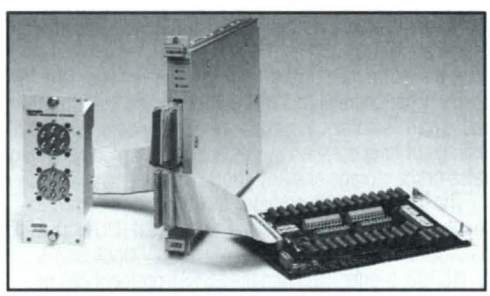
VX4223

Tek's C-size, single wide dual channel VX4223 Counter/Timer module features fourteen measurement functions including phase and pulse parameters, rise and fall times, and frequency profiling. DC Coupling allows measurements from DC to 160 MHz on Channel A, DC to 100 MHz on Channel B, and an optional Channel C allows frequency measurements up to 1.3 GHz. AC coupling allows measurements from 10 Hz to 160 MHz on Channel A and 10 Hz to 100 MHz on Channel B. The VX4223 has selectable input impedances of 50 Ω or 1 MΩ and selectable input attenuation of X1 or X10.

The VX4223 has frequency and period resolution of nine digits in one second. 1 Hz resolution at 1 GHz and 10 mHz resolution at 10 Hz are obtainable in 1 second to meet high precision requirements. Averaged measurements have 100 picosecond resolution as narrow as 5 ns. The VX4223 can be externally armed by a TTL trigger signals or, using the gate signal, the VX4223 can synchronize other modules by driving a TTL trigger line. The VX4223 time base is selectable between the system's 10 MHz clock or an external clock source.

VX4440

Common to almost every ATE system is the need to route signals between test instruments and a DUT. The VX4440 Scanner Master provides the necessary control signals for Tek's TSS40 series of relay drivers, switch cards, and modules. The TSS40 series provides switches for high and low voltage and currents as well as RF switch modules capable of switching signals up to 18 GHz. The VX4440 features a connector to supply power for the Tek P6510 family of active Spring Contact Probes for high impedance board testing and P6500 series of microprobes for hybrid/wafer testing.



VX4440 Shown Attached at the Head to One Switch Module and One Switch Card

The VX4440 is a message based, C-size, single wide module providing 6 ports to control 6 switch cards or 12 RF modules. Switch control commands are executed directly in the immediate mode, scanned one at a time in the stored mode, or in the sequence mode a 500 step buffer is used to store switch settings. The VX4440 can execute prestored switch settings after a command or internal TTI trigger. The VX4440 can also provide a TTI trigger "ready" signal to other test system instruments before proceeding to the next sequence of switch steps.

COMPLETE SIGNAL SWITCHING/DUT INTERFACING SOLUTIONS IN A SINGLE PACKAGE

The Test System Interface (TSI) family comprises a group of components that provide complete switching and physical interfacing solutions for IEEE Standard 488 (GPIB) system builders. Although designed primarily for the manufacturing ATE environment, the TSI family has proven its worth in a variety of uses.

Test engineers will benefit from the flexibility and versatility of the TSI family. It is especially well-suited for complex test requirements and for applications requiring periodic test set-up changes. Examples of these applications include testing of components, hybrids, circuit boards, sub-assemblies, and complete products.

In applications where DUTs span a wide range of bandwidth, power, signal-routing, and physical-interfacing requirements, most test interfaces have had to be custom designed and built. In addition to being time-consuming and expensive, these custom fabrications were difficult and costly to maintain, and documentation was a problem. The TSI family of off-the-shelf components offers an ideal solution.

These products can be easily and affordably configured to fit a majority of signal switching and DUT interfacing needs: digital or analog; front and rear signal access; remote switching; signal levels from microvolts to 400 volts; currents from microamps to 10 amps; and frequency ranges to 18 GHz. Two custom driver cards are available for routing specialty signals or for controlling devices such as actuators, solenoids, stepper motors, and robotics.

Systems can range in complexity from a mainframe and a single switching assembly, to DUT-interfacing adapters and multiple card/module switching configurations for up to 768 channels. Rackmounting and IEEE-488 bus operation are standard features of the TSI 8150. Conformity with Tektronix Codes and Formats assures standardized bus operation.

The *TSI 8150 Mainframe* is the basic building block of the Test System Interface product family. It is an intelligent and flexible interface mainframe that provides power, control, timing, and housing for TSI family scanner cards and modules. The TSI 8150's mechanical architecture provides flexible front and rear access to installed cards and modules.

The *TSX 8140 Expansion Chassis* doubles the mainframe capacity without doubling the expense, and allows twice as many channels to be controlled from a single bus address.

Physical interface to the DUT is provided by the *TSA 8140 Test System Adapter*. The TSA can be mounted horizontally, vertically, or in a system rack with optional rack slides. An extensive offering of interchangeable test adapters lets you test a wide variety of device types, such as hybrids, circuit boards, and components. Test adapters can be easily modified to accept various Zero Insertion Force (ZIF) sockets and adapters. An optional Test Head Receiver is Virginia Panel Corporation Series-3200 compatible, which opens the door to a large selection of vacuum bed-of-nails test adapters for circuit board testing.

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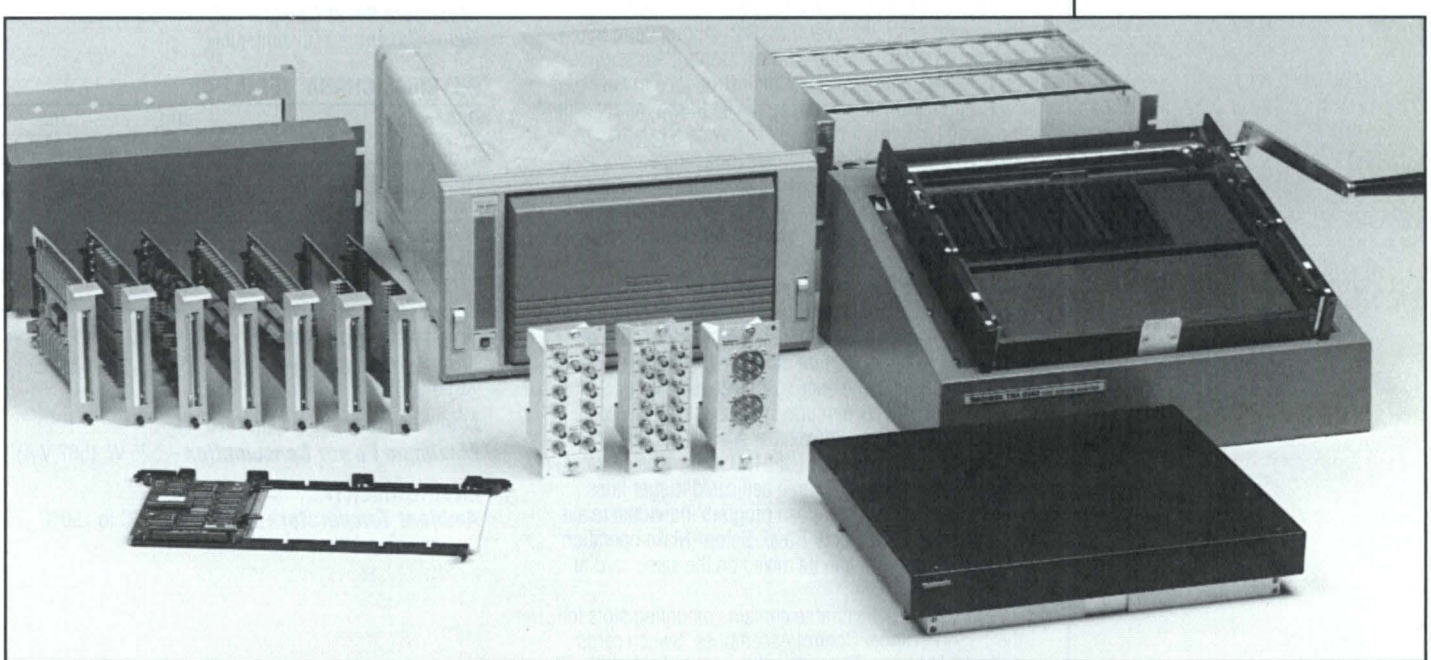


TSI 8150 (center rear) and Family

TSI 8150

- ***Complete Line of Scanner Cards and Modules***
- ***Complete Line of Accessories for Switch-Mounting and DUT-Interfacing Requirements***
- ***Flexible Mechanical Architecture Permits Signal Access from Both Front and Rear of Mainframe***
- ***Low-Noise Linear Power Supply in Mainframe, Plus Remote Switching (at the DUT) for Signal Integrity***
- ***Intelligent Mainframe and Control Assemblies Free System Controller for Other Tasks***
- ***Real-Time Sequencing Maximizes Throughput***

GPIB* IEEE-488

Switches are mounted on cards or modules that can be mounted in the mainframe, in auxiliary mounting units, or in the test system adapter, up to 40 feet away from the mainframe. (Lower-frequency switches are built on a circuit card and are referred to as Switch or Scanner cards; higher-frequency switches are built into modular metal cases and are referred to as modules.) Mounting the switch assemblies in the test-system adapter puts the switching as close to the DUT as possible, helping the TSI ensure signal integrity. Numerous other techniques are used to make sure your signals stay clean, such as individually shielded function cards and a low-noise linear power supply in the mainframe.

The TSI 8150 mainframe provides switch timing and control information through *TSS40 Scanner Control Assemblies*. Each switch card, or each two identical switch modules, has a dedicated TSS40 that provides real-time control for up to 32 switches in any closure pattern, with storage of up to 500 test sequences. Add programmable make-before-break (MBB) or break-before-make (BBM) for each switch, and you have unparalleled control over your switches.

TSI 8150 TEST SYSTEM INTERFACE MAINFRAME

In some test systems, the controllers don't lend themselves to real-time operation. For these systems, combining TSI 8150 mainframe local intelligence with its timing capability produces a powerful team. The TSI 8150 mainframe's handling of switch sequencing and timing frees the controller for other tasks.

The TSI 8150 mainframe receives instructions from the system controller over the GPIB, storing up to 500 test steps on each TSS40 Scanner Control Assembly. Each TSS40, in turn, passes the instructions to the switching assemblies (one card or up to two modules of the same type) that it controls. The system can then use external triggers, internal triggers, or a single command to increment each test sequence step. Using stored settings and either a trigger or a single bus command, a test system can change the state of hundreds of switches at the same time.

Two independent programmable timers provide flexible control for sequencing and delay generation, thus offloading these tasks from the system controller. The TSI 8150 also includes a 24 bit up/down totalizer. The timers and the totalizer can be tied to an extensive trigger system. This connection provides flexible real-time control of scanners. Unlike other scanning systems that have only one trigger, the TSI 8150 mainframe contains 10 general-purpose and three dedicated trigger lines.

Test-system engineers can program individual relays for Make-Before-Break or Break-Before-Make operation. The two capabilities can be mixed on the same card or module.

The TSI 8150 mainframe contains mounting slots for the TSS40 Scanner Control Assemblies. Switch cards and relay driver cards can then be mounted either directly on their scanner control assemblies, or remotely with an extension ribbon cable. Switch modules can be mounted either remotely, or on brackets supplied on the front and rear of the TSI mainframe, using different lengths of ribbon cable.

Up to twelve TSS40s can be mounted in each mainframe when the switch cards are mounted remotely. When switch cards are mounted directly on the scanner control assemblies, only six such combinations will fit in each mainframe. A cableway in the bottom of the mainframe allows convenient routing of cables between the front and rear of the system.

CHARACTERISTICS

TOTALIZE

General – Programmable gate, preload, reset, and source select. Can send SRQ on underflow/overflow.

Maximum Count – 16,777,215 (24 bits).

Minimum Pulse Width – 250 ns.

Maximum Repetition Rate – 1 kHz.

TIMER

General – Two independent pulse generators, source and destinations are trigger lines; programmable source, destination, period, width, delay, burst pulse count, and gate; can generate an SRQ at end of last pulse count.

Resolution – 10 ms.

Delay Accuracy – 0.01% +10, -10 ms.

Period, Width Accuracy – 0.01% +100, - 0 μs.

Minimum Period – 20 ms.

Maximum Delay, Period, Width – 655.35 seconds.

Maximum Burst Count – 66535 or continuous.

Input/Output – TTL compatible.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	483	19.0
Height	264	10.4
Depth	641	25.3
Weight	**kg**	**lb**
Net	23.9	52.5
Shipping	35.4	78.0

POWER REQUIREMENTS

Line Voltage Ranges – 100, 110, 120, 200, 220, or 240 V ±10%.

Line Frequency – 48 Hz to 66 Hz.

Maximum Power Consumption – 525 W (567 V A).

ENVIRONMENTAL

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

* *The TSI 8150 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.*

TSX 8140 EXPANSION CHASSIS

The TSX 8140 Expansion Chassis lets TSI 8150 users double their channel scanning capacity, while retaining single mainframe control. The TSX 8140 uses the same main interconnect as the TSI 8150 Mainframe, and can accommodate the same number of switches. Another plus of the TSX 8140 is that twice as many channels can be controlled from a single GPIB address. Besides saving a bus address, this simplifies control and programming.

Control for the TSX 8140 is provided by the TSI 8150 mainframe. One TSX 8140 can be connected to each TSI 8150. To ensure adequate power for a maximum number of channels, the TSX 8140 has its own built-in power supply, the same high-quality, and low-noise linear supply used in the mainframe.

Using the TSX 8140 and 016-0861-00 Auxiliary Card Racks, a switching system can be configured with as many as 720 general-purpose relay channels or 768 matrix switching channels. When the TSX 8140 is used with the 016-0862-00 Auxiliary Mounting Units, up to to 576 Coax, RF, or Microwave channels are possible.

TSA 8140 TEST SYSTEM ADAPTER

The TSA 8140 Test System Adapter provides system builders with a direct link between the device under test (DUT) and the test system.

One-of-a-kind DUT interface designs are often expensive to build, inadequately documented, and difficult to service. When the original system builders change jobs, they take their design concepts with them. Another problem is that one-of-a-kind designs are difficult (or impossible) to adapt to changing test system needs. Using the TSA 8140's commercially available test heads cuts DUT adapter development time and materials costs.

The TSA 8140 ensures excellent signal integrity by allowing system builders to place switching and custom signal conditioning circuits very near the DUT. Steel construction shields test circuits from low-frequency magnetic fields. The removable top panel allows system builders to configure the TSA 8140 for a dedicated application.

The TSA 8140 can be mounted horizontally or vertically. In either configuration, rack slide rails can be added with the *TSA F01* rack-mounting kit. For visual inspection of hybrid integrated circuits with a microscope, or other situations where a level stand is needed, the *TSA F02* converts the TSA 8140 work surface from its normal slant to a level attitude.

For quick and easy DUT interconnections, the *021-0435-00 Test Head Receiver* is used with *TSA F09* and the *TSA F10* Quick Connect assemblies and the *021-0434-00* and *021-0436-00 Interchangeable Test Adapter* (ITA) assemblies. The TSA F09 Universal Low-Frequency Quick Connect provides a connection from any one TSS4x switch card, relay driver card, or TSD42 interface card. The TSA F10 Low-Frequency Quick Connect provides connections from any two TSS42 General-Purpose Scanner cards.

The *TSA F11* High-Frequency Quick Connect and *021-0441-00 ITA* provide the same quick and easy DUT interconnection capability for TSS44 and TSS45 scanner modules.

The TSA 8140 Test System Adapter is also compatible with Virginia Panel Corporation's 3200-Series test heads.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width	558	22.0
Height (front)	115	4.5
Height (back)	222	8.8
Depth	470	18.5
Weight	**kg**	**lb**
Net	11.8	26.0
Shipping	14.0	31.0

TSX 8140

- *TSI 8150 Expansion Chassis*
- *Doubles Capacity of TSI 8150*
- *Same Features as TSI 8150*

TSA 8140

- *Configurable Top Panel for Dedicated Applications*
- *Optional Test Head Receiver Allows Easy Interfacing to a Wide Range of Devices Under Test*
- *Interchangeable Test Adapters Provide for Custom Interfacing (Hybrids, Components, etc.) plus Commercially Available Bed-of-Nails Test Heads*
- *Accepts the Entire TSI 8150 Family of Scanners to Maintain Signal Integrity by Minimizing Cable Lengths*
- *Rugged Steel Construction for Low-Frequency Noise Shielding*

ACR/AMU

- *Fit into Standard 19-inch Racks for Convenient Placement*
- *Accept up to 12 Scanner Cards (ACR) or 6 Scanner Modules (AMU)*
- *Can be Mounted in a Vertically- or Horizontally-Configured TSA 8140 Test System Adapter for Greater Flexibility*

TSS40

- *Real-Time Control of up to 32 Switches for a Variety of Operations*
- *Storage of up to 500 Test Steps for Higher System Throughput*
- *Programmable Trigger Sources for Flexible System Timing Coordination*
- *Switch Programming for Make-Before-Break or Break-Before-Make Switch Control*
- *Low-Cost 32 Bit Output and 5 Bit Input Interface*

AUXILIARY CARD RACK (ACR) AND AUXILIARY MOUNTING UNIT (AMU)

In large ATE systems, system builders must sometimes distribute switching functions: some switches near the DUT, some near the stimulus instruments, and some near the measurement instruments. The Auxiliary Card Rack, or ACR (016-0861-00) and the Auxiliary Mounting Unit, or AMU (016-0862-00) solve this problem by providing the hardware that system builders need to physically mount switches in remote locations. The TSI 8150 mainframe provides the power and control for remotely-mounted scanner cards and modules.

The 016-0861-00 and 016-0862-00 can be placed in standard 19-inch racks. They can be attached to either the front or back of a standard rack cabinet. The 016-0861-00 accepts all TSI 8150 family scanner/switch cards or relay driver cards, and can be placed in the back of a horizontally-mounted TSA 8140 Test System Adapter. Two can be placed in the back of a vertically-mounted TSA 8140.

The 016-0862-00 accepts all TSI 8150 family scanner modules. One 016-0862-00 can be mounted inside the TSA 8140.

PHYSICAL CHARACTERISTICS

	ACR		AMU	
Dimensions	**mm**	**in**	**mm**	**in**
Width	483	19.0	483	19.0
Height	178	7.0	222	8.8
Depth	267	10.5	86	3.4
Weight	**kg**	**lb**	**kg**	**lb**
Net	4.8	10.5	2.3	5.0
Ship	5.5	12.0	2.7	6.0

TSS40 SCANNER CONTROL ASSEMBLY

The TSS40 Scanner Control Assembly simplifies the system builder's task of controlling switches. In the Tektronix TSI 8150 family of scanners, each TSS40 controls one scanner card or up to two modules of the same type.

Switch control can be immediate or stored by use of either scan or sequence mode. In the immediate mode, commands from the host GPIB controller directly program the switches. In the stored mode, the switches can be scanned one relay at a time or a sequence of up to 500 steps can be preprogrammed. With this buffer, the sequence can open or close more than one switch with each step.

In either storage mode, a single command or one of 12 hardware triggers can increment the test sequence. The output latch provides a TTL-latched output to drive the scanners. In the immediate or stored modes, TSI 8150 mainframe hardware synchronizes all switch state changes at each step. A single command can change the state of up to 768 switches.

The control section performs timing functions, senses the scanner type that the TSS40 is controlling, and provides programmable make-before-break or break-before-make control. The trigger-line select block is a programmable matrix that selects the lines that will trigger the TSS40.

Though designed to control scanners in the TSI 8150 family, the TSS40 can be used in a variety of special applications. In standalone applications, the TSS40 provides a TTL-compatible, 32 bit digital output and a 5 bit digital input interface. Typical applications are 32 bit pattern generation and reading an encoded word on interchangeable test heads (to assure installation of the proper test head).

The TSS40 includes two program maskable output signals. Both are wire-ORed with the outputs of other scanner control assemblies. The READY line signals a change in the switch pattern and then starts a timer preset for the switch closure and bounce time. After the preset time has passed, the READY line signals the establishment of a new path. The SEQUENCE-DONE line signals completion of the last pattern in the switch storage buffer.

At power-up, the TSS40 reads a relay code from the scanner card or module(s) that it controls. From this code, the TSS40 checks an internal table to determine the switch settling time and card configuration. When driving custom relays, the user can program the TSS40 with the switch settling time.

POWER REQUIREMENTS

The TSI 8150 mainframe or the TSX 8140 Expansion Chassis provides power to the TSS40.

TSD42 DIGITAL INTERFACE

The TSD42 can be used to interface other TSI 8150 system components to the DUT. The card provides 32 parallel non-isolated TTL input lines and 32 parallel non-isolated output lines. All signal lines have transient protection networks to prevent card damage when operated in adverse environments.

The 32 bit output port of a TSS40 Scanner Control Assembly provides the output data, in either immediate mode or from pre-stored patterns in the 500-step scanner sequence buffer. The input word is multiplexed and read through the TSS40's "relay type" input.

Control for the TSD42 is provided by a TSS40 mounted in a TSI 8150 Mainframe or TSX 8140 Expansion Chassis. The TSD42 can be mounted on the TSS40, or externally connected by a ribbon cable up to 12 meters long.

TSI FAMILY SCANNER/SWITCH CARDS

The TSI 8150 family of scanner cards are controlled by a TSS40 Scanner Control Assembly mounted in a TSI 8150 Test System Interface mainframe. Each card can be mounted in a TSI 8150 mainframe, or mounted outside and connected to the TSI 8150 mainframe with a ribbon cable assembly, up to 12 meters (40 feet) long.

TSS41 LOW-LEVEL SCANNER CARD

The TSS41 Low-Level Scanner Card answers the system builder's need for multiplexing low-level signals. The differential thermal EMF (electromotive force) is $\leq$ 40 μV ($\leq$ 1 μV with Option 01). In its standard configuration, the TSS41 offers two 1x10 switch trees. Moving a jumper creates a 1x20 tree. An additional tree switch relay prepares the TSS41 for use in larger multiplexed systems by reducing parasitic capacitance when no channel in the 1x20 branch is selected.

The TSS41's ability to simultaneously switch two signal lines plus guard per channel lets you drive balanced inputs to DUTs. The guard line isolates capacitance around the signal channels and thereby improves bandwidth.

The standard TSS41 is well suited for applications as diverse as checking balanced transmission lines in audio testing and making transducer measurements in mechanical stress testing. The optional 1 μV differential thermal offset makes the TSS41 especially useful for many transducer measurements and most differential signal test set-ups designed to eliminate common mode problems.

TSS41 Board layout optimizes matching of parasitic capacitances of high and low signal paths to provide well-balanced quality routing for critical signals.

TSS42 GENERAL-PURPOSE SCANNER CARD

The TSS42 General Purpose Scanner Card is a highly configurable, long-life switch assembly. It performs the many routine but essential multiplexing chores that complex test systems require. This versatile card arranges the channels in one group of 1x8, four groups of 1x4, and three groups of 1x2. Each channel is a single wire.

The TSS42 uses long-life mercury-wetted switches, minimizing system downtime for switch replacement. For users concerned about operating in mercury-prohibited environments or about mechanical positioning, Option 01 offers dry-reed switches in the same switch configuration.

Printed circuit pads near the switches let you attach snubber networks for switching inductive loads.

The TSS42's many special features make it suited to a variety of applications. The long life, bounceless operation, consistent channel resistance over switch life and configuration flexibility qualify the TSS42 for many demanding manufacturing ATE test set-ups.

Multiple channels permit such uses as functional board testing. Other special uses include: audio switching; low-current power-supply switching into the DUT; bias-voltage control; and operations such as component testing that require high-repetition, long-life operations.

TSS43 POWER SWITCH CARD

The TSS43 Power-Switch Card provides 10 independent switch lines designed to let you switch primary or secondary supplies to the DUT.

Each channel consists of one normally open (NO) and one normally closed (NC) contact. Transient suppressors are wired between each NO and common and each NC and common. These suppressors protect the contacts when the card switches inductive loads.

The TSS43 can switch up to 10 A or 250 V (rms), and is useful for switching power to the DUT. The most common use is dc or 60 Hz, but similar applications exist in 400 Hz avionic set-ups. A special use is switching miscellaneous units such as device handlers, solenoids, and other line-operated fixturing actuators. The TSS43 has a 60-A inrush surge rating, enabling it to switch loads such as a one-quarter horsepower 120 V ac motor.

TSD42

- *Low-Cost Digital Input/Output*
- *12 WPS Input/1K WPS Output*
- *Input and Output Latches*
- *All Signal Lines Protected*

TSS41

- *One 1x20 or Two 1x10 Switch Trees*
- *Multiplexes Signals with Differential Thermal Offset Down to 1 μV*
- *Offers Fast Settling Time for High Throughput*
- *Switches High, Low, and Guard*

TSS42

- *30 Cost-Effective Channels for Configuration Flexibility*
- *Bounceless Mercury-Wetted Contacts for Long Switch Life*
- *Consistent Channel Resistance (± 20 mΩ Typical) Over Switch Life for Greater Test Reliability*
- *Dry-Reed Version (Option 01)*

TSS43

- *Ten Independent Power Channels for Primary and Secondary Power Switching*
- *Transient Suppressors for Switch Protection with Inductive Loads*
- *Switches dc through 400 Hz for Applying Power to a DUT*
- *High-Power Switch Applications (250 V, 10 A, 2000 V A)*
- *Useful for System Power Up Sequencing*

TSS48

- *Choice of 5x6 or 2x16 Switch Topologies*
- *Choice of Bounceless Mercury-Wetted Switches for Long Switch Life, or Dry-Reed Switches for Mercury-Prohibited or Position-Sensitive Environments*
- *Consistent Channel Resistance (± 20 m Ω Typical) over Switch Life for High Repeatability*

TSI 8150 FAMILY SCANNER CARD SELECTION GUIDE

Features	TSS41	TSS42	TSS43	TSS48
Thermal Offset	Std: < 40 µV differential (< 80 µV with tree switch); Opt 01: < 1 µV (< 2 µV with tree switch)	< 100 µV	< 100 µV	< 100 µV
Maximum Current, Switched/(Carry)	500 mA dc or peak ac/(1A)	1 A dc or peak ac/(2 A)	10 A dc; 60 A surge for 2 ms/(10 A)	1 A dc or peak ac (2 A)
Maximum Switched Voltage	250 V dc or pk ac; 175 V rms	400 V dc or pk ac (250 V Opt. 01)	150 V dc; 250 V rms	400 V dc or pk ac (250 V Opt. 01 and 03)
Maximum Switched Power	10 W	50 VA	2000 VA	50 W
Dielectric Standoff	300 V rms, 400 V dc or peak ac	300 V rms, 400 V dc or peak ac	300 V ac, 400 V dc	300 V rms, 400 V dc or peak ac
Settling Time	4 ms	4 ms	51 ms	4 ms
Channel Resistance (total circuit)	< 1.8 Ω (each wire)	< 150 m Ω < 250 m Ω*1	< 150 m Ω	< 150 m Ω < 250 m Ω*1
Switch Life	10^8 @ signal level 10^6 @ rated load	10^9 @ signal level 10^7 @ rated load 10^8 @ signal level*1 10^6 @ rated load*1	$3x10^7$ mechanical 10^5 @ rated load	10^9 @ signal level 10^7 @ rated load 10^8 @ signal level*1 10^6 @ rated load*1
Switch Closures	20 3PST (high, low, and guard)	30 SPST	10 SPDT	30 SPST 32 SPST*2
Power Requirements 24 V dc supplied from TSI 8150, TSX 8140, or external source				
Environmental Operating: 0°C to +50°C; Nonoperating: – 40°C to +75°C				

*1 *Option 01 (and 03 for TSS48)*
*2 *Options 02 and 03*

TSS48 MATRIX SWITCH CARD

The TSS48 Matrix Switch Card is designed to route a variety of signals, and is suited to testing a varied series of DUTs or anywhere a full crossbar matrix is needed. Flexibility is provided by the choice of 5x6 (standard and Option 01) or 2x16 (Options 02 and 03) matrix configurations. Each cross point is a single wire.

Each row and column is connected to two connectors, allowing easy expansion of the matrix in a row dimension, the column dimension, or both dimensions by adding TSS48 cards. Each switch trace on the printed circuit board includes blank pads so you can install snubber networks for switching inductive loads.

The standard (and Option 02) switches are long-life, mercury-wetted relays. These relays minimize system down-time for switch replacement. Options 01 and 03 substitute dry-reed switches in place of the mercury-wetted contacts. This substitution allows operation in environments that prohibit the use of mercury, or in mechanical position-sensitive applications.

The long life, bounceless operation, consistent channel resistance over the life of the switch, and configuration flexibility qualify the TSS48 for many demanding manufacturing ATE test set-ups. The large number of channels available supports applications such as functional board testing. Other special uses include: audio switching; low-current power supply switching to the DUT; bias-voltage control; operations that require high repetition and long-life, such as component testing.

RELAY DRIVER CARDS

021-0417-00 HIGH-CURRENT DRIVER CARD
021-0418-00 60-mA DRIVER CARD

The 021-0417-00 and 021-0418-00 driver cards conveniently interface user-supplied relays and other devices to the TSI 8150 Test System Interface mainframe. The 021-0417-00 switches up to 1 A per channel; the 021-0418-00 switches up to 60 mA per channel. Each driver card provides printed circuit board prototyping features for users who want to interface their own relays into the TSI 8150 Test System Interface family.

Typical uses for these cards include operating special relays such as optical switches, microwave transfer switches, and picoamp low-current switches. Other uses include driving dc devices such as air valves, solenoids, handlers, and actuators. These cards provide easy interface of the devices to the General Purpose Interface Bus (GPIB) IEEE Standard 488.

The card's output drivers contain internal diodes that clamp the back EMF generated by a relay-coil opening to the coil supply voltage. Coil voltage for the relays passes through a limiting fuse. The return path connects to chassis ground.

All of the TSS40 command functions are available for the driver cards. The configuration command always returns 1 of 24. On the 021-0417-00, multiple switch channels can be closed simultaneously, providing the total current does not exceed 4 A. Other features available on these prototype cards include: sequence storage, break-before-make and make-before-break capability, timing control, and user-programmable bounce timing.

The driver cards are controlled by a TSS40 Scanner Control Assembly mounted in a TSI 8150 mainframe. The cards can be mounted in the TSI 8150 mainframe, or mounted outside and connected to the TSI 8150 mainframe with a ribbon cable assembly, up to 12 meters (40 feet) long.

TSI FAMILY SCANNER MODULES

The TSI scanner modules are controlled by a TSS40 Scanner Control Assembly (SCA) mounted in a TSI 8150 Test System Interface or TSX 8140 Expansion Chassis mainframe. Each module has an expansion connector that allows a second identical module to be controlled by the same TSS40.

The modules can be mounted in a TSI 8150 or TSX 8140, or externally in an Auxiliary Mounting Unit or Test Head Receiver frame. Remote mounting up to 12 meters (40 feet) from the TSS40 is possible.

A 50-conductor ribbon cable assembly provides control from the TSS40 to the module, and from module-to-module when in the extended (two modules controlled by one TSS40) mode of operation. A control cable approximately 21 inches long is included with each module; longer cables are required for external (remote) mounting.

Two extended cable accessories are available: part number 198-5581-01 provides six pre-assembled 2 meter (6 feet) cables; part number 198-5579-01 is a kit that includes 30. 5 meters (100 feet) of ribbon cable and 24 connectors.

TSS44 COAX SCANNER MODULE

The TSS44 Coax Scanner Module multiplexes moderate bandwidth signals through shielded conductors, using coaxially shielded relays arranged in two 1x6 trees. Each channel consists of one switched signal wire and an unswitched shield that is common to the other shields in the same tree. To eliminate low-frequency ground loops, the shield common is isolated from chassis ground.

TSS45 RF SCANNER MODULE

The TSS45 RF Scanner Module provides 6-to-1 multiplexing of VHF/UHF signals in either 50 Ω or 75 Ω environments. Two independent 1x6 trees contain the switches. Each channel consists of a switched center-conductor, and an unswitched shield that is common to the other shields and chassis ground.

The binary tree switching technique used allows selection of only one channel at a time in each tree. This eliminates unterminated stubs and equalizes path lengths through all channels.

In the standard and Option 01 units, both switch trees include a port that can be used to terminate the commons line when no switch is selected. One of the termination connectors can also be jumpered to the other switch tree's common line to form a 1x12 switch tree with reduced specifications.

Option 02, available only with 50 Ω switches, provides eight back-terminated channels, arranged in two 1x4 switch trees. A similar binary switching method is used, with the switch contacts arranged so the signal lines are terminated in 50 Ω when not selected. The terminators do not affect switch specifications or performance when the signal line is connected. The port for terminating the commons is not available with this option.

The TSS45 can be used in areas such as: time-domain and frequency-domain testing across the UHF range; frequency-domain device testing with no switch characterization required in the HF and VHF ranges; routing single-ended logic signals (for example, in GaAs testing); testing general communications equipment; video distribution and routing of video test signals (75 Ω option).

RELAY DRIVER CARD

- *Control up to 24 User-Supplied Relays for Custom Applications*
- *Open Collector, NPN Darlington Drivers*
- *Allow 24 Channels of Control for Solenoids, Actuators, Handlers, and Other Devices*
- *Low-Voltage Detection Circuit Generates Error Message if Power Supply Fails*
- *Blank Prototype Area for User Wiring*
- *Back EMF Diodes for Switching Inductive Loads*

TSS44

- *Two Independent 1x6 Trees*
- *Shield-Common Isolated from Chassis Ground, Preventing Low-Frequency Ground-Loop Problems*
- *High Level of Isolation and Low Crosstalk for Low-Level Measurements*
- *BNC Connectors for Easy and Economical Interconnections*

TSS45

- *Two Independent 1x6 Binary Switch Trees (Standard and Option 01)*
- *Choice of 50 Ω or 75 Ω Switching Environments, for ATE, Data Acquisition or Video Switching*
- *Wide Bandwidth for TDR and Communication Frequency Tests*
- *Back-Termination Available (Option 02) in 1x4 Switch Topology*

TSS46

- *18 GHz Bandwidth (-0.5 dB) for Microwave Test Setups*
- *Two Independent 1x6 Switch Trees*
- *SMA Connectors for Attaching Flexible and Semi-Rigid Coaxial Signal Paths*
- *Back-Terminated Option Available*

TSS46 MICROWAVE SCANNER MODULE

The TSS46 Microwave Scanner Module provides an extremely wide bandwidth (18 GHz), with flat frequency response. These attributes allow use in systems with reduced bandwidth requirements without concern for insertion loss or risetime degradation.

The TSS46 is matched for use in 50 Ω environments. Each module contains two independent 1x6 switch trees. Each channel consists of a switched center-conductor and an unswitched shield that is common to the other shields and to chassis ground.

The TSS46 allows more than one channel in a switch tree to be connected to Common at a time. Any two channels in a tree can be closed concurrently with a 100% duty factor. More than two channels in a tree can be closed concurrently, but with an unspecified duty factor. Duration of relay activation when using three or more channels concurrently should not exceed 1 minute.

An option provides back-termination for all twelve channels. The switch contacts are arranged so that each signal line is automatically terminated in 50 Ω when its switch is open. Switch performance and specifications are not affected when the switch is closed.

The TSS46 is useful in applications such as: UHF and low-end microwave testing without switch characterization; multiplexing of TDR tests for hybrid, stripline, microstrip, and controlled-impedance testing; broadband parametric testing that requires two switches to be closed concurrently.

TSI 8150 FAMILY SCANNER MODULE SELECTION GUIDE

Features	TSS44	TSS45 (Std.)	TSS45 (Opt 1)	TSS46
Insertion Loss (any port to common)	< 0.1 dB @ 100 kHz < 0.25 dB @ 50 MHz < 1.0 dB @ 200 MHz	< 0.75 dB @ 800 MHz < 1.0 dB @ 1.2 GHz < 3.0 dB @ 2 GHz	< 0.75 dB @ 400 MHz < 1.5 dB @ 1.0 GHz	< 0.1 dB @ 3.0 GHz < 0.3 dB @ 12 GHz < 0.5 dB @ 18 GHz
Channel Isolation any port to common)	> 80 dB @ 100 kHz > 45 dB @ 50 MHz > 40 dB @ 200 MHz	> 60 dB @ 800 MHz > 50 dB @ 1.2 GHz > 40 dB @ 2.0 GHz	> 60 dB @ 700 MHz > 50 dB @ 1.0 GHz	> 90 dB @ 3.0 GHz > 70 dB @ 12 GHz > 60 dB @ 18 GHz
Crosstalk Isolation (between any two ports with common and all unused ports terminated)	> 80 dB @ 100 kHz > 45 dB @ 50 MHz > 40 dB @ 200 MHz	> 60 dB @ 800 MHz > 40 dB @ 1.2 GHz > 30 dB @ 2.0 GHz	> 60 dB @ 700 MHz > 50 dB @ 1.0 GHz	> 90 dB @ 3.0 GHz > 70 dB @ 12 GHz > 60 dB @ 18 GHz
VSWR (any port to common)	< 1.05:1 @ 100 kHz < 1.2:1 @ 50 MHz < 2.1:1 @ 200 MHz	< 1.3:1 @ 800 MHz < 1.5:1 @ 1.2 GHz < 3.5:1 @ 2.0 GHz	< 1.5:1 @ 400 MHz < 2.3:1 @ 1.0 GHz	< 1.1:1 @ 3.0 GHz < 1.3:1 @ 12 GHz < 1.5:1 @ 18 GHz
Maximum Switched Current	500 mA dc or peak ac	1.0 A dc or peak ac	1.0 A dc or peak ac	50 mA dc or peak ac
Maximum Switched Voltage	150 V dc or peak ac	24 V dc or peak ac	24 V dc or peak ac	15 V dc or peak ac
Maximum Carry Current	1.0 A			3.0 A
Maximum Switchable Power	10 W (resistive); 200 mW (RF into mismatched load)	10 W (RF into 50 Ω); 5 W (RF into mismatched load)	10 W (RF into 75 Ω); 5 W (RF into mismatched load)	125 mW (RF into 50 Ω)
Maximum Carry Power	500 mW (RF into 50 Ω)	10 W (RF into 50 Ω); 5W (RF into mismatched load)	10 W (RF into 50 Ω); 5W (RF into mismatched load)	450 W to 100 MHz; 200 W to 700 MHz; 100 W to 3.5 GHz 50 W to 18 GHz
Dielectric Standoff	250 V dc or peak ac	50 V dc or peak ac	50 V dc or peak ac	50 V dc or peak ac
Switch Life	$5x10^7$ operations	10^5 operations	10^5 operations	10^6 operations
Settling Time	4 ms	31 ms	31 ms	41 ms
Power Requirements	24 V, from dc coil supply in TSI 8150, TSX 8140, or from external source			
Environmental	Operating: 0°C to +50°C; Nonoperating: – 40°C to +75°C			

P6513/P6517 PROBE SCANNER SUPPORT KITS

Optional probe scanner accessory kits are available for the TSS44 and TSS45. These kits provide hardware support to let the TSS44 and TSS45 scan *P6513* and *P6517* Spring Contact Probes. These 10X probes provide high bandwidth, low circuit-loading signal acquisition (300 MHz, 1 M Ω, < 3.8 pF for the P6513). The P6513 is designed for mounting on 100-mil centers, the P6517 for 50-mil mounting. The P6513 and P6517 are described in more detail in the Accessories Section of this catalog beginning on page 383.

With the probe scanner kits, a fully-automated, GPIB-controlled, vacuum-operated bed-of-nails test fixture with low circuit loading and high bandwidth can be built. The TSS44 and TSS45 Scanner Modules used in conjuction with these kits are installed in an 021-0435-00 Test Head Receiver; an interchangeable test adapter (ITA) supplied by Virginia Panel Corporation is also required.

Two kits are available: 021-0444-00 is the basic kit, one of which is required for each system. Each 021-0444-00 kit includes a 12-probe carrier (mounting assembly) and a power connector that mount in the ITA; a mating power connector that mounts in the Test Head Receiver; and a power regulator board that mounts in the TSI 8150. The 021-0444-00 kit includes all the hardware needed for interfacing and powering twelve probes.

Additional ITAs, for different applications, can then be built using 021-0443-00 kits. The 021-0443-00 kit includes the probe carrier and the ITA power connector module.

For more information on the Interchangeable Test Adapters, contact a Tektronix Sales Representative or call Virginia Panel Corporation. Virginia Panel's headquarters can be reached at (703) 949-8376.

TSI 8155 TEST SYSTEM INTERFACE PACKAGE

The TSI 8155 Test System Interface Package is a collection of TSI family hardware, selected to simplify the job of building a test system. The TSI 8155 package by itself can provide a complete test interface and fixturing solution; its "add-on" flexiblity serves a wider variety of testing applications.

The package is based on the TSI 8150 Test System Interface. Standard hardware includes switch cards, auxiliary mounting units, a test system adapter, interchangeable test adapters, plus all the cables and connectors needed to complete the interface. The basic package provides DMM switching, power supply switching, and general-purpose switching. Tree and matrix switching are supported for both stimulus and measurement.

Options are available for adding high-frequency switching up to 18 GHz. The switches are mounted right in the TSA 8140 Test System Adapter, using the 016-0862-00 Auxiliary Mounting Unit. This provides a benefit unique to Tek and the TSI 8150; switching right at or very near the DUT. The reduced cable lengths to the DUT, plus the additional shielding of the TSA 8140, yields a major improvement in signal integrity.

Deluxe coaxial and RF option kits enhance signal integrity and convenience even more; switches are mounted in a 021-0435-00 Test Head Receiver, then interfaced to the DUT with a TSA F11 High-Frequency Quick Connect. This eliminates one set of connectors and some cabling.

The DMM, power supply, and general-purpose switches are remote-mounted too, using the 016-0861-00 Auxiliary Card Rack. An added advantage of remote switch mounting is that it frees the TSI 8150 mainframe to be mounted in the most convenient place, thus optimizing valuable rack space.

Switches can be mounted up to 24 feet from the mainframe without affecting switch performance. The standard package comes with a 198-5579-01 Extension Cable Kit. This kit includes 100 feet of switch control wire (50-lead ribbon cable) and 24 connectors, enough for twelve control cables.

Each scanner card is customer-wired to a 64-pin Virginia Panel Corporation connector module installed in the Test Head Receiver. Each of two 021-0447-00 GP Virginia Panel kits provides 128 36-inch signal patchcords for this purpose. Mating connector modules and signal pins for DUT interconnection are also provided.

The TSI 8150 mainframe provides the GPIB interface and power supply for all the switching cards and modules. The basic system configuration uses six of the twelve available slots in the mainframe. These slots hold the six TSS40 Scanner Control Assembly (SCA) cards that control six switch cards mounted in the Auxiliary Card Rack. When optional coaxial, RF, or microwave scanners are added, more TSS40 cards are mounted in the TSI 8155 mainframe.

P6513/P6517
Probe Scanner Support Kits

- *Combines Functional and In-Circuit Testing for Low to Medium Volume Applications*
- *Quickly and Easily Reconfigure Test Systems for Diverse Applications*
- *Wide-Bandwidth Probes with Low Circuit-Loading Characteristics Provide High-Frequency, Low-Aberration Testing*

TSI 8155

- *Standard Switching for DMMs, Power Supplies, Oscilloscopes, Counters, Signal Sources, and All Signals to 2 MHz*
- *Package Options Provide Switching and Configuration for Coaxial, RF, and Microwave Signals to 18 GHz*

ORDERING INFORMATION

TSI 8150 Test System Interface $3,595
Includes: Rackmounting hardware; User's Manual; Configuration manual; Programmer's reference guide; Power cord.

TSI 8155 Test System Interface Package $15,995
Includes: (1) TSI 8150; (6) TSS40; (1) 198-5579-01 Extension Cable Kit; (1) 016-0861-00; (1) 016-0862-00; (2) TSS41; (2) TSS42; (1) TSS43; (1) TSS48; (1) TSA 8140; (1) TSA F01; (1) 021-0435-00; (1) TSA F09; (1) TSA F10; (1) 021-0434-00; (2) 021-0447-00 GP Virginia Panel Kits

TSX 8140 Expansion Chassis $3,250
Includes: Rackmounting hardware; Instruction sheet; TSI 8150 interconnection cable and buffer board; Ground strap; Power cord.

TSA 8140 Test System Adapter $575

016-0861-00 Auxiliary Card Mounting Rack $330

016-0862-00 Auxiliary High-Frequency Mounting Unit $180

TSD42 32 bit General-Purpose Digital Interface Card $450

TSS40 Scanner Control Assembly $305

TSS41 Low-Level Scanner Card $655

TSS42 General-Purpose Scanner Card $695

TSS43 Power Switch Card $495

TSS44 Coax Scanner Module $695

TSS45 RF Scanner Module $400

TSS46 Microwave Scanner Module $2,095

TSS48 Matrix Switch Card $725

021-0417-00 High-Current Driver Card $395

021-0418-00 60 mA Driver Card $295

OPTIONS

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

TSI 8155

Opt. 01 – Adds Basic Coaxial Kit +$2,295
Opt. 02 – Adds Deluxe Coaxial Kit +$2,995
Opt. 03 – Adds Basic RF Kit +$2,995
Opt. 04 – Adds Deluxe RF Kit +$3,995
Opt. 05 – Adds Microwave Kit +$10,495
Opt. 09 – Adds Digital I/O Kit +$1,525

TSS41/TSS42/TSS43/TSS48

Opt. 10 – Delete Front Panel (for installation in Auxiliary Card Rack) NC

TSS41

Opt. 01 – Substitute 1 μV thermal differential relays +$425

TSS42/TSS48

Opt. 01 – Substitute dry-reed relays NC

TSS44/TSS45

Opt. 09 – Move output commons to rear panel NC

TSS45

Opt. 01 – Substitute 75 Ω relays +$125
Opt. 02 – Add back-termination +$125

TSS46

Opt. 02 – Add back-termination +$525

TSS48

Opt. 02 – Substitute 2x16 matrix configuration NC
Opt. 03 – Substitute dry-reed relays in 2x16 matrix NC

OPTIONAL ACCESSORIES

System Service Manual – Order 070-5767-01 $50
Card Extender (Service) – Order 067-0162-00 $150
Auxiliary Card Mounting Rack – For TSD42, TSS41, TSS42, TSS43, TSS48, 021-0417-xx, and 021-0418-xx. Order 016-0861-00 $330
Auxiliary HF Mounting Unit – For TSS44, TSS45, and TSS46. Order 016-0862-00 $180
Extension Cable Kit: – Incl. 30.5 m (100') of cable and 24 connectors. Order 198-5579-01 $450
Extension Cable Assembly – Six 2-meter (6.5') extension cables. Order 198-5581-01 $300
Test Head Receiver – Compatible with test fixtures from Virginia Panel. Order 021-0435-00 $3,250
Interchangeable Test Adapters –
Full-size: Order 021-0434-00 $550
Half-size: Order 021-0436-00 $595
Extended-frame: Order 021-0441-00 $795
TSA F01: Rackmounting Hardware Kit for TSA 8140 $195
TSA F02: Hybrid Fixture (leveling) Kit for TSA 8140 $350
TSA F09: Universal LF Quick Connect $425
TSA F10: LF Quick Connect $425
TSA F11A: HF Quick Connect $450
ITA/Rcvr/Power Probe Scanner Kit – Complete support kit. Order 021-0444-00 $350
ITA Probe Scanner Kit – Support for additional ITAs. Order 021-0443-00 $125
Virginial Panel Fixturing Kits – Contact Tek Sales Representative for detailed descriptions.
128-Ch. Signal/4-Ch. Power Kit –
Order 021-0447-00 $450
128-Ch. Bed-of-Nails Kit – Order 021-0448-00 $195
Interface Tool Kit – Order 021-0450-00 $1,800
24-Ch. RF Kit – Order 021-0454-00 $595
8-Ch. Microwave Kit – Order 021-0455-00 $2,225

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

PEP 201 SYSTEMS CONTROLLER

The PEP 201 Systems Controller brings 32 bit 80286 data-acquisition and processing power to instrument systems control. The PEP 201 processing power is essential to acquiring data and converting it to engineering units. The PEP 201 has disk, memory, and processor speeds optimized for controller applications that do not require the power or speed of the 80386 16 MHz PEP 301 or 20 MHz PEP 303.

PEP 201 GPIB hardware and software make the controller productive quickly. GURU II software provides flexible instrument access through interpreted BASIC or Menu selection. GURU II Signal Processing and Display functions provide access to waveform acquisition, analysis, arithmetic, and display on a variety of hardcopy devices.

For applications needing more speed than the interpreter can provide, GURU II connects to compiled BASIC. Supplemental software provides the link to Microsoft QuickBASIC.

The display card and the 14 inch monochrome monitor provide maximum compatibility with TekWare and other software while providing capability to meet demanding graphics needs.

PEP 201 SOFTWARE

MS-DOS Operating System

MS-DOS version 3.3 is upwardly compatible with MS-DOS 3.2 and provides new commands and extensions to existing ones.

In addition to the extensions of MS-DOS, added commands include a system speed command, to set the speed of the processor to 8 or 12 MHz clock speed. This allows speed-dependent programs written for a PC/XT, for example, to be executed properly on the PEP 201.

GW-BASIC Language Interface

GW-BASIC, like BASICA, allows quick interactive programming in interpreted BASIC. GW-BASIC provides additional screen modes. The screen editor is improved with help modes and improved editing.

The Tektronix PEP 201 System Controller

SYSTEM UNIT

The main processor uses a 12 MHz Intel 80286 32 bit processor. The 1 MByte of Random Access Memory uses interleaving and 120 ns access parts with one wait state. The 3.5" 720 KByte floppy along with the 20 MByte Hard Disk supply ample storage for demanding controller task.

Keyboard

The system keyboard is a 101 key "Enhanced AT" style with key click and tactile feel.

Display System

The display controller installed in the systems unit has 256 KBytes of video memory, a high resolution 640 X 480 mode, and is fully compatible with IBM EGA Standard.

GPIB Applications Software

GURU II+ includes a Test-procedure generator, Menus mode for selecting pre-written BASIC routines, as well as Tektronix Digitizer support for 2220, 2221, 2230, 2430, 2430A, 2440, 336, 390AD, 468, 494P, 5223, 7D20, 7912AD, 7854, 11401, 11402 and RTD 710.

Ordering Information on Page 323

PEP 201

- *12 MHz Intel 80286 System*
- *1 MByte Memory*
- *720 KByte Floppy*
- *20 MByte Hard Disk*
- *Serial Port*
- *Parallel/Printer Port*
- *14-inch EGA Mono-Graphics Display U.S. Only*
- *101 Key Advanced Keyboard*
- *Controllable Clock Speeds*
- *GURU II Software*
- *Clock Calendar w/Battery Backup*
- *All Software Pre-Installed*
- *Tektronix 1 Year Warranty*
- *800 Hotline Support*
- *Up to Four Hours with a Tektronix Trained Application Engineer*

GPIB* IEEE-488

**The PEP 201 complies with IEEE Standard 488.2 and Tektronix Standard Codes and Formats*

PEP 301

- *16 MHz Intel 80386 System with the 80387 Co-Processor*
- *2 MByte Memory – Expandable to 4 MBytes*
- *40 MByte Hard Disk and 1.2 MByte High Density Floppy Disk*
- *14-inch Color Graphics Display with CGA, EGA, and 800 X 600 Resolution Modes*
- *Detached 101 Advanced Keyboard with Tactile Keys*
- *Clock Speed Controllable to 4.77, 6, 8, or 16 MHz to Permit Maximum Compatibility with Existing User Software*
- *GURU II Software for Easy GPIB Access and Control*

L to R, PEP 301, PEP 301R, in a rack, PEP 303

GPIB IEEE-488 *

- *GPIB Interface Board for 488 IEEE Instrument Control*
- *Clock/Calendar w/Battery Backup*
- *All Software Pre-Installed and Integrated on the Hard Disk*
- *Tektronix 1 Year Warranty*
- *800 Hotline Support*
- *Up to Four Hours with a Tektronix Trained Application Engineer*

**The PEP 301 complies with IEEE Standard 488.2 and Tektronix Standard Codes and Formats*

PEP 301 SYSTEMS CONTROLLER

The PEP 301 Systems Controller brings 32 bit 80386/80387 data-acquisition and processing power to instrument systems control. With processing power 3-4 times a standard 12 MHz 80286-based system, tasks that took too long or were too big to tackle, become reasonable. Computation is an important part of the task of a controller when used to help analyze the data. The processing power is also essential to acquire data and convert it to engineering units. The PEP 301 has disk, memory, and processor speeds optimized for demanding applications.

GPIB hardware and software make the controller productive quickly. GURU II software provides flexible instrument access through interpreted BASIC or Menu selection. Signal Processing and Display functions GURU II provide access to waveform acquisition, analysis, arithmetic, and display on a variety of hardcopy devices. GURU II software includes six applications programs written in interpreted BASICA. They may be used as is or modified by the user.

For applications needing more speed than the interpreter can provide, GURU II connects to compiled BASIC. Supplemental software provides the link to Microsoft QuickBASIC.

MS-DOS compatibility protects users investment in existing instrument control software, and of other software used in the Engineering environment that run on PC/XT, PC/AT, or compatibles.

PEP 301 HARDWARE

System Unit

The main processor uses a 16 MHz Intel 80386 32 bit processor and 80387 numeric coprocessor. The 80387 supports the instruction set of both the 80287 and 8087, offering additional enhancements that include full compatibility with the IEEE Floating-Point Standard, draft 10. The performance of a 16 MHz 80387 is about eight times faster than a 5 MHz 80287.

The 2 MBytes of Random Access Memory in the PEP 301, uses interleaving and 100 ns access parts to keep the processor from having to wait for instructions or data–zero wait states.

Memory includes 1 MByte above the 1 MByte address space that can be configured to conform to the Lotus/Intel/Microsoft Expanded Memory Standard. Many applications, such as Framework II and Lotus 1-2-3, use Expanded Memory (EMS area) for data.

Upon initialization, the ROM BIOS is loaded into random-access high memory. By loading a copy of the BIOS into zero-wait-state memory, performance is kept at top operating speed. To aid set-up, CMOS RAM retains stored settings, and "INSTAL" utilities simplify installing memory management, RAM drivers, and hard disks. Set-up is through simple menu and form-fillout sequences.

Mass storage peripheral space, in addition to the 40 MByte Hard disk, is available for up to two more half-height or one more full-height disk. This means that the system can expand to meet future growth needs.

Keyboard

The system keyboard is a 101 key "Enhanced AT" style with key click and tactile feel.

Display System

The display controller installed in the systems unit has 256 KBytes of video memory providing 16 colors out of a palette of 64. The display card and the monitor (a multi-sync display) provide maximum compatibility with TekWare and other software while providing capability to meet demanding color graphics needs.

PEP 301 SOFTWARE

MS-DOS Operating System

MS-DOS version 3.3 is upwardly compatible with MS-DOS 3.2 and provides new commands and extensions to existing ones.

In addition to the extensions of MS-DOS, added commands include:

System speed command, to set the speed of the processor to 4.77, 6, 8, or 16 MHz clock speed. This allows speed-dependent programs written for a PC/XT, for example, to be executed properly on the PEP 301. In the "Smart" mode, the PEP runs at 16 MHz until floppy-disk access is required. This assures reading floppy disks brought from other PC compatible products.

Memory manager for installing and using memory above the 1 MByte address limit following the Lotus/Intel/Microsoft standard.

GW-BASIC Language Software

GW-BASIC, like BASICA, allows quick interactive programming in interpreted BASIC. In addition to features found in IBM Advanced BASIC, GW-BASIC provides additional screen types including MGA (monochrome graphics adaptor) modes. The screen editor is improved with help modes and improved editing.

PEP 301R

- *PEP 301 System Unit, Monitor, and Keyboard are Rackmountable Conforming to EIA RS-310 Standard*
- *101 Key Keyboard is Mechanically and Electrically Lockable*
- *All Disk Drives are Enclosed and Shock Mounted to Protect Them from Harsh Environments*

Ordering Information on Page 323

GPIB IEEE-488 *

**The PEP 301R complies with IEEE Standard 488.2 and Tektronix Standard Codes and Formats*

GPIB Applications Software

GURU II includes:

1. Test-procedure generation suited for Tektronix GPIB compatible instruments.
2. Menus mode for selecting pre-written BASIC routines for interrogating and transmitting information on the GPIB, string comparisons, waveform acquisition (in ASCII or binary format), waveform storage and recall from disk, plus nine other frequently needed functions.
3. Digitizer support for 2220, 2221, 2230, 2430, 2430A, 2440, 336, 390AD, 468, 494P, 5223, 7D20, 7912AD, 7854, 11401, 11402 and RTD 710.
4. Pulse-Analysis program to simplify characterizing waveform data by rise, fall, and commonly used pulse-measurement parameters.
5. Waveform storage in ADIF (Analog Data Interchange Format) common to it and Signal Processing and Display software (SPD) to simplify transferring data to signal processing environment.
6. Sample application the user can run as is or modify to meet individual needs.
7. Rise and fall-time pulse measurements with the 2445 and 2465 oscilloscopes.
8. Scope verification using the CG 5001 programmable oscilloscope calibration generator.
9. Audio-distortion analysis using the AA 5001 Programmable Distortion Analyzer and SG 5010 Programmable Oscillator.

Controller Feature Summary

FEATURE	301	301R
Processor	80386	80386
Speed	16 MHZ	16 MHZ
Co-Processor	80387	80387
Std. Memory	2 MB	2 MB
Speed	100 NS	100 NS
Wait States	0	0
Hard Disk	40 MB	40 MB
Access Time	28 MS	28 MS
Floppy Disk	5.25" 1.2 MB	5.25" 1.2 MB
Available Slots	3	3
14-inch Monitor	COLOR	COLOR
Graphics EGA	800x600	800x600
MS-DOS/GW-Basic	YES	YES
GURU II 3.1	YES	YES
EZ-Test PC 3.0*1	OPT11	OPT11
QuickBASIC 4.5*2	AVL	AVL
SPD 2.2*3	AVL	AVL
Windows/386	NO	NO
Mouse	NO	NO
Rackmountable	NO	YES
Extended Warranty	AVL	AVL
Price*4	$7995	$9995

*1 *Price of OPT11 is $395. EZ-TEST PC (S45F030) is $1795.*
*2 *QuickBASIC is not an Option, available as (S3FG500) $99.*
*3 *SPD is not an Option, available as (S3FG130) $995.*
*4 *Prices are USD.*

For more information on GURU II, SPD, and other TekWare MS-DOS software products, see the Test and Measurement Software section.

PEP 301 AND PEP 301R

MONITOR

The display monitor is an Automatic Synchronizing (multi-sync) display.

Scan Rates: Horizontal is 15.5 kHz to 37 kHz. Vertical is 45 Hz to 75 Hz.

Display Area: 250 mm by 180 mm

Dot Pitch: 0.31 mm

Video Bandwidth: 30 MHz

INTERFACES

Communications – Two RS-232-C serial ports: One 9-pin "D" male connector, one 25-pin male "D" connector. Programmable baud rate from 50 to 9600 baud. The GPIB port conforms to IEEE Standard 488.

Printer Interface – The printer connector is a Centronics-compatible 25-pin "D" female connector.

POWER REQUIREMENTS

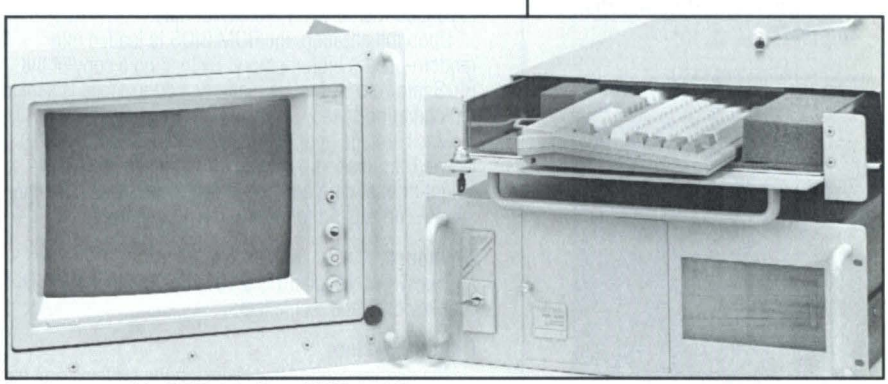
Power Consumption – System Unit: 200 W Display. Monitor: 85 W.

ENVIRONMENTAL

Temperature – Operating: -10°C to +40°C. Nonoperating: -10°C to +60°C.

Humidity – Operating: 20% RH to 80% RH noncondensing. Nonoperating: 10% RH to 90% RH noncondensing.

Altitude – Operating: to 10,000 feet. Nonoperating: to 15,000 feet.



Rackmountable PEP 301R or PEP 303R

PHYSICAL CHARACTERISTICS

	PEP 301/PEP 303						PEP 301R/PEP 303R					
	System Unit		Keyboard		Monitor		System Unit		Keyboard		Monitor	
Dimensions	mm	in.	mm	in.	mm	in.	mm	In.	mm	In.	mm	In.
Width	533	21.0	485	19.1	395	15.6	482.6	19.0	486.2	19.0	486.2	19.0
Height	165	6.5	19.1	0.8	291	11.5	177.8	7.0	88.9	3.5	355.6	14.0
Depth	432	17.0	208	8.2	400	15.8	609.6	24.0	609.6	24.0	546.1	21.5
Weights	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**
Net	19.0	41.9	2.7	6.0	14	30.8	26.3	58.4	9.8	21.7	20.6	45.8

PEP 303

- *20 MHz Intel 80386 System with the 80387 Co-Processor Standard*
- *2 MBytes Memory Standard – Expandable to 4 MBytes*
- *1.2 MByte H/D Floppy and 70 MByte Hard Disk*
- *Signal Processing and Display (SPD) Software for Waveform Analysis and Hardcopy*
- *Windows/386 for Multi-Tasking, and Graphical User Interface*
- *GURU II Software for Compatibility with Existing TekWare and User Written Software*
- *14-inch Color Graphics Display with CGA, EGA, and 800 X 600 Resolution Modes*
- *Detached 101 Advanced Keyboard with Tactile Keys*
- *Mouse*
- *Clock Speed Controllable to 4.77, 6, 8, 12, 16, or 20 MHz to Permit Maximum Compatibility with Existing User Software*
- *All Software Pre-Installed and Integrated on the Hard Disk*
- *Tektronix 1 Year Warranty*
- *800 Hotline Support*
- *Up to Four Hours with a Tektronix Trained Application Engineer*

PEP 303 System Controller

GPIB* IEEE-488

**The PEP 301 complies with IEEE Standard 488.2 and Tektronix Standard Codes and Formats*

PEP 303 SYSTEMS CONTROLLER

The PEP 303 Systems Controller brings windowed multi-tasking software to benchtop and laboratory data acquisition, data analysis, and instrument systems control.

GPIB hardware and software are included to make the controller productive quickly. GURU II software provides flexible instrument access through interpreted BASIC or Menu selection. Signal Processing and Display functions provide waveform acquisition, analysis, arithmetic, and display on a variety of hard copy devices.

As a PC based instrument controller, the PEP 303 preserves the usefulness of existing instrument control programs, and of many other programs used in the Engineering environment that run on PC/XT, PC/AT, or compatibles.

PEP 303 HARDWARE

System Unit

The main processor uses a 20 MHz Intel 80386 32 bit processor and 80387 numeric co-processor. The 80387 supports the instruction set of both the 80287 and 8087, offering additional enhancements that include full compatibility with the IEEE Floating-Point Standard, draft 10. The performance of a 20 MHz 80387 is about ten times faster than a 5 MHz 80287.

The 2 MBytes of Random Access Memory in the PEP 303, uses interleaving and 80 ns access parts to keep the processor from having to wait for instructions or data–zero wait states.

Memory includes 1 MByte above the 1 MByte address space that can be configured to conform to the Lotus/Intel/Microsoft Expanded Memory Standard. Many applications, such as Framework II and Lotus 1-2-3, use Expanded Memory (EMS area) for data.

Upon initialization, the ROM BIOS is loaded into random-access high memory. By loading a copy of the BIOS into zero-wait-state memory, performance is kept at top operating speed.

Mass storage peripheral space, in addition to the 70 MByte Hard disk, is available for up to two more half-height or one more full-height disk. This means that the system can expand to meet future growth needs.

Keyboard

The system keyboard is a 101 key "Enhanced AT" style with key click and tactile feel.

Display System

The display controller installed in the systems unit has 256 KBytes of video memory providing 16 colors out of a palette of 64. The display card and the monitor (a multi-sync display) provide maximum compatibility with TekWare and other software while providing capability to meet demanding color graphics needs.

PEP 303 SOFTWARE

Like the PEP 301 the PEP 303 controller software includes version 3.3 of the MS-DOS operating system, GW-BASIC language software, and the GURU II + GPIB applications software as well as the following:

- Window/386 to add graphical windows interface and multi-tasking.
- A text processing program for report preparation.
- A graphics drawing and editing program.
- A data communications program.
- Data acquisition, display and signal processing libraries (SPD).

Users can acquire waveforms from most Tektronix digitizers and perform signal analysis (FFT, IFT, etc.) and paste the graphics directly into engineering or quality control reports. With multi-tasking, up to 16 tasks can be operating on the PEP 303 at one time. Lengthy sorting, or communications transfers can be done in the background mode. Most important is the ability to connect the results of one application to another.

MS-DOS Operating System

MS-DOS version 3.3 is upwardly compatible with MS-DOS 3.2 and provides new commands and extensions to existing ones.

In addition to the extensions of MS-DOS, added commands include:

System speed command, to set the speed of the processor to 4.77, 6, 8, 16, or 20 MHz clock speed. This allows speed-dependent programs written for a PC/XT, for example, to be executed properly on the PEP 303. In the "Smart" mode, the PEP runs at 20 MHz until floppy-disk access is required. This assures reading floppy disks brought from other PC-compatible products.

Memory manager for installing and using memory above the 1 MByte address limit follows the Lotus/Intel/Microsoft standard.

GW-BASIC Language Interface

GW-BASIC, like BASICA, allows quick interactive programming in interpreted BASIC. In addition to features found in IBM Advanced BASIC, GW-BASIC provides additional screen types including MGA (monochrome graphics adaptor) modes. The screen editor is improved with help modes and improved editing.

GPIB Applications Software

GURU II includes:

1. Test-procedure generation suited for programmable power supplies, digital voltmeters, signal sources, and counters.
2. Menus mode for selecting pre-written BASIC routines for interrogating and transmitting information on the GPIB, string comparisons, waveform acquisition (in ASCII or binary format), waveform storage and recall from disk, plus nine other frequently needed functions.
3. Digitizer support for 2220, 2221, 2230, 2430, 2430A, 2440, 336, 390AD, 468, 494P, 5223, 7D20, 7912AD, 7854, 11401, 11402 and RTD 710.

PEP 303R SYSTEM UNIT

The PEP 303R System Unit is the same as the PEP 303 except for the following:

Mass storage and floppy disks are enclosed and protected from access of foreign material from the physical site with access doors.

Compared to the benchtop PEP 303 additional cooling and shock mounting are provided. Shock mounting extends the application of hard disks to more severe environments. Additional cooling not only provides additional air flow, but provides positive pressure inside the system unit to limit access to air-borne particulate material. See photo of PEP 303R on page 321.

PEP 303R KEYBOARD

The system keyboard is a 101 key "Enhanced AT" style with key click and tactile feel. The keyboard is mounted in a drawer that can be closed and locked to protect the system mechanically. When opened for access the edge of the drawer acts as a rest for the keyboard user's hands. See photo of PEP 303R on page 321.

PEP 303R DISPLAY SYSTEM

The PEP 303R display system is the same as the PEP 303 except for being rackmountable in a standard EIA rack. See photo of PEP 303R on page 321.

Controller Feature Summary

FEATURE	201	301	301R	303	303R
Processor	80286	80386	80386	80386	80386
Speed	12 MHZ	16 MHZ	16 MHZ	20 MHZ	20 MHZ
Co-Processor	NONE	80387	80387	80387	80387
Std. Memory	1 MB	2 MB	2 MB	2 MB	2 MB
Speed	120 NS	100 NS	100 NS	80 NS	80 NS
Wait States	1	0	0	0	0
Hard Disk	20 MB	40 MB	40 MB	70 MB	70 MB
Access Time	70 MS	28 MS	28 MS	28 MS	28 MS
Floppy Disk	3.5"	5.25"	5.25"	5.25"	5.25"
	720 kB	1.2 MB	1.2 MB	1.2 MB	1.2 MB
Available Slots	0	3	3	3	3
14-inch Monitor	MONO	COLOR	COLOR	COLOR	COLOR
Graphics EGA	640x480	800x600	800x600	800x600	800x600
MS-DOS/GW-Basic	YES	YES	YES	YES	YES
GURU II 3.1	YES	YES	YES	YES	YES
EZ-Test PC 3.0*1	OPT11	OPT11	OPT11	OPT11	OPT11
QuickBASIC 4.5*2	AVL	AVL	AVL	YES	YES
SPD 2.2*3	AVL	AVL	AVL	YES	AVL
Windows/386	NO	NO	NO	YES	YES
Moused	NO	NO	NO	YES	NO
Rackmountable	NO	NO	YES	NO	YES
Extended Warranty	AVL	AVL	AVL	AVL	AVL
Price*4	$3995	$7995	$9995	$9995	$11995

*1 *Price of OPT11 is $395. EZ-TEST PC (S45F030) is $1795.*
*2 *QuickBASIC is not an Option, available as (S3FG500) $99.*
*3 *SPD is not an Option, available as (S3FG130) $995.*
*4 *Prices are USD.*

PEP 303R

- ***PEP 303 System Unit, Monitor, and Keyboard are Rackmountable Conforming to EIA RS-310 Standard***
- ***101 Key Keyboard is Mechanically and Electrically Lockable***
- ***All Disk Drives are Enclosed and Shock Mounted to Protect Them from Harsh Environments***

ORDERING INFORMATION

PEP 201 Instrument Controller **$3,995**
PEP 301 Instrument Controller **$7,995**
PEP 301R Instrument Controller **$9,995**
PEP 303 Instrument Controller **$9,995**
PEP 303R Instrument Controller **$11,995**

OPTIONS

Opt. 21 – Adds 3.5 in. 1.44 MB disk drive **+$295**
Opt. 37 – RS-232 Controller hardware only **–$495**
Opt. 38 – Delete rackmount of keyboard and display (PEP 301R, 303R) **–$500**
Opt. 41 – Total 4 MB RAM **+$1,995**

KEYBOARD OPTIONS

Opt. 4A – UK keyboard **NC**
Opt. 4B – French keyboard **NC**
Opt. 4C – Swedish keyboard **NC**
Opt. 4F – Danish keyboard **NC**
Opt. 4G – German keyboard **NC**
Opt. 4I – Italian keyboard **NC**
Opt. 4S – Spanish keyboard **NC**

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, 60 Hz. **NC**
Opt. A4 – North American 240 V, 60 Hz. **NC**
Opt. A5 – Switzerland 220 V, 50 Hz. **NC**

MANUFACTURING TEST SYSTEMS

- ***Fully Integrated Functional Test Systems***
- ***Fixed Price Quote***
- ***Fixed Project Schedule***
- ***Professional Customization***
- ***Professional Documentation***
- ***Tektronix Service and Support***

For manufacturing test, Tektronix integrates IEEE-488 and VXI-based test systems. Tektronix specializes in automated functional test for the commercial and military sectors.

Some of the manufacturing test systems Tektronix has installed include:

- Audio Test Systems
- Automotive Test Systems
- Bare Board TDR Test Systems
- Computer Board Test Systems
- Industrial Control Board Test Systems
- Mil Radar Hybrid Test Systems
- Power Hybrid Test Systems
- Video Test Systems

Because individual manufacturing test departments vary in staffing levels and expertise, Tektronix's philosophy is to help by becoming an extension to your resources. And Tektronix offers a range of capabilities to do just that.

Tektronix Test System Manufacturing

The process of implementing a new test program involves the following steps:

1. Identify a need or opportunity. (May be due to a new product or by an opportunity to achieve higher productivity.)
2. Develop a test strategy. (Determine the number and location of control points and what type of tests to use.)

The following steps apply to each control point identified:

3. Develop a test procedure. (Determine the parameters to measure on the device, the tolerances for those parameters, and the sequence of measurement.)
4. Develop a system concept. (If a custom test system is required, this consists of a block diagram and a generic equipment list.)
5. Design the system. (This details the physical layout, wiring, switching, custom mechanical and electrical elements, fixturing, and software specifications.)
6. Integrate the system.
7. Test and debug the system.
8. Install the system.
9. Train engineers and test operators.

Finally, to drive this process to completion, all of these steps have to be project managed. Tektronix offers a range of services to assist you in performing each of these steps. Depending on your situation you may wish to use our help with all or just selected portions of the project.

OPPORTUNITY IDENTIFICATION AND STRATEGY DEVELOPMENT

Tektronix maintains applications engineers and system specialists at its sales offices. At your request, these people will visit your site and review with you ideas on how to test your new products most effectively or how to improve the effectiveness of your current test operation. The focus of these visits is cost reduction and quality improvement.

REQUIREMENTS ANALYSIS

After the test strategy is developed, and it is decided where Tektronix can be of further help, the next step is to determine specific details of how to test specific devices. Tek's systems specialists can reduce both the tedium and the time required for this task by working closely with your staff in an interactive process. Combining your unique knowledge with Tek's systems experience and expertise results in a cost-effective, thorough analysis. For those of you who do not have the resources to analyze the test requirements, Tek can perform this analysis for you. The result of this analysis is a written proposal including a system description, statement of work, price, and warranty information. You know up front exactly what you are paying for, but without being locked into a rigid proposal. Additional system features can always be negotiated into the project.

DESIGN

Upon acceptance of the proposal, Tek can design every facet of the system. Over 40 years of designing test and measurement equipment assures you of clean signals and reliable results from your test system. If your application requires a special purpose instrument from another manufacturer, Tek will purchase it and integrate it into the system. Throughout the design phase, Tek will maintain close contact with you in order to ensure that no surprises are designed into your system.

MANUFACTURING

For some test system builders, the physical integration of a system is trying because of the variety of miscellaneous and customized parts needed for assembly. Tektronix avoids needless production delays by maintaining a shop with all of the miscellaneous parts on hand. Adjacent to the integration area at Tek is a model shop to build the parts needed to adapt special equipment to the system. Tek's experienced and innovative technicians use the same materials and care used to make the highly reliable Tektronix test instruments.

CUSTOMIZATION

All systems require customization beyond instrument configuration. Tek can provide customization of software, switching, fixturing, and user interfaces.

Software: Tek's test program professionals can develop a unique software package for your specialized applications. Using Tektronix Test Management System software, or a variety of high-level languages, the Tek specialist can build test procedure software that is easy to learn and to use. All software is well documented.

Switching: Tek's TSI 8150 Switch Controller is an extremely flexible card-modular switching system that provides low-noise, power, and general purpose switching from DC to 18 GHz. It can be configured to meet almost any system switching requirement. For special requirements, Tek provides custom cards that fit into the TSI 8150 architecture.

Fixturing: Tek's TSA 8140 Test System Adapter mates directly to the Virginia Panel line of fixturing hardware. For quick change-over fixturing this feature almost makes building fixtures as easy as assembling off-the-shelf hardware. For other types of fixturing, Tek both fabricates fixtures and works with fixture specialists to provide a solution to match your needs.

User Interfaces: Tek has a custom modification team with both the electronic and mechanical expertise to design and manufacture special user interfaces such as patch panels, keypads, touch screens, etc.

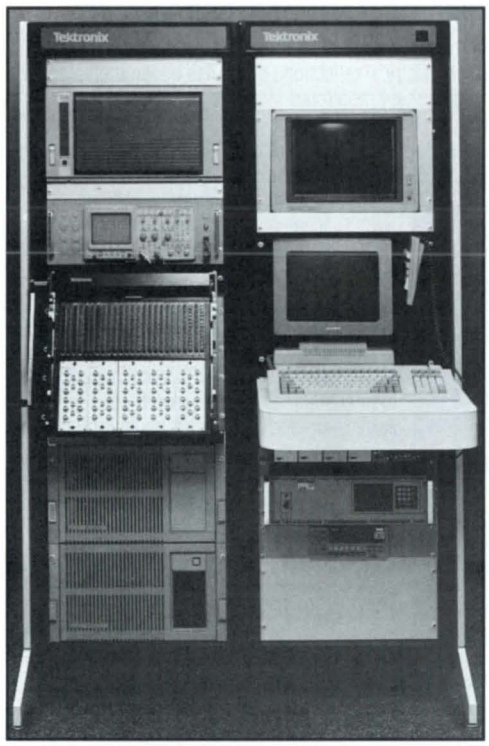
System Test: Where feasible, Tektronix provides self-test fixturing and self-test software. This allows Tektronix to assure that your system is fully functional before it is shipped and after it is received. It also allows you to easily test your system for proper functionality on a regular basis.

DOCUMENTATION

Because good documentation is a time-consuming, grueling task, custom systems typically come with sketchy documentation. Tektronix provides complete documentation including safety practices, operating instructions, system drawings and a functional description of the system.

INSTALLATION

Often the purchaser of new equipment is left with the responsibility of set-up and start-up. If it does not run, the user does not know if the equipment is defective or merely hooked up incorrectly. This generally leads to extended telephone calls to the vendor (if anyone is available) while the buyer learns how to bring the equipment up. On-site installation is always available with Tek's test systems.



Combined Analog and Digital Video Test System

SUPPORT AFTER SALE

Regular maintenance and periodic servicing are essential to maximizing the return on your test system investment. Test systems will sometimes require modifications as new test procedures are implemented. And spare parts must be available for the life of the system.

Service: All of Tek's manufacturing test systems include a standard 90-day limited on-site warranty in addition to standard warranties on the individual instruments. Extended on-site warranties are also available. And Tektronix maintains service facilities around the globe for overseas customers.

Long-term Support: Tek's experience with military contracts, where products are kept in use longer than in commercial applications, assures you of replacement instruments and parts for extended periods. When a product is phased out, Tek maintains support for most spare parts for nine years.

Applications Support: Tektronix maintains a staff of experts in each field office to answer questions about hardware or software, to write new test procedures, or to provide start-up training for new technicians and operators.

ORDERING INFORMATION

For further information on how Tek can help you be successful in automated test contact your local sales representative or call: 1-800-426-2200 ext. 778.

NEW

AUTOMATED IMPEDANCE TEST SYSTEMS

- *Cable Testing*
- *Wire Harness Testing*
- *Bare Circuit Board Testing*
- *Backplane Testing*

Automated Impedance Test System

ORDERING INFORMATION

TDR 200 Semi-automated TDR Test System **$48,500**

AUTOMATED IMPEDANCE TEST SYSTEM
Call 1-800-426-2200 ext. 837 or contact your local sales representative to discuss fixturing requirements and pricing.

Unique TDR test applications can be configured through our custom manufacturing test system facility. See page 324.

For more information on these products ask your Tektronix sales representative for literature numbers 3HW-7511 and 3HW-7603.

TIME DOMAIN REFLECTOMETRY

Time Domain Reflectometry (TDR) is a technique in which electrical reflections of a pulse transmitted along a conductor are monitored. Voltage variances in the reflected waveform indicate a change in the impedance of the line. Monitoring these impedance changes can be used to locate breaks in telephone lines and automotive and aircraft wiring. It can also be used to verify the frequency handling capabilities of bare circuit boards and backplanes and to control the manufacturing process for bare pcb's and controlled impedance cables.

Tektronix offers a full range of impedance test solutions, using TDR, from manual test to fully automated test to match your application and manufacturing environment. Some considerations in selecting a level of automation are as follows:

Manual test requires a technician to set up the test equipment, manually place the test probe, interpret the test results from an oscilloscope screen, and record the data. This method has the lowest equipment cost, the highest labor and maintenance cost, the lowest throughput, the lowest measurement accuracy, and the highest error rate. However, in an environment demanding extreme portability, there is no alternative. For information on manual TDR test equipment, see catalog pages 45 and 448.

Semi-automated impedance test systems typically consist of programmable TDR instrumentation, an instrument controller, application software, and manual probes. This approach provides throughput and repeatability enhancements over manual test due to the ability to store and recall instrument settings and digitally process and log data. Probing is still performed manually. This alternative has a higher equipment cost, lower labor cost, higher throughput, and lower error rate than the fully manual approach. The accuracy is generally higher than that obtained from manual testing. Very consistent operators should be able to obtain a repeatability of ±5% of the impedance reading.

Automated Impedance Testing uses automated fixturing together with a switching capability that automatically sequences the test system through all of the test points on the device being tested. The repeatability of this system is much superior to either the manual or semi-automated approaches due to the automation of the probing and to the accuracy-enhancing calibration processes built into the system. The standard accuracy offered is ±2.0%. Higher accuracy systems can be obtained on a custom basis. The advantage of higher accuracy is that even if your device tolerances are much wider than this, it may allow you to implement sample plan testing which could reduce your test costs up to 90%. The automated system has the highest equipment cost, the lowest labor and maintenance costs, the highest throughput, and the highest accuracy/repeatability of the alternatives.

TDR 200

The semi-automated TDR 200 is configured for benchtop testing of impedances, propagation delays, and transmission line quality. It consists of a 16-MHz, 80386-based system controller, an 11802 Sampling Oscilloscope with a 35 picosecond rise time TDR head, a printer, two manual 50 Ω TDR probes for single ended and differential testing, and calibration standards. The software provided allows you to menu select the type of test, enter the test tolerances for pass/fail determinations, and establish a file for data logging. Application support is included to install the equipment and train you at your site.

AUTOMATED IMPEDANCE TEST SYSTEM

The automated Impedance Test System is configured for automated bare pcb and multiconductor cable testing. In addition to the state-of-the-art Tektronix 11800-series measurement instrumentation, the system comes complete with fixturing, software, printer, and mouse interface. This is all packaged in a 4 foot equipment rack and an AnthroCart® controller stand. It is a complete turnkey system. All you have to do is provide the floor space, operator, and power.

Creating a test procedure consists of filling in the blanks in a menu with choices selectable from pop-up windows. A 40 trace test can easily be developed in 10 minutes.

Running a test program simply requires selecting the test program from a menu, placing the device to be tested on the fixture, and pressing enter. Serial numbers can be entered from the keyboard or with an optional bar code reader. The test program automatically sequences through all test points and analyzes and logs the data.

TDR 200 Semi-automated Impedance Test System

CUSTOM DIGITIZER SYSTEMS

Researchers, engineers, and manufacturing test system designers are often faced with the task of adapting, reconfiguring, or rebuilding test systems to meet specialized testing requirements. New test specifications must be written. Measurement instruments from different vendors must be evaluated. Questions such as, "What are the hardware and software requirements?" and "How easily can the test system be reconfigured or upgraded?" must be considered. It's a tedious and time consuming process – time that could be better spent in the lab or adding value to products.

TEKTRONIX HAS THE SOLUTION

The Tek Digitizer Custom Systems team is a group of hardware, software, and system specialists whose sole purpose is to provide total, integrated measurement solutions.

We specialize in measurement systems solutions requiring high-speed, multiple-channel data acquisition, data logging, and diagnostic testing; time domain measurement systems, and automated test systems for low-run manufacturing environments. Our high-performance, specialized systems are currently utilized in such diverse fields as fusion research, high-energy physics, radar, lidar, communications, component radiation hardness testing, and nuclear magnetic resonance, to name just a few.

Our modular instrument approach ensures system flexibility for easy reconfiguring or expansion to meet a variety of test situations.

SYSTEMS TAILORED TO THE USER'S NEEDS

From complete integration and installation of one-of-a-kind systems to simple modifications of selected products, Tek's Digitizer Custom Systems team can tailor a complete high-performance measurement system based upon your present and future needs, your budget, and your required degree of continuity with existing hardware and software components.

YOU PROVIDE YOUR UNIQUE MEASUREMENT REQUIREMENTS – TEKTRONIX WILL PROVIDE THE PROFESSIONAL EXPERTISE IN INSTRUMENT SYSTEMS INTEGRATION

Together we'll evaluate your hardware and software requirements (including refined application and diagnostic programs and the drivers to run them), custom cabinetry or racks, and even non-Tek components if Tek does not have the instrument to fit a particular application.

We'll define your exact requirements, and settle contract terms and conditions. The result will be the total solution required, whether you need just an off-the-shelf modified product, or a multi-instrument, multi-channel custom system.

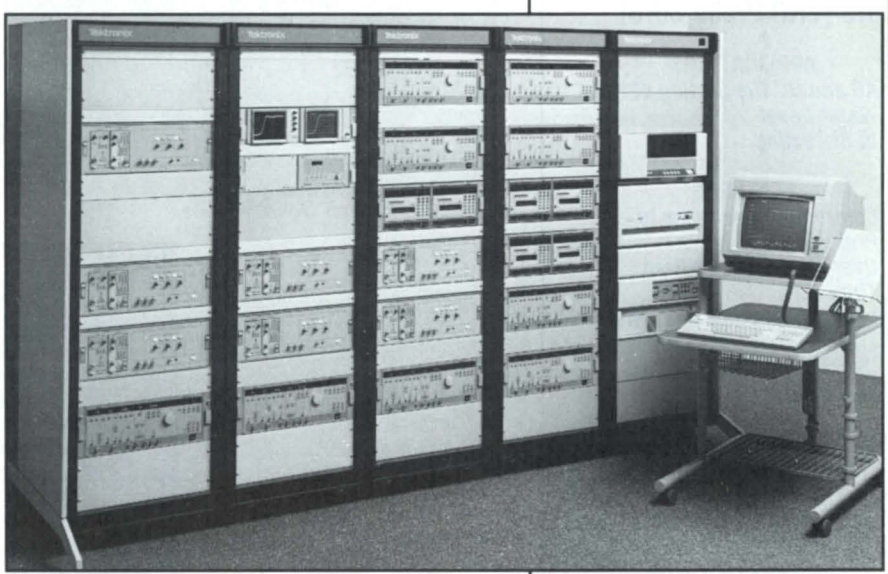
SPECIALIZED SYSTEMS

Any number of standard and modified products can be integrated into large, multichannel test and research systems incorporating a wide variety of Tek digitizers and high-bandwidth acquisition instruments, both for major military installations and defense contractors, and for a variety of commercial test applications, such as fiber optics research and testing.

POST-INSTALLATION SUPPORT

Product warranties, stipulated for each system instrument, cover all hardware and software. System warranty covers installation and service at your site for 90 days from the date of acceptance, or 120 days from shipment. Maintenance contracts are available through Tektronix for extended support periods.

Pre-installation consultations or training for operators, technicians, engineers or maintenance staff may also be arranged at the Tek home office, at regional sales offices, or on-site. And when you need additional support down the road, Tek's applications engineering and product service staffs can help keep your systems tuned and your people informed.



Typical Specialized System

A TOTALLY INTEGRATED MEASUREMENT SOLUTION

Tektronix provides fully integrated speciality system solutions by combining the best waveform acquisition instrument on the market with automated stimulus and acquisition capability and the world's most respected technical support.

Custom Digitizer Systems and Products

By blending the best of technologies, we can build systems that do in minutes tasks that may now take days.

- *Total Measurement Systems Solutions*
- *Tailored to User's Needs*
- *Fully Integrated Hardware and Software*
- *Specialized Designs*
- *Modified System Products*
- *System Installation*

ORDERING INFORMATION

Call your local Tektronix sales representative for total measurement system solutions today.

Engineering Support Services (1 hour increments) available:

Support Services Order 068-9161-00	**$95/hr.**
Technical Services Order 068-9162-00	**$125**
Engineering Services Order 068-9163-00	**$175/hr.**

Contents

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576/176 Curve Tracer 331
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NEW P6521

Very High Density Probe Card (VHD Probe Card)

APPLICATIONS

- ***AC and DC Die Sorting at the Wafer Level***
- ***VLSI Testing***

FEATURES

- ***Controlled Impedance to Probe Tip***
- ***Over 1 GHz, 175 ps Rise Time***
- ***Low Maintenance and Long Life***
- ***Density Over 360 Contacts and 4 mil Pitch***

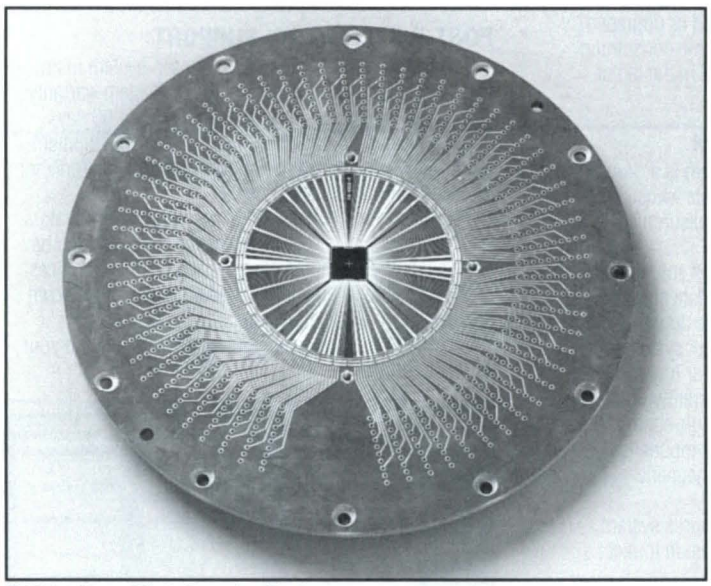
ORDERING INFORMATION

P6521 VHD Probe Card	*1
P6521 VHD Probe Card Data Sheet 48W-7156-1	NC

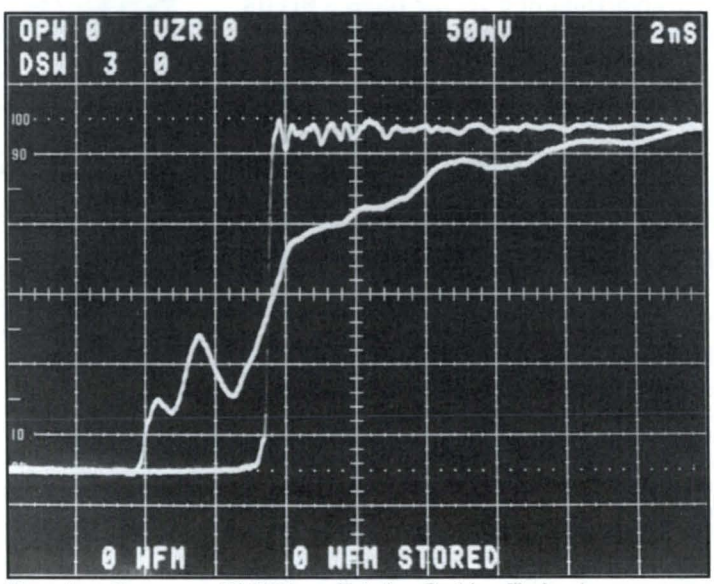
*1 *Contact your local sales representative.*

The Tektronix P6521 VHD probe card is used for ac/dc sort of die at the wafer level to guarantee performance prior to packaging. Sorting at wafer level reduces package cost and selects unpackaged ICs with critical ac speeds.

The P6521 consists of a thin film, high performance pliable hybrid on which probe tips or contact pads are connected to controlled impedance strip lines. The hybrid is bonded mechanically and electrically to a rigid circuit board containing the test head "contactor footprint." Interface cards exist for most VLSI systems and in-house custom ATE.



P6521 Very High Density Probe



Transient Response of P6521 vs. Existing Probing Technology

The new industry standard 370 and 371 curve tracers provide dc parameter characterization of transistors, thyristors, diodes, SCRs, MOSFETs, optoelectronic components, solar cells, solid state displays and other semiconductor devices. The 370 and 371 provide measurements to compare a device to the manufacturer's specifications, identification of components with the same characteristics and failure analysis.

Typical measurements include leakage, breakdown voltages up to 3000 V, MOSFET gm/Idss/Vgs(th)/Igss, SCR Vdrm/Idrm/Irrm/Vgt/Igt, DIODE Vf/PIV/Ir, ZENER Vz/Vf, resistance as well as other dc parameters.

PROGRAMMABLE CONTROL

With non-volatile memory cartridges, the 370/371 provide automatic test sequencing. Also the GPIB interface and a PEP 301 or other IBM compatible PC allow external controller test sequencing. With either method, the 370 or 371 front panel setting can be recalled and measurements made with storage of the results for later review or comparison.

INTERACTIVE CONTROL

The 370 and 371 use the same familiar interactive manual controls that are available on Tektronix 576, 577D1 and 577D2 curve tracers. With interactive control, characterizations can be refined for unique devices during research or design. After the completion of the characterization definition, the interactive setting can be automated by storing the curve tracer setting in the curve tracer's non-volatile memory or an external controller.

DIGITAL STORAGE DISPLAY

The digital storage display provides a bright, flicker-free trace and allows precise measurements and comparisons. There are 100 points per division in the vertical and horizontal directions for high resolution measurements. On-screen readout displays specific values to assure accurate measurements and eliminate interpretation errors.

On-screen annotation with 24 characters of displayed information can be done from either the front panel of 370 and 371 or remotely from an IBM PC compatible controller such as the Tektronix PEP 301.

HARDCOPY

Plotter output data is sent directly from the 370 and 371 without the need for a controller. While plotting, the 370 and 371 can continue performing the next tasks.

INTERFACE

The 370 and 371 provide both a GPIB interface conforming to IEEE Standard 488.1-1987 and with Tektronix codes and formats as well as an 8-bit parallel port supporting HPGL compatible plotters.

TEST FIXTURING

Adapters allow mounting most popular devices for easy test characterizations. For other devices, the blank adapter allows mounting custom sockets.

SOFTWARE

For automated custom device characterization, the 370 Utility Software or 371 Utility Software with an IBM PC such as the Tektronix PEP 301 provides customized tests, consistent measurements and logging of results. The 370 Device Test Software allows automatic characterization of most semiconductor components.

370 CHARACTERISTICS

Range	16 V	80 V	400 V	2000 V
Max Peak Current	10 A	2 A	.4 A	.05 A
Peak Current Pulsed	20 A	4 A	.8 A	.1 A
Min.Series Res. (ohms)	.26	6.4	160	20 k
Max Series Res. (ohms)	800	20 k	500 k	12.5 M

ACQUISITION

In storage mode, information is displayed in one of three ways: normal, envelope or average.

COLLECTOR/EMITTER CURRENT

Measurement range is 100 nA/div (1 nA resolution) to 2 A/div for collector current and 100 pA/div (1 pA resolution) to 2 mA for emitter current.

COLLECTOR/BASE/EMITTER VOLTAGE

Measurement range is 5 mV/div (50 µV resolution) to 500 V/div for the collector and 5 mV/div (50 µV resolution) to 2 V/div for base or emitter voltage.

STEP GENERATOR

The step generator has 0 to 10 steps, 50 nA to 200 mA in the current mode and 50 mV to 2 V in the voltage mode. Offset control is variable from –10 to +10X step amplitude. In pulsed mode, the step generator changes from stair step output to either 80 µs or 300 µs wide pulses.

AUXILIARY SUPPLY

The auxiliary supply is a third voltage source for biasing devices from – 40 V to + 40 V with 20 mV resolution.

S370DT

The S370DT is a complete 370 curve tracer system that includes the 370, PEP 301 controller (IBM compatible computer) with GPIB interface/GPIB software/system software, HC100 four color plotter for direct 370 hardcopy, S48P104 Device Test Software for automatic measurements and S48P105 Utility Software for custom device measurements.

S370FA

The 370 automates the task of identifying failed pins on integrated circuits with up to 567 pins. The S370FA is specifically for identification of the pins which have failed before lid removal of integrated circuits. The S370FA system software highlights results from pins that don't match normal performance as well as logs results from all pins for future reference or comparison. The S370FA can be easily reconfigured as a standard 370 with a PEP 301 and GPIB interface.

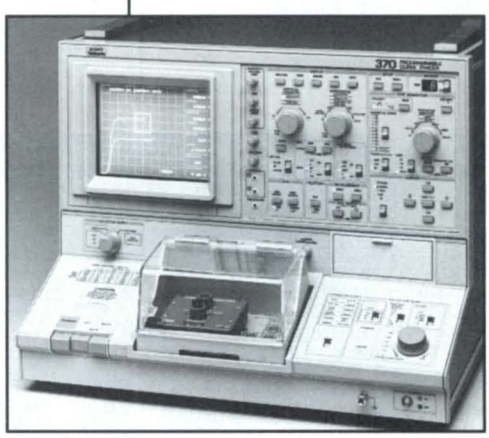
Programmable Curve Tracer

AUTOMATED DEVICE CHARACTERIZATION FOR:

- *Manufacturing Processes*
- *Incoming Inspection*
- *Semiconductor R & D*
- *Quality Control*
- *Component Engineering*
- *Component Matching*
- *Failure Analysis*

FEATURES

- *Automatic Tests Sequences*
- *Non-Volatile Storage via GPIB Interface*
- *Waveform Comparison*
- *Dot Cursor*
- *Windowing*
- *Auxiliary Supply*
- *On Screen Readout*
- *Envelope Display*
- *Digital Storage Display and Non-Storage Mode*
- *Waveform Averaging*



370 Curve Tracer

370
Device Test Software

- *Automatic Measurements from a PEP 301 IBM Compatible PC with GPIB*
- *Select from Common Device Types*
- *Select One to All Common dc Measurements*
- *Software Automatically Handles GPIB and 370 Controls*
- *Pass/Fail Result Comparison*
- *Log Files for Storage of Results*

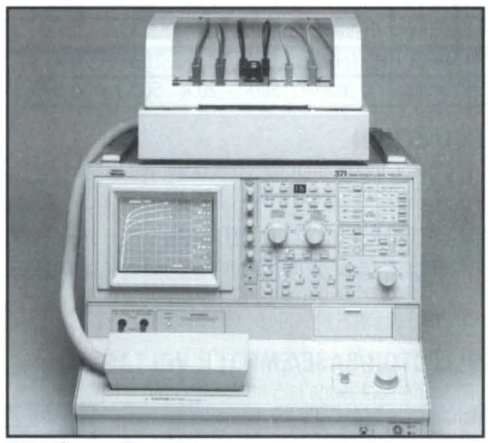
370 or 371
Utility Software

- *Automatic Measurements from a Tektronix PEP 301 with GPIB or IBM Compatible PC*
- *Develop Custom Device Tests*
- *Archives Curves and Front Panel Settings*
- *Example Test Programs*
- *Source Code Included*
- *Log Files for Storage of Results*

371 CHARACTERISTICS

Peak Power Watts	3 k*1	300*1	30*2	3*2
Collector Current Available				
Amps	400	40	40 mA	4 mA
Maximum Peak Collector Voltage				
Volts	30	30	3 k	3 k

*1 *250 µsec pulsed collector supply*
*2 *Sinewave collector supply*



371 Curve Tracer

TEST FIXTURING

The test fixture is a standard accessory that provides a safety enclosure when device measurements are performed to assure operator protection. The test fixture accommodates standard A1001 through A1005 with Kelvin sensing, 3-pin adapters without Kelvin sensing (013-0128-00, 013-0073-00, 013-0070-01, 013-0072-00) and the A1023 device socket adapter. Also the test fixture accommodates devices as large as 8" x 5" x 4.75" with special attachment leads included with the 371 Test Fixture.

If you wish to construct a unique test fixture unit, order the optional Field Wiring Cable (cable/plug assembly without test fixture enclosure).

COLLECTOR CURRENT

Peak Power	Resolution	Current/Div
3 kW	10 mA	1 A to 50 A
300 W	5 mA	.5 A to 5 A
30 W	1 µA	100 µA to 5 mA
3 W	100 nA	10 µA to 500 µA

COLLECTOR VOLTAGE

Measurement resolution is 100 mV/div (1 mV resolution) to 5 V/div at 3 kW and 300 W. For 300 W and 3 W, measurement resolution is 50 V/div (500 mV resolution) to 500 V/div.

STEP GENERATOR

The step generator provides 0 to 5 normal staircase steps for 30 W and 3 W or pulse mode steps for 3 kW and 300 W. Pulsed current steps are 500 µseconds pulses. The current range is 1 µA to 2 mA with normal steps and 1 mA to 2 A with peak power at 3 kW or 300 W. In voltage mode, voltage steps range from 200 mV to 5 V.

370 DEVICE TEST SOFTWARE

The pop-up windows prompt selection of devices and tests:

NPN and PNP transistors: V(br)ceo, V(br)ebo, V(br)cbo, Vce(sat), Vebo(sat), Icev, hFE
N and P MOSFET: BVdss, Idss, Vgs(th), Id(on), Rds(on), gm, Igss
N and P JFET: Idss, V(br)gss, Igss, gm, Vgs(off)
SCR: Vdrm, Idrm, Irrm, Igt, Vgt, Vtm, Ih
Diode: Vf, PIV, Ir
Zener: Vz, Vf
Resistor: Ohms

These common dc measurements are typically performed at least four times faster than manual methods.

370 OR 371 UTILITY SOFTWARE

With a library of user defined custom measurements stored in the IBM PC or compatible, unique or uncommon device measurement sequences can characterize any device. The Utility software menu provides easy-to-use access to functions that simplify curve tracer operations.

The 370 and 371 Utility Software are separate products to optimize the performance for each curve tracer.

Since the measurements are performed by the same method with a PC, devices are quickly and consistently characterized.

ORDERING INFORMATION

370 Curve Tracer — **$18,950**
Includes: Blank adapter A1001; In-line transistor adapter A1002; Axial diode lead adapter A1005; 4 and 6 lead transistor/FET adapter A1007; non-volatile memory (020-1310-00); protective cover (337-3344-00); spare fuses 125 V/4A (159-0259-00); slow blow 250 V/2A (159-0160-00); power cord (161-0066-00); operator's manual (070-6064-00); instrument interfacing guide (070-6067-00) and pocket reference guide (070-6066-00).
Opt. 1P – HC100 Plotter — **+$900**
Opt. 1R – Rackmount — **+$450**
Opt. 25 – PEP 301 System Controller — **+$7,995**
Opt. 26 – Utility Software — **+$890**
Opt. 27 – Device Test Software — **+$1,850**

OPTIONAL ACCESSORIES
Service Manual – Order 070-6065-01 — **$55**
Calibration Fixture – Order 067-1286-00 — **$440**
Rackmount Kit – Order 016-0930-00 — **$415**
Socket Adapters – See adapters section
Cart – K217 Rack Instrument Cart — **$570**

S370DT – Device Test System — **$30,465**
Includes: 370, PEP 301; Device Test Software (S48P401); 370 Utility Software (S48P104) and HC100 Plotter.
S370FA – Failure Analysis — **$49,190**
Includes: 370, PEP 301; 93 pin system; 40 pin adapter; TSI8150; operators manual (070-6852-00) and rack cabinet.

OPTIONS
Opt. 01 – Delete PEP 301 — **–$5,000**
Opt. 02 – 189 pin expansion — **+$6,350**

OPTIONAL ACCESSORIES
Service Manual – Order 070-6853-00 — **$30**

371 High Power Curve Tracer — **$22,780**
Includes: A1002 In-line transistor adapter; A1003 TO3/TO66 adapter; non-volatile memory (020-1310-00); power cord (161-0066-00); operator's manual (070-6839-00); and pocket reference guide (070-6841-00).

OPTIONAL ACCESSORIES
Service Manual – Order 070-6840-00 — **$55**
Calibration Fixture – Order 067-1345-00 — **$3,200**
Service Maintenance Cable – Order 174-1001-00 — **$65**
Service Maintenance Kit – Order 067-1286-00 — **$440**
371 Rackmount Kit – Order 016-0930-00 — **$415**
Cart – K217 Rack Instrument Cart — **$570**
Sockets – See adapters section

SOFTWARE
S48P104 370 Utility Software — **$900**
S48P105 371 Utility Software — **$900**
S48P401 370 Device Test Software — **$1,860**
Order Opt. 01 with all software products to specify 5 1/4" media — **NC**

APPLICATION NOTES
Bipolar Measurements – 48W-6756 — **NC**
MOSFET Measurements – 48W-6757 — **NC**

DATA SHEETS
370 Data Sheet – 48W-6938 — **NC**
371 Data Sheet – 48W-6827 — **NC**
S370FA Failure Analysis – 48W-6940 — **NC**
S48P104/5 Software – 48W-6778-1 — **NC**
S48P401 Software – 48W-6762 — **NC**

THE 576/176 CURVE TRACER

The 576 performs well where high current and high voltage characterization is required. The Tektronix 576 curve tracer is the industry standard for manual interactive control.

The 576 curve tracer allows dc parameter characterization of transistors, thyristors, linear IC's, diodes, SCR's, MOSFETs, optoelectronic components, solar cells, solid state displays and other semiconductor devices.

Typical measurements include leakage, breakdown voltages up to 1500 V, MOSFET gm, SCR Vgt/Igt, Diode Vf, ZENER Vz/Vf, resistance as well as other dc parameters.

INTERACTIVE CONTROL

The 576 provides the industry standard and familiar interactive manual controls available on Tektronix curve tracers. With interactive control, the curve tracer can provide refinement of characterizations for unique devices during research or design.

DISPLAY

The 165 mm (6.5 inch) rectangular display provides a 10 x 10 cm display with parallax-free, illuminated graticule. The readout, adjacent to the CRT, gives alphabetic and numeric indicators for vertical division, horizontal division, step size and either Beta or gm.

CHARACTERISTICS

Voltage Range	15 V	75 V	350 V	1500 V
Max. Continuous Peak Current	10 A	2 A	.5 A	.1 A
Peak Current Pulsed	≥20 A	≥4 A	≥1 A	≥.2 A
Min. Series Res. (ohms)	.3	6.5	140	3 k
Max Series Res. (ohms)	65 k	1.4 M	6.5 M	6.5 M

COLLECTOR/EMITTER CURRENT

Measurement range is .1 μA/div to 2 A/div for collector current and 1 nA/div to 2 mA for emitter current.

COLLECTOR/BASE/EMITTER VOLTAGE

Measurement range is 5 mV/div to 200 V/div for the connector and 5 mV/div (50 μV resolution) to 2 V/div for base or emitter voltage.

STEP GENERATOR

The step generator provides 0 to 10 steps, 5 nA to 200 mA in the current mode and 5m V to 2 V in the voltage mode. Offset control is variable from –10 to +10X step amplitude. In pulsed mode, the step generator changes from stair step output to either 80 μs or 300 μs wide pulses.

TEST FIXTURING

The standard test fixture (650-0459-01) is a plug-in to the 576 with two sets of 5 pin test terminals and operator safety shield.

Replacing the standard test fixture with the optional Tektronix 176 Pulsed High Power fixture provides the 576 with pulsed-collector operation increased to 200 A and pulsed-based steps to 20 A peak. With the 176, small signal transistors can be tested under pulsed-collector breakdown conditions without excessive power dissipation.

Socket adapters allow mounting most popular devices for easy test characterizations. For other devices, the blank adapter allows mounting custom sockets.

The Tektronix 577D1 and 577D2 curve tracers require either an optional Tektronix 177 plug-in or the Tektronix 178 plug-in. The 577D1 and 577D2 perform well at power levels up to 100 W.

576/176
Curve Tracer

- *Measures dc Parameters for 2 and 3 Terminal Devices*
- *Convenient Scale Factor Readout*
- *Up to 220 W*
- *Up to 1000 W with Optional 176 Test Fixture*

APPLICATIONS

- *Semiconductor R & D*
- *Production Device Testing*
- *Incoming Inspection*
- *Component Engineering Characterization*

ORDERING INFORMATION

576 Curve Tracer **$18,040**
Includes: Standard Test Fixture (650-0459-01); A1002 Opt. 01 In-line TO220 transistor adapter; A1003 Opt. 01 TO3/TO66 power transistor adapter; A1005 Axial diode lead adapter; A1007 transistor and MOSFET adapter; A1009 FET adapter; 013-0110-00 stud diode adapter; safety cover (337-1194-02); manual; (070-0905-01).
Opt. 01 – Delete readout **–$975**

OPTIONAL ACCESSORIES

176 Pulsed High Power Fixture **$7,960**
Includes: TO36 adapter (013-0110-00); stud diode adapter (013-0112-00); safety shield (337-1194-02); manual (070-1073-01).
Readout – Order 020-0031-00 **$1,735**
Test Set Up Cards – Package of 250 Order 070-0970-01 **$10**
Cart – K217 Rack Instrument Cart **$570**
C-59A – Camera and Adapter **$1,375**
Calibration Fixture – 067-1286-00 **$440**
Rackmount Kit – Order 016-0930-00 **$415**
Socket Adapters – See adapters section
576/577 Data Sheet – 48W-3346-3 **NC**

577D1/577D2
Curve Tracer System

FEATURES
- *Measures dc Parameters for 2 and 3 Terminal Devices*
- *Display Storage*
- *Up to 100 watts*
- *Lowest Price Curve Tracer System*

APPLICATIONS
- *Semiconductor R & D*
- *Production Device Testing*
- *Incoming Inspection*
- *Component Engineering Characterization*

ORDERING INFORMATION

577D1 Storage Curve Tracer Requires 177 or 178 — **$8,270**
577D2 Nonstorage Curve Tracer Requires 177 or 178 — **$7,260**

OPTION
Opt. 10 – 10 x 10 graticule — **+$98**

TEST FIXTURES
177 Standard Test Fixture — **$1,710**
Includes: A1005 Axial diode lead adapter; A1007 transistor adapter; safety cover (337-1194-02); instruction manual (070-1436-00).
178 Linear-IC Test Fixture — **$4,130**
Includes: 16 DIP IC socket (136-0442-00); standard op-amp card (013-0149-02); interchangeable nomenclature panel for function switch (333-1770-00); instruction manual (070-1977-00).

577D1/D2 OPTIONAL ACCESSORIES
Test Set Up Cards – Package of 250 (070-1639-01) — *1
CRT Implosion Shield – Clear For 577D1 Order 337-1440-00 — **$4.25**
Camera – C-5C — **$530**
See Instrumentation Documentation Devices section
Cart – K213 — **$660**
Socket Adapters – See Adapters section

178 OPTIONAL ACCESSORIES
2 Inch Patch Cord – Package of 1 Order 012-0200-00 — **$7.00**

TEST CARDS
Standard Op Amp – (included with 178) Order 013-0149-02 — **$260**
Hardwire Op Amp – Order 013-0150-02 — **$130**
Multiple Op Amp – Order 013-0155-01 — **$750**
Positive Regulator – Order 013-0147-00 — **$1,735**
Negative Regulator – Order 013-0148-00 — **$1,545**
576/577 Data Sheet – 48W-3346-3 — **NC**

APPLICATION NOTES
Testing 2N3904 – 48W-4021-1 — **NC**
Testing 2N4441 – 48W-4020-1 — **NC**

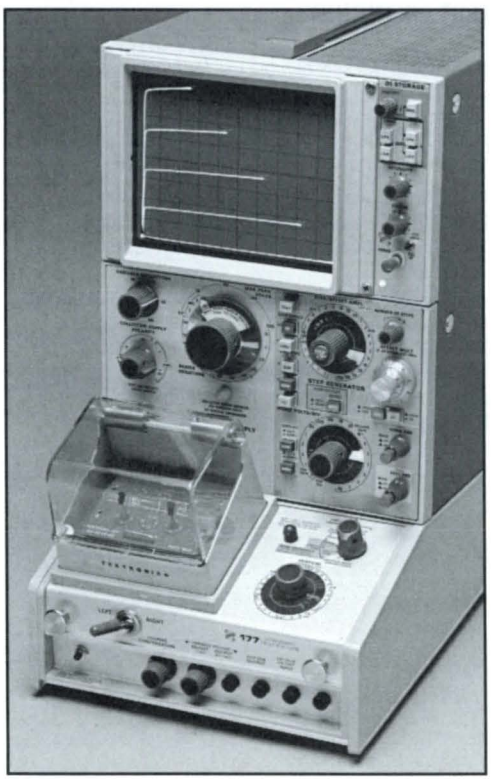
*1 *Contact your local sales representative.*

The 577D1 and 577D2 curve tracers with the Tektronix 177 plug-in adapter allow dc parameter characterization of transistors, thyristors, linear ICs, diodes, SCRs, MOSFETs, optoelectronic components, solar cells, solid state displays and other semiconductor devices. By selecting one of three application specific adapters with the 178 plug-in, expanded parameter measurements are available for linear op-amps, SCRs and three terminal regulators.

Typical measurements include leakage, breakdown voltages up to 1600 volts, MOSFET Vgs(th), SCR Vgt/Igt, Diode Vf, ZENER Vz/Vf, resistance as well as other dc parameters.

INTERACTIVE CONTROL
The 577D1 and 577D2 provide the same industry standard and familiar interactive manual controls available on Tektronix 370, 371 and 576. With interactive control, the curve tracer can provide refined characterizations on standard and unique devices for component engineering, research or design.

DISPLAY
The 165 mm (6.5 inch) rectangular display provides a 8x10-cm display with parallax-free, internal graticule. The 577D1 has a split screen storage display useful for comparison of two devices. The 577D2 has a non-storage display.



CHARACTERISTICS

Voltage Range	6.5 V	25 V	100 V	400 V	1600 V
Max Continuous Peak Current	10 A	2.5 A	.6 A	.15 A	.04 A
Peak Current Pulsed	20 A	5 A	1.25 A	.3 A	.08 A
Min. Series Res. (ohms)	.12	1.9	30	500	8 k
Max Series Res. (ohm)	8 k	120 k	2 M	8 M	8 M

COLLECTOR CURRENT
Measurement range is .2 nA/div to 2 A/div for collector current.

COLLECTOR/BASE VOLTAGE
Measurement range is 5 mV/div to 200 V/div for the collector and 5 mV/div to 2 V/div for base voltage.

STEP GENERATOR
The step generator has 0 to 95 steps, 5 nA to 200 mA in the current mode and 5 mV to 2 V in the voltage mode. Offset control is variable from −10 to +10X step amplitude. In pulsed mode, the step generator changes from stair step output to 300 µs wide pulses.

TEST FIXTURING
The 577D1 and 577D2 require either the Tektronix 177 or 178 plug-in test fixture.

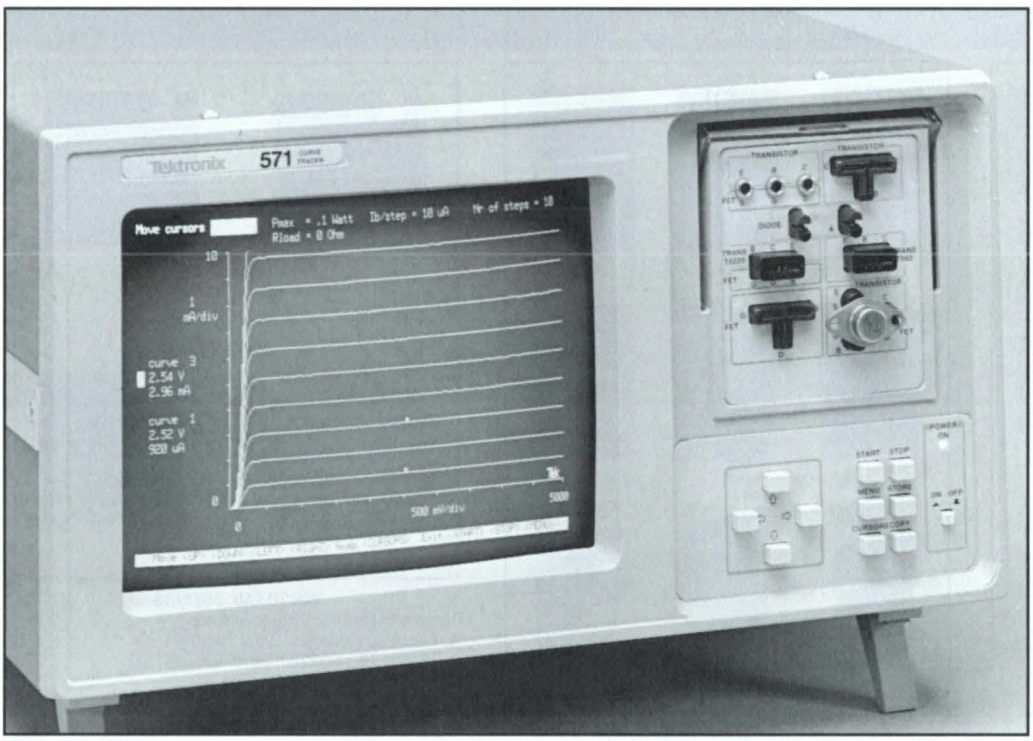
With the 177 plug-in, the 577D1 and 577D2 are standard curve tracer systems that can make traditional dc parametric measurements. Socket adapters for different device package styles are described in the socket adapter section.

The 577515E curve tracer system adds an SCR adapter to extend the 177 plug-in to measure turn-off time characteristics of SCRs for forward currents up to 5 amps.

With the Tektronix 178 plug-in, the 577D1 and 577D2 provide measurements at low currents for linear IC characterization. In addition to the 178, a test card and a device socket adapter must be selected.

Selection of standard, hardwire, or multiple op-amp test cards with a 178 and a 577D1/D2 provides common op-amp measurements: ±input current, offset voltage, CMRR, gain, ±PSRR, – supply current and collector current. Four device socket adapters are available: 8 or 10 lead TO package and 14 or 16 pin dual in line packages.

With a positive or negative regulator card as well as the 178 and 577D1 or 577D2, three terminal regulator parametric measurements can be performed: output voltage, load regulation, line regulation, ripple regulation, quiescent and common-terminal current. Standard socket adapters with Kelvin sensing are described in the next section.



571 Curve Tracer

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 always indicate which push-buttons are active.

Up to 12 parameter set-ups (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 monitor for classroom viewing can be connected to the monochrome video output.

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 volt 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.

Video – BNC connector. 50 Hz frame rate, 17.8 kHz line rate.

Printer Out – Centronics® parallel interface. Output format for Epson® or IBM® compatible.

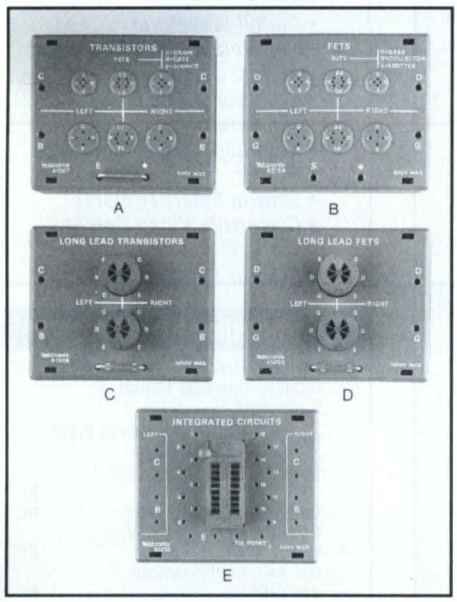
571
Curve Tracer

- *Easy to operate*
- *Menu Driven*
- *Digital Waveform*
- *Non-Volatile EEROM – Store 12 Test Setups*
- *Accurate Cursor Measurements*
- *Hard Copy Output to Matrix Printer*
- *Built-in Safety Features*
- *Composite Video Output (50 Hz)*
- *Built-in Test Sockets*

ORDERING INFORMATION

571 Curve Tracer Includes: Operators Manual, Power Cord	**$2,950**
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**
OPTIONAL ACCESSORIES	
Printer Cable 9 ft. Male to Male Centronics (012-1284-00)	**$75**
Printer Cable – Shielded (012-0555-00)	**$125**
Camera – C-4 Opt. 11	**$475**

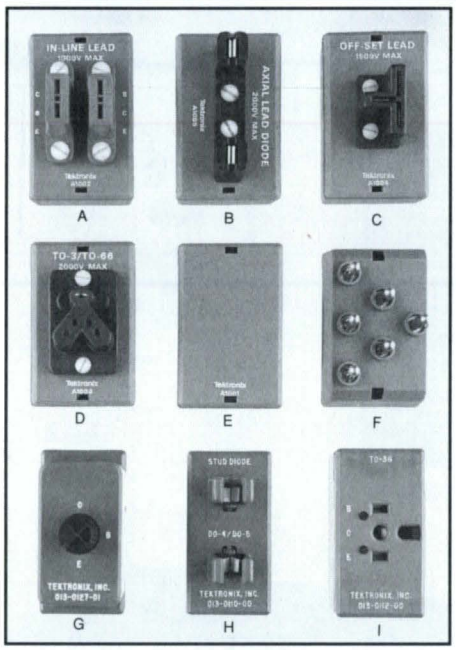
SOCKET ADAPTERS



DUAL WIDTH ADAPTERS

Adapters A1006 through A1010 fit the side-by-side terminals on test fixtures of the 370, 576 and 177 Curve Tracers. These adapters allow either 1 or 2 devices mounted in the adapter which is useful for alternating comparisons of 2 devices.

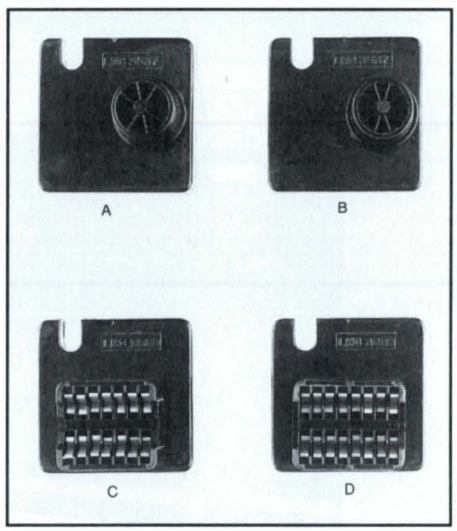
A. Transistor Adapters for Bipolar Transistors and some MOSFETs – Order A1007 **$290**
B. FET Adapter for most FETs – Order A1009 **$290**
C. Long Lead Transistor Adapter For Transistors with Untrimmed Leads – Order A1006 **$260**
D. Long Lead FET Adapter for FETs with Untrimmed Leads – Order A1008 **$260**
E. Integrated Circuit Adapter for Multi-Pin Dual-in-line Devices 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 **$400**



KELVIN SENSING ADAPTERS

These adapters fit the test fixtures of the 370, 371, 576, 177 and 178 Curve Tracers.
NOTE: For adapters A1001 through A1004 order with option 01 for use with the 576, 177 and 178.

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 **$130**
B. Axial Lead Diode Adapter – Order A1005 **$130**
C. Offset Lead Adapter for Power Transistor – Order A1004 **$130**
D. TO-3/TO-66 Adapter for Power Transistors – Order A1003 **$130**
E. Blank Adapter for Mounting Custom Sockets – Order A1001 **$80**
F. Example showing 6th pin for Base/Gate Kelvin Sensing.
SOT-23 Adapter for Surface Mount Devices – Order A1023 **$240**
NOTE: The three adapters below should only be used with 576, 177 and 178 curve tracers.
G. Transistor Adapter Accepts Long or Short Lead Transistors – Can be rewired to fit non-standard configurations. Order 013-0127-01 **$100**
H. Stud Diode Adapter – Order 013-0110-00 **$120**
I. TO-36 Adapter – Order 013-0112-00 **$120**

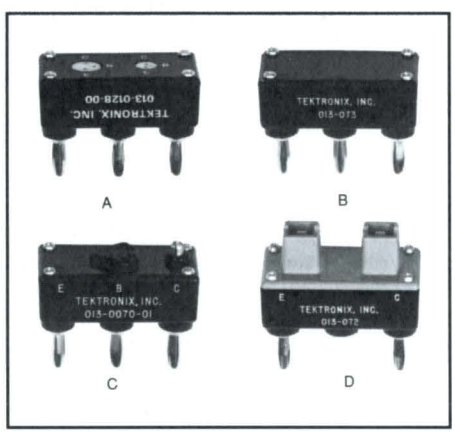


MULTILEAD SOCKETS

These sockets are only used with the 178.

A. 8 lead TO package – Order 136-0444-00 **$70**
B. 10 lead TO package – Order 136-0441-00 **$70**
C. 14 lead dual-in-line package – Order 136-0443-00 **$70**
D. 16 lead dual-in-line package – Order 136-0442-00 **$60**

These four sockets are the most commonly required in curve tracer applications. Other socket configurations are available from Textool Products, 1410 W. Pioneer Dr., Irving, TX 75061.



3 PIN ADAPTERS

The 3 pin adapters can be used with any Tektronix curve tracers. They do not have Kelvin sensing contacts.

A. TO-5 and TO-18 transistors – Order 013-0128-00 **$50**
B. Blank adapter for mounting special sockets – Order 013-0073-00 **$30**
C. TO-3 and TO-66 transistor adapter – Order 013-0070-01 **$70**
D. Axial lead diode adapter – Order 013-0072-00 **$110**

PTS101 PERSONAL TEST SYSTEM DYNAMIC A/D CONVERTER TEST

PTS101 PERSONAL TEST SYSTEM

The Tektronix PTS101 Personal Test System is a PC based, integraded hardware and software package that provides dynamic testing and characterization of analog-to-digital (A/D) converters. Digitizing rates to 20 Mega samples per second (MS/s) and resolution to 12 bits can be tested with the PTS101. Higher speed expansion "H" options are available by contacting your Tektronix representative.

At the heart of the system are two PC instrumentation cards, a high performance Arbitrary Waveform Generator (AWG) and an Acquisition Memory (ACQM). The AWG provides a pure sine wave, required for testing A/D converters. Both cards plug into the 386-based controller supplied with the complete system. The GPIB interface is built in, which allows the PTS101 to drive external GPIB instruments. This allows easy expansion for future higher performance applications.

The Tektronix developed, windowed POLARIS® software provides an easy-to-use interface that controls both the measurement sequence and all system elements. The mouse-based, menu-driven operation and concise documentation are designed to have new users operating their systems within an hour.

Design and test engineers will find the PTS101 system software ideal for their purposes. The highly interactive mouse-based interface allows fast parameter changes, and instantly displays results in color graphics on a windowed display. A library of built-in functions make common operations easy and flexible. When more functions are needed, the system is easily expanded by adding procedures.

The software users interface uses five waveform windows. Once a waveform is displayed in any window, the operator can zoom in for a closer look, just one of several waveform utilities.

The software features a proprietary high performance effective bit measurement algorithm for dynamic A/D Converter testing. Tests available include:

- Effective Bits
- Flattop FFT
- Spectral Averaging
- Signal-to-Noise Ratio
- Histogram/Code Density
- Differential Nonlinearity
- Effective Bits Curve

IBM CLONE UPGRADE KIT

The PTSF01 upgrade kit is now available for use on all 386 IBM Compatible PC clones.

CHARACTERISTICS

ARBITRARY WAVEFORM GENERATOR

Output Signal – 1 or 2 V peak-to-peak into 50 Ω, 4 V peak-to-peak into an open circuit.

Sine Wave Performance – 1 Hz to 6.7 MHz.

Harmonic Distortion – less than 60 dB without filters. Filters are supplied for special test frequencies for 12 bit testing.

Spurious Distortion – less than 70 dB.

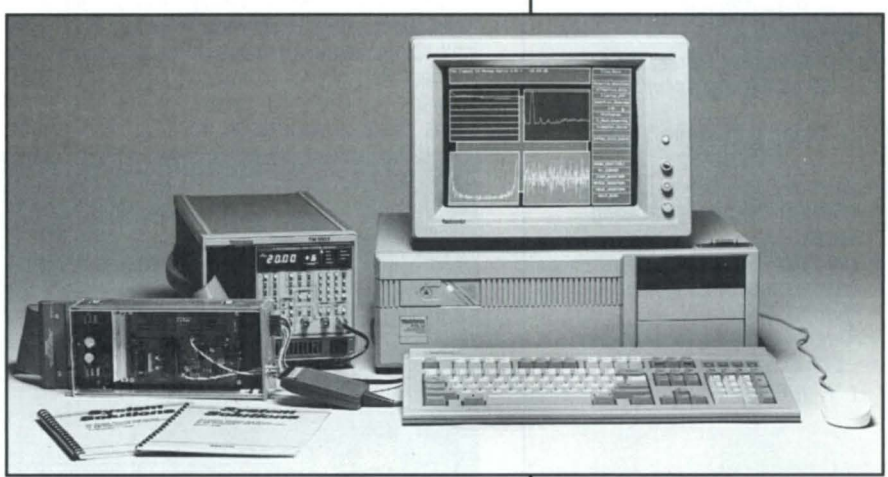
AQUISITION MEMORY CARD

Maximum Memory Word Width – 16 bit

Maximum Aquisition Rate – 20 MS/s

Threshold Level Range – – 5 V to 5 V

On Board Memory – 4 k



PTS101 shown with DUT

PRINTER SUPPORT

The PTS101 supports Epson compatible graphics dot matrix printers that use the Centronic printer interface.

ELECTRICAL

Power Requirements – All operating power supplied by PEP 301 Controller (115/230 V, 50/60 Hz, 230 ac switching power supply).

Safety Certification – UL 478, CSA C22.2 (No. 154-M).

ENVIRONMENTAL

Temperature – Operating: +10°C to + 30°C.

Nonoperating: –10°C to + 60°C.

PHYSICAL

System Unit – 21.0 in (533 mm) W, 6.5 in. (165 mm) H, 17.0 (432 mm) D; 41.9 lb (19 kg).

Keyboard – 19.1 in. (485 mm) W, 0.75 in. (19 mm) H, 8.2 in (208 mm) D; 6.0 lb (2.72 kg).

Display Monitor – 15.6 in. (395 mm) W, 11.5 in. (291 mm) H., 15.75 in. (400 mm) D; 30.8 lb (14.0 kg).

TYPICAL APPLICATIONS

- *Evaluate A/D Converter Chips*
- *Evaluate Digitizer Performance*
- *Production Test of A/D Converters*

FEATURES

- *Up to 20 MS/s, 12 Bit Testing*
- *Fast Test Results*
- *Built-In Functions Library of Common Operations Speeds Testing*
- *Highly Interactive Software for Easy Parameter Changes*
- *Open Software Architecture for Easy Expansion*
- *Higher Speed Options Available*

ORDERING INFORMATION

PTS101 A/D Converter Test System **$19,950**
Includes: PEP 301 Controller; POLARIS Application Software (install on hard disk with backup copy on 5.25-inch floppy disk); Turbo PASCAL Version 5.0 Development Software; Arbitrary Waveform Generator (AWG); Acquistion Memory (ACQM); Two P6451 Probes; Serial Mouse, User's and Programmer's Manual; a Diagnostic Aid (067-0180-00); Standard PEP 301 Power and Keyboard options available.

PTSF01 Upgrade Kit Upgrades an existing PEP 301 or IBM PC clone to a full PTS101 configuration. **$11,999**

PTS101H High speed system built to custom specifications. Contact your Tektronix representative for details.

TYPICAL APPLICATIONS
- *Production Testing of High-Performance IC Devices*
- *Engineering Characterization and Device Verification*

BENEFITS
- *Reduced Cost of Acquisition and Ownership*
- *High Accuracy Improves Guardbands, Raises Yield*
- *Modularity Provides Cost-Effective Upgrades as New Functionality is Needed*

LT-1001/1101/1201 FEATURES
- *Up to 512 I/O Channels*
- *–2.5 V to +7.5 V I/O Channel Operating Range*
- *100 MHz/200 MBit Pattern Data Rate Without Multiplexing*
- *16 Switchable Timing Sets*
- *± 290 ps Timing Accuracy*

LT-1000/1000+/1100/1100+ FEATURES
- *Up to 512 I/O Channels*
- *5.5 V I/O Channel Operating Range*
- *100 MHz/200 MBit Pattern Data Rate without Multiplexing*
- *Four Switchable Timing Sets*
- *± 275 ps Timing Accuracy ("+" models)*

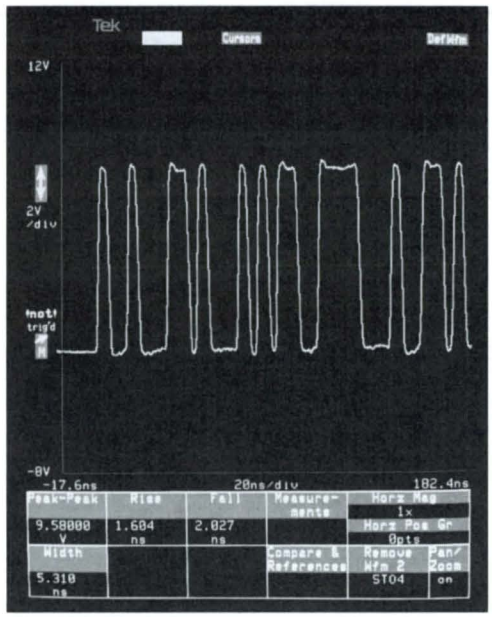
THE VISTA SERIES

The Vista Series semiconductor test systems provide wide-ranging automated test solutions for high-performance IC devices. The entire Vista product line is based on innovations that adapt Tektronix proprietary technology to the stringent demands of the semiconductor test environment, delivering unsurpassed performance while reducing the cost of ownership and operation.

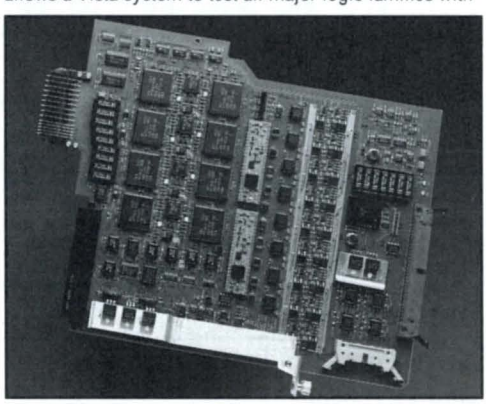
The Vista Series is built on three characteristic technologies: functional integration, modularity, and external automated calibration.

IC PIN ELECTRONICS

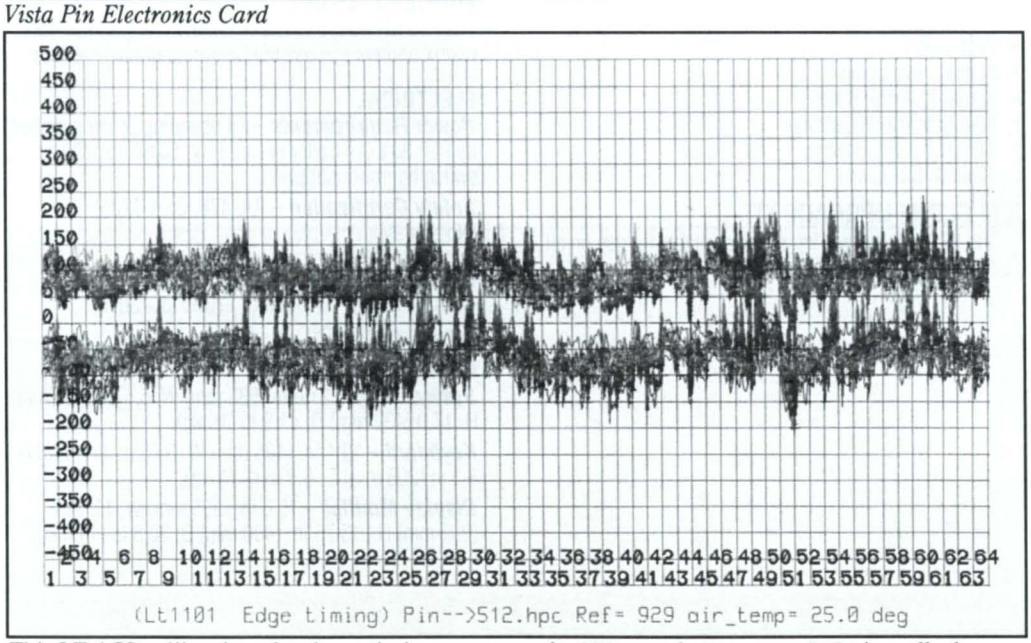
Vista systems utilize a patented IC pin electronics implementation as the basis of a high-performance architecture that advances the "tester-per-pin" concept. Each I/O channel's drivers, timing generators, active loads, and comparators are integrated into a set of monolithic ICs situated within inches of the DUT. This approach yields a 10 V I/O operating range and extraordinarily fast risetimes (1.9 ns or less for a 10 V signal) and allows a Vista system to test all major logic families with a single type of test head. The IC pin electronics implementation consumes only 1/6th the power of conventional high-speed ATE circuitry. Reduced power means reduced heat, which in turn means lower air conditioning costs, improved reliability, and less drift. Floor space requirements are much reduced – to about 1/3rd that of comparable products – due to the inherent compactness of Vista architecture. Maintenance costs are also lower – there are fewer circuit board types in the system, requiring fewer spares and less time to localize failures.



The Vista Series systems are capable of data rates of 200 Mbits/s, as seen here. Note risetimes of 1.6 ns for a full-range signal excursion.



Vista Pin Electronics Card



This LT-ACS calibration plot shows timing accuracy of ± 250 ps or better across 512 pins; all edges, all formats, all timing positions.

MODULARITY AND CONFIGURABILITY

With the pin electronics card as the fundamental modular building block, Vista systems offer practical configurability of pin count to meet evolving needs. Pin count can be added with no loss of performance, and without disproportionate cost. Easy field upgrades are available in standard 64-pin increments. Regardless of pin count, the Vista systems' performance in critical areas such as timing accuracy, skew, and signal integrity is consistent across the product line. This makes it practical to start with an "entry-level" configuration (as few as 64 pins) and expand to 512 pins when the need arises. This reduces up-front capital costs yet ensures that a reserve of expandability is available for future needs.

EXTERNAL AUTO-CALIBRATION

The third element of Vista technology, external automated calibration, is implemented in the LT-ACS Auto-Calibration Station. This mobile instrumentation cart "docks" to the testhead and exhaustively measures system timing, skew, and dc parametric performance. It calculates, then loads correction factors into the pin electronics card, providing a calibration that counteracts cumulative system errors. System accuracy specs are guaranteed within three inches of the DUT and the system is guaranteed to remain within spec tolerances for a minimum of one month. Unlike the more common internal self-calibration hardware found in most ATE systems, the LT-ACS can itself be taken to a certified facility and calibrated to NBS standards, providing a traceable reference for full-system calibration, and ultimately, for device measurements. One mobile LT-ACS can provide calibration for all Vista Series Test Stations at a site, distributing the cost of calibration and improving correlation across all testers.

All Vista systems are of course software-compatible. The programming workstation offers an efficient user interface optimized for test programming needs. Like the LT-ACS, a single workstation can serve multiple test stations.

Any of the three system components – Test Stations, LT-ACS, or workstation – may be purchased separately as new throughput needs evolve.

WORLDWIDE SERVICE AND APPLICATIONS SUPPORT

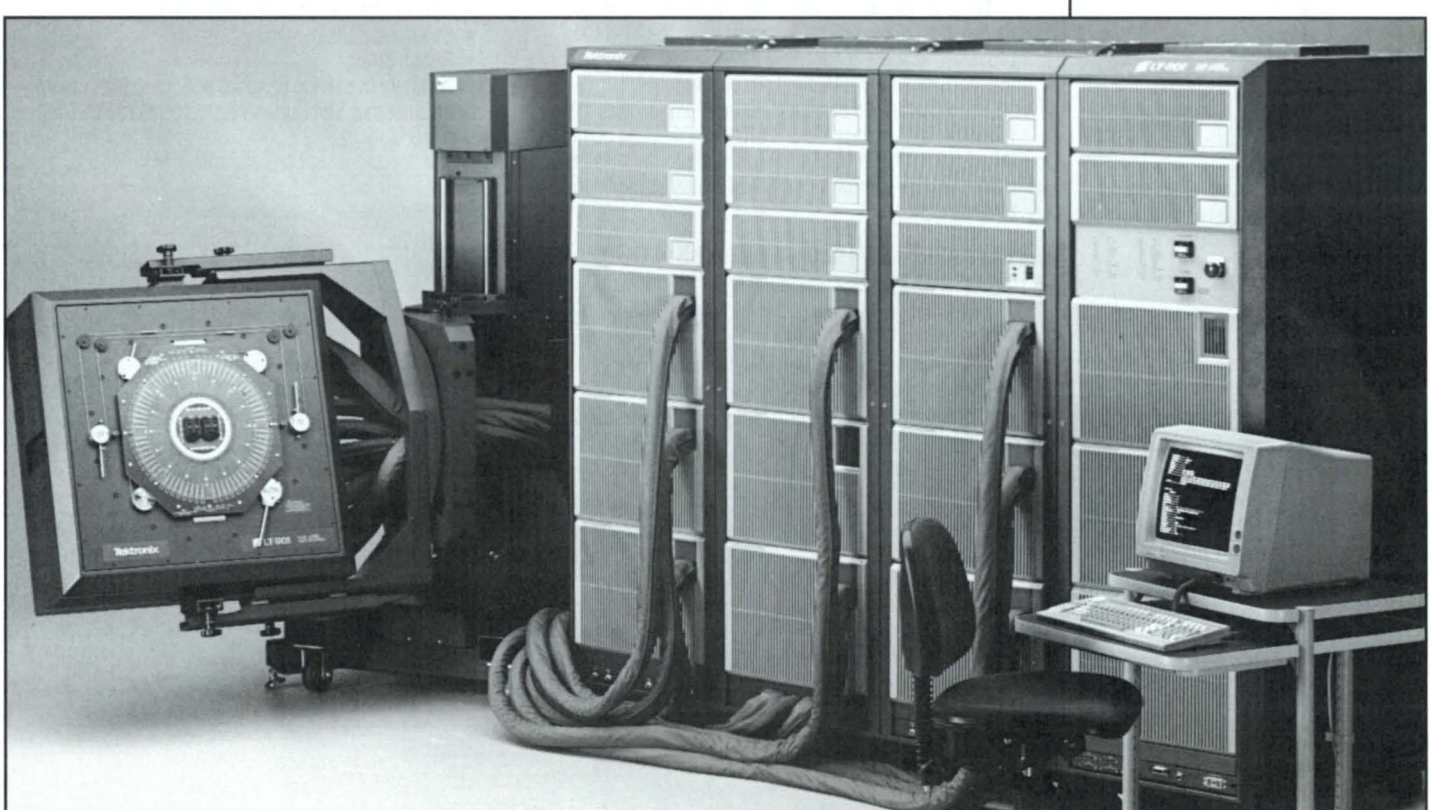
Tektronix supports the Vista Series from conveniently-located service centers throughout the world. Like the Vista systems themselves, service programs can be configured to meet your needs. Vista owners may choose guaranteed response times, various levels of spare parts kits, periodic preventive maintenance visits, or any of several other options. To supplement hands-on service calls, a modem-based Remote Diagnostic Interface connects your Vista system to a duplicate system at a Tek service facility where a Vista system engineer can assume full control of your system to diagnose problems.

Similarly, applications engineering services are available worldwide.

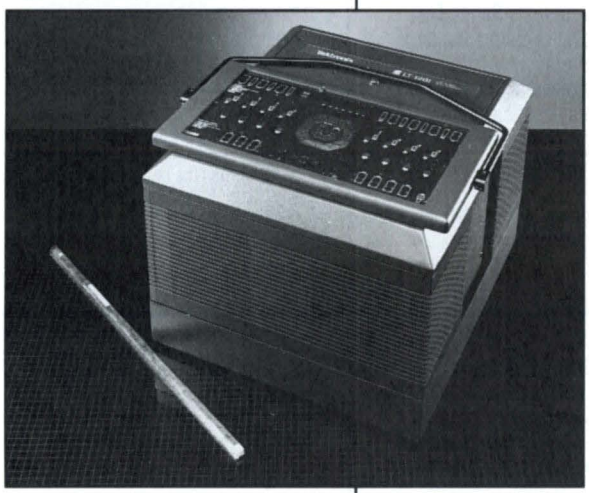
ORDERING INFORMATION

Tektronix Vista Series systems are manufactured to order, with deliveries 4-6 weeks ARO. Configurations are determined by your performance and capacity needs, and may vary from system to system of the same model number. Options such as the number of I/O pins, the number of test heads, the number and type of DUT power supplies, and warranty /service program options need to be considered at the time of ordering.

Vista Series Sales Engineers are available to consult on your test system needs. Contact Tektronix Semiconductor Test Systems Division Marketing at (503) 629-1435 (USA) for the name and location of the Vista Sales Engineer nearest you.



LT-1101 VLSI Logic Test System



The compact 37-pound test head of the LT-1201 LSI Logic Test System offers the industry's highest performance for SSI/MSI/LSI testing.

VISTA SERIES

LT-1201 LSI LOGIC TEST SYSTEM

The LT-1201 applies Vista Series VLSI tester technology to commodity SSI/LSI production testing. It addresses the performance needs of high-speed CMOS and AS-TTL devices as well as standard TTL, CMOS, BiCMOS, and ECL. The system can test two devices simultaneously (on each of two test heads) and its timing accuracy, data rate, and pattern vector depth far exceed those of competitive products. The LT-1201 provides a unique value in production ATE.

LT-1001 VLSI LOGIC TEST SYSTEM

The LT-1001 VLSI Logic Test System's 256-pin capacity and uncompromised Vista performance make it an ideal candidate for testing today's high-volume VLSI devices–gate arrays, cell-based ICs, microprocessors, etc. The LT-1001 addresses the requirements of both bipolar and CMOS devices at data rates up to 100 MHz.

LT-1101 VLSI LOGIC TEST SYSTEM

Whether you measure your testing costs in cost per device, cost of operation, or capital cost, the LT-1101 provides the most economical 512-pin test solution in the industry–with no tradeoffs in performance.

The Vista Series' easily expandable architecture makes it feasible to purchase the LT-1101 in a reduced configuration (for example, 128 pins) to handle today's test requirements, and grow to the full 512 pins as the need arises.

LT-1000/1100/1000+/1100+VLSI LOGIC TEST SYSTEMS

The LT-1000 and the LT-1100 are high-performance CMOS testers with 256 and 512 I/O pins, respectively. The "+" models provide enhanced accuracy and 200 MBit/sec testing capability. This latter feature allows greater flexibility in data formatting for complex ASICs and similar devices.

S-3200 SERIES

The S-3200 Series complements the Vista Series with 20 MHz products that are suitable for manufacturing production testing, mil-spec screening, and engineering characterization.

The S-3200 Series consists of four models: S-3295, S-3270, S-3225, and S-3220.

S-3295 VLSI TEST SYSTEM

128 I/O pins, advanced pattern processor, timeset switching, programmable risetime.

S-3270 LSI TEST SYSTEM

64 I/O pins, single-pass ac timing measurement system, 14-phase timing system, pattern computer or stored response testing.

S-3225 ADVANCED LOGIC TESTER

64 I/O pins, 125 ps timing edge resolution, 2.4 V TTL risetimes, 1 mV driver programming resolution. Precision and speed for high-performance SSI and MSI testing.

S-3220 TEST SYSTEM

S-3200 performance in a compact, low-cost package. The S-3200 product group is chartered to provide full support of its large installed base. Support services include:

- Retrofit enhancements
- Software updates and networking products
- Applications assistance
- Applications and maintenance training
- Extensive parts inventory
- Refurbishing

A variety of service program options exists, ranging from Customer Site Support Agreements to Per-Call service.

- *Graphical, Iconic User Interface*
- *Stimulus Management and Editing*
- *Automatic Test Program Generation*
- *LV500 Communication Support*
- *Direct Printer and Plotter Support*
- *Automatic Conversion of Test Program Vectors to Stimulus Patterns*

LINK DESIGN AND TEST

TekWAVES provides a software environment to link design with test. Running on the design engineer's Apollo workstation, the TekWAVES Waveform Analysis and Verification Environment provides for the creation and editing of stimulus data, and the ability to generate a test program for the LV 500 ASIC Verification System. TekWAVES consists of a core Test and Measurement framework, along with an ASIC Verification module that provides tools for the ASIC design engineer.

ICONIC, GRAPHICAL WORKBENCH

TekWAVES software is easy to use, featuring an intuitive, iconic user interface. At the heart of TekWAVES is a test and measurement framework, a Workbench. To perform a task you simply pick up a tool from the Card File, put it on the Workbench, and begin working with it.

STIMULUS MANAGEMENT AND EDITING

TekWAVES provides direct read and write capability for Genrad HILO and Mentor Graphics QuickSim simulation data, and TSSI SEF format stimulus files. In addition, translators are provided to bring simulation data from Valid's ValidSim, Teradyne's LASAR, and Daisy VLAIF into TekWAVES. You create, display, and edit stimulus vectors using a STATE EDITOR, TIMING EDITOR and TIMESET EDITORS.

The STATE EDITOR lets you view waveform data in its character format, edit individual state characters, cut and paste blocks of states, or write waveform subroutines and algorithmically generate clock patterns. Changes made in the State Editor are immediately reflected in the Timing Editor, and vice-versa.

The TIMING EDITOR lets you edit waveforms graphically, by dragging edges where you want a transition. You can search for common timing functions and display the capabilities of the target tester.

The TIMESET EDITORS let you create timeset subroutines to use as templates for common functions, for example microprocessor read, write, or fetch operations. You can create subroutines describing different timing versions, to perform margin testing.

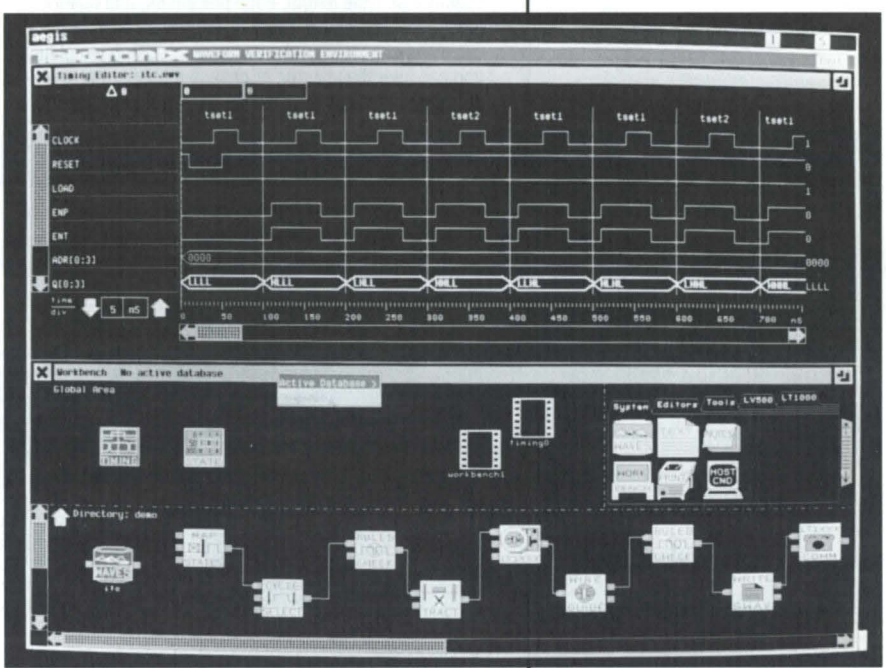
In addition to the editors for the creation and modification of stimulus data, a series of filters let you adjust stimulus data to eliminate glitches, change the default mapping of logic states, align waveform edges or cycle boundaries, and scale its timing to control the frequency of a transition.

AUTOMATIC TEST PROGRAM GENERATION

TekWAVES saves designers from learning a specialized programming language specific to their tester. After editing stimulus data, you can bring that data to the tester quickly and easily. TekWAVES checks stimulus data for compliance with the tester resources and capabilities, and graphically displays problems such as dead zone violations, misaligned cycle boundaries, and narrow pulses. Cycle assignment, timeset extraction, allocation of tester resources, and test program generation are all performed automatically. Designers control each iteration of this process by wiring up the icons that represent individual tasks, then running all the tasks with a click of the mouse.

LV 500 COMMUNICATIONS

TekWAVES can generate a test program that uses all the advanced features of the LV 500, and it provides easy transfer of files back and forth to the tester via RS-232, GPIB, or LAN communications.



CONVERSION OF TEST VECTORS TO SIMULATION PATTERNS

Once the test program is downloaded, you can make changes on the tester, then upload the modified test program back onto the TekWAVES Workbench. TekWAVES translates the program back into test patterns for a variety of simulators, including HILO and QuickSim. You can also write test program data in TSSI SEF format, preserving all the pattern and timing information to let you re-simulate. This lets you verify any changes in the tester against the original simulation model.

PRINTER AND PLOTTER SUPPORT

TekWAVES can print data to any Postscript printing device, such as an Apple LaserWriter, or to any Hewlett Packard plotter that can interpret HPGL, Hewlett Packard Graphics Language.

ORDERING INFORMATION

WAV20V TekWAVES/LV for Apollo Computers	$4,990
Opt. Q9 – 12 months Software Subscription Service (US)	+$900
Opt. 1S – 12 months Software Subscription Service (Int.)	+$900
WAV2GP Apollo GPIB Card and SW	$995
WAV2RV 12 months Software Subscription Service (excludes media and documentation)	$750
WAV2UV Update kit WAV20V, Inc. SW and documentation	$1,800
Opt. Q9 – 12 months Software Subscription Service (US)	+$900
Opt. 1S – 12 months Software Subscription Service (Int.)	+$900

NEW

LV 500 *ASIC VERIFICATION SYSTEM*

The Designers Solution

- *Per-Cycle Definition of Timing*
- *Compact Benchtop System*
- *50 MHz Test Rates*
- *64 TO 256 I/O Channels*
- *64k Pattern Depth*
- *Up to 16 Clocks (32 Programmable Edges)*

VERSATILE CLOCKING

The LV500 is the first ASIC Verification System able to match the timing flexibility found in logic simulators and large production testers. Its sophisticated timing allows much more of the simulation information to be transferred to the test program. Until now verification systems have been equipped with fixed vector timing, limiting their ability to reproduce simulation vectors and making it difficult to compare simulation and prototype test results. Using the LV500, you can reproduce your simulation vectors much more accurately.

The key to providing all this flexibility in the LV500 is the use of "templates." A template allows the user to specify test cycle length, edge placement, and channel function (force, sense, mask or inhibit) on a cycle-by-cycle and channel-by-channel basis. Using templates you can alter the test rate or change the timing of any data channel at any time during a test sequence.

The LV500 provides up to 16 clock sources (timing generators). Each of the data channels is assigned to one of the 16 clocks. Events on any data channel are programmed to occur on either of the clock edges. As with large testers, the test cycle length may be changed from one cycle to the next.

CONFIGURABLE RESOURCES

The LV500 system tests digital devices with up to 256 bi-directional channels at data rates up to 50 MHz. With a deep (64K) pattern memory, tests are performed realistically and efficiently.

Configured in multiples of 64 channels, the LV500 provides 64, 128, 192 or 256 I/O channels. Systems with less than 256 channels can easily be expanded when the need arises. Two device power supplies are also included.

EFFICIENT HUMAN INTERFACE

The human interface of the LV500 allows designers to work in a familiar environment. In the template screen, for example, timing is defined in the same format as that found in IC data books. Timing diagrams show the time relationships among the signals for each cycle. Users can adjust the timing at will using pop-up menus.

The configuration screen allows quick setting of power supplies, force voltages, and compare voltages. The DUT wiring screen maps data signals to the tester channels. The mapping of channels may be set up automatically, defined inter-actively, or extracted from a previous setup.

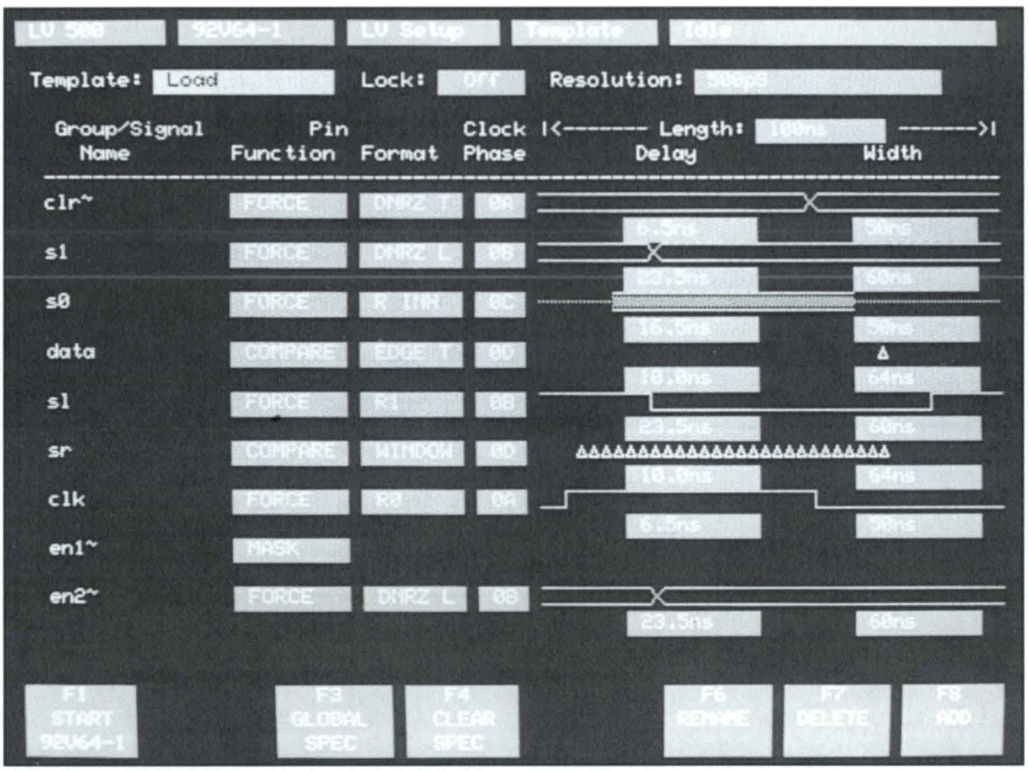
POWERFUL TEST VECTOR CREATION

You can easily use simulation design data to create test vectors for the LV500. The system can accept data from virtually any logic simulator. It has turnkey solutions for Mentor's QuickSim, Daisy's DLS, Hilo, Valid, and Lasar. During the translation process, timing and functional information is extracted from the simulation data to automatically set up the Template screens (defining test cycle timing), the Pattern screen (defining test vectors), the Channel Grouping screen, and the DUT Wiring screen with little or no manual input. In many cases no further setup is necessary.

Sometimes you may want to create or edit test patterns manually. The pattern editor is simple yet powerful, with the ability to create high level pattern macros. This makes it easy for you to generate and document test patterns for your devices.

THE TekWAVES CONNECTION

A companion product to the LV500 is the TekWAVES ASIC Verication Software package. TekWAVES allows development of complete LV500 test programs on the designer's workstation. For more specific information, please refer to the TekWAVES information on page 339.



LV 500 template setup screen for timing definition.

ORDERING INFORMATION

Each LV 500 system is configured with the following standard equipment:

LV 500 Mainframe includes: 40 MByte hard disk, 1.2 MByte floppy drive, 8 MByte system memory, GPIB/ Expansion module (LV514 only), pattern board(s) and error board(s) with cables.

LV 500T color display terminal
LV 500 Expansion Mainframe (LV 514 only)
Testhead with specified number of channels
Continuity Test, PGA, and DIP DUT Cards
Two Programmable Power Supplies
Schmoo Plot Software
LV 500 User's Manual with Binder
Backup Software
Tutorial Package

LV511 64 Channel ASIC Verification Unit	**$55,000**
Opt. Q0 – On-site Installation and Set-up	**+$600**
Opt. Q2 – +1 Yr. Warranty, On-site Coverage	**+$3,300**
Opt. Q3 – +2 Yrs. Warranty, On-site Coverage	**+$6,600**
Opt. Q9 – S/W Subscription/Warranty	**+$1,300**
LV512 128 Channel ASIC Verification Unit	**$94,000**
Opt. Q0 – On-site Installation and Set-up	**+$700**
Opt. Q2 – +1 Yr. Warranty, On-site Coverage	**+$5,640**
Opt. Q3 – +2 Yrs. Warranty, On-site Coverage	**+$11,280**
Opt. Q9 – S/W Subscription/Warranty	**+$1,300**
LV513 192 Channel ASIC Verification Unit	**$133,000**
Opt. Q0 – On-site Installation and Set-up	**+$800**
Opt. Q2 – +1 Yr. Warranty, On-site Coverage	**+$7,980**
Opt. Q3 – +2 Yrs. Warranty, On-site Coverage	**+$15,960**
Opt. Q9 – S/W Subscription/Warranty	**+$1,300**
LV514 256 Channel ASIC Verification Unit	**$172,000**
Opt. Q0 – On-site Installation and Set-up	**+$900**
Opt. Q2 – +1 Yr. Warranty, On-site Coverage	**+$10,320**
Opt. Q3 – +2 Yrs. Warranty, On-site Coverage	**+$20,640**
Opt. Q9 – S/W Subscription/Warranty	**+$1,300**

The following options are available for all LV 500 systems:

Opt. 2C – GPIB/Expansion module (standard on the LV 514)	**+$1,950**
Opt. 4C – EtherNet LAN Interface Module	**+$3,450**
Opt. 3M – Simulator Translators S/W	**+$1,000**
Opt. 14 – 20 MB Removable Hard Disk	**+$1,200**
International Power Plug Options	
Options A1 – A5 – Available	**NC**

See page 488 for description.

TEST AND MEASUREMENT SOFTWARE

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GURU II + ... 352
GPIB Interface 352
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11000 Series DSO IBM PC Utility 356
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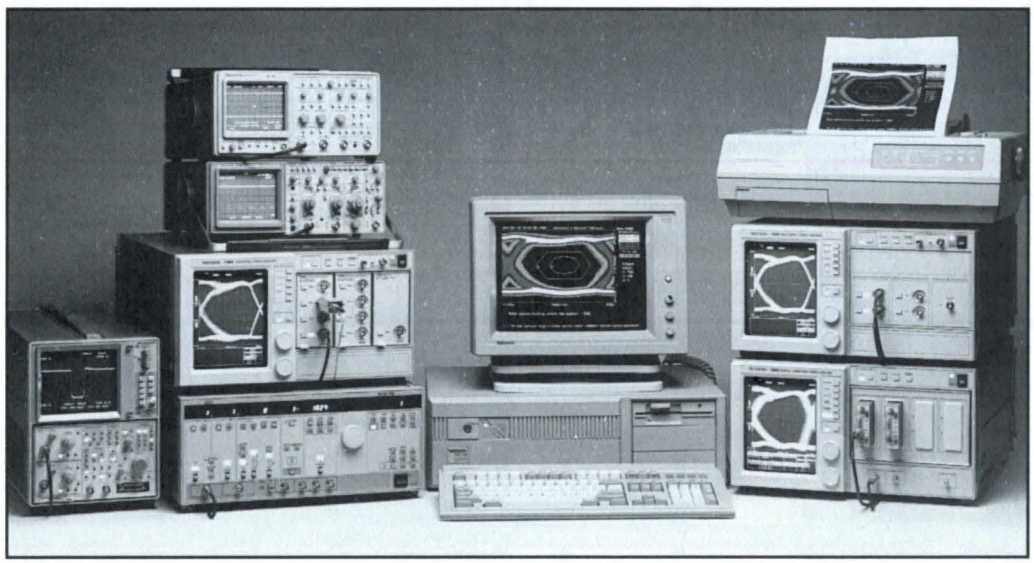
Integrated TeleServicing Support 358



TEKWARE PROGRAMS COMPLEMENT TEKTRONIX INSTRUMENTS AND CONTROLLERS

With technology more complex and schedules becoming shorter, the need to automate test and measurement environments is greater than ever.

Tek can meet your need for improved test and measurement productivity in the lab, on the factory floor, or at the remote site. Tekware programs are designed to enhance the productivity of Tektronix instruments and controllers.

Tektronix has performed extensive software testing to verify that all standard Tekware measurement, analysis, and utility packages run reliably with Tek instruments and controllers. MS-DOS Tekware programs have been tested for compatibility with 286/386 IBM compatible PCs and the PEP family of system controllers.

Applications Software

Tekware applications software provides a wide selection of ready-to-use general purpose control, measurement, and display capabilities. Simply load Tekware applications into your controller, and your system is ready to go to work for you. If your software requirements do not call for unique processing or specialized control functions, Tekware applications software could be the shortest path to a complete system solution.

Development Software

Tekware development software tools can be used to create new software or to modify existing software. Some Tekware development software products contain test program generators enabling you to create test procedures without writing a single line of code.

If your testing requirements call for development of a custom program or for customizing an existing program, a Tekware development software tool could be the key to the solution.

Utility Software

Tekware utility software instrument drivers, peripheral drivers, processing modules, and display modules can be linked to other Tek or non-Tek software to produce custom programs. Using Tekware utility software whenever possible, rather than developing your own code, can substantially reduce software development time.

Software Support

To keep your software current and up-to-date, our software support is available at no charge during the warranty period. Post-warranty software support is available on a subscription basis.

Technical Assistance Services (TAS)

When you need technical assistance to supplement your own resources, Tektronix can provide the services of an Applications Engineer skilled in meeting your needs. For more information see page 358.

MS-DOS TEKWARE AT A GLANCE

The software product chart on the following pages provides an easy way to match MS-DOS Tekware programs to Tek instruments and to your measurement needs.

How to use the Tekware Chart:

By software package

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

By instrument

Find your instrument in the list at the top of the column. Follow down the column to identify Tekware packages which support this instrument. Other instruments supported by a particular software package, features provided, and languages supported are given in the row for each software package.

By application

Follow down the applications column to identify Tekware packages which support your particular application. Instruments supported, other features, and languages supported are given in the row for this software package.

By features provided

Follow down the column for the feature of interest to identify Tekware packages with this feature. Instruments supported, other features, and languages supported are given in the row for this software package.

By language supported

Follow down the column for the programming language to identify Tekware packages that support this language. Instruments supported, features provided, and other languages supported are given in the row for this software package.

By hardcopy support

Follow down the hardcopy column to identify Tekware packages that support particular hardcopy devices. Other instruments and features supported by a particular software package are given in the row for each software package.

MS-DOS TEKWARE CHART

Here are definitions for some of the terms used in the Tekware chart:

- ***ADIF Format***
  A Tektronix Format for interchange of waveform data between instruments.
- ***Data Logging***
  Data or results can be stored to disk or other peripherals.
- ***Extended Graphics***
  Supports graphics cards with resolution higher than CGA (e.g. EGA, VGA).
- ***Front Panel Control***
  Front-panel settings of associated instruments can be read and/or set.
- ***GPIB Communication***
  Data can be sent and received via GPIB.
- ***Instruments from Other Vendors***
  Supports instruments from other vendors that comply with the IEEE-488 Standard.
- ***Programming Language Support***
  Produces source code or object files which can be read by the specific languages.
- ***Pulse Parameters***
  Can perform pulse measurement functions such as risetime, falltime, width, etc.
- ***RS-232 Communication***
  Data can be sent and received via RS-232.

MS-DOS TEKWARE™ AT A GLANCE

PRODUCT NAME	PRODUCT NUMBER	Page Reference	DSA 601/602	11801/802/803T	11201/11401/402/403	11302/A Pgrm Analog Scope	7104/R7103 1 GHz, Analog Scope	7854 Wfm Processing Scope	7D20 Programmable Digitizer	2467B/65A/B/45A/B Scope	2430A/31L/32A/40 DSO	2402/2410 TekMATE	2221/24/30/32 DSO–GPIB	2221/24/30/32 DSO–RS-232	336/A DSO	222 Handheld DSO	RTD 710/A Digitizer	RTD 720 Digitizer	7250 Transient Digitizer	7912 AD/HB Pgm. Digitizer	DCS01/MUX04/16 Digital Camera	1230 Logic Analyzer	2782 Program., Spectrum Analyzer	490P-2750P-Series PgmSpectrum	TM 5000 Mod. Inst.	ARG5101 (Arb Wfm Gen)	VXI Instruments	TSI 8150 Test System Interface	370 Pgm. Curve Tracer	371 Hi-Power Pgm. Curve Tracer	Instruments frm other vendor	2510 TestLab Waveform Analyzer
			INSTRUMENTS SUPPORTED																												
Test Management System (TekTMS)	S3FT100	347	●	●	●						●														●		●	●			
EZ-TEST	S45F030	349	●	●	●	●			●	●	●	●	●				●			●					●			●			
GURU II+	S3FG100/110	352		●	●			●	●	●	●	●	●		●		●			●				●				●	●	●	
GPIB Interface	S3FG120/121/122	352																													
Signal Processing & Display (SPD)	S3FG130	353	●	●	●			●	●		●	●	●	●			●	●		●	●										*1
ASYST & Drivers	S47P305/S42P301/302	350	●	●	●			●	●		●		●				●		●	●										●	*2
ASYSTANT GPIB	S42P311	350	●	●	●			●	●		●		●																	●	*2
LabWindows	S3FG910/912	351		●	●			●			●		●				●			●					●	●				●	*2
DADiSP Signal Analysis	S3FG916/918	354		●	●						●						●								●	●				●	*1
i-Pattern™	S47P107	355	●	●	●	●	●		●	●	●		●	●			●				●										
Template/Waveform Processing Program	S47P110	355	●	●	●	●					●																				
11000 Series DSO Utility	S47P108	356	●	●	●																										
11302A Utility	S47P103	356				●																									
7854 Time & Amplitude	S42P202	356						●																							
7854 Communications & Control	S42P101	356						●																							
DITS ANSI/CCITT	S37J101/102/103	455									●	●																			
TGEN	S37T100	*3									●	●																			
EZ-TEK 2400	S38A101	*3								●															●						
2402 TekMate DSO Util.	S37UT01	357									●	●																			
Program Development Pkg	S37UD01	357									●	●																			
Integrated TeleServicing	S41TSS1	358												●																	
2220/2221/2230 Instrument Utility	S49Z201/202/203	*3											●	●																	
Interactive Meas. S/W for RTD 710A Digitizer	S45D010	*3															●														
DCS Acquisition, Graphics and Analysis	062-9859-00	*3				●	●			●										●	●									●	
DCS01 Functional Library	S58DC01	*3				●	●			●										●	●									●	
MUX Option 10/11/13/15 DCS MUX04/16		*3				●	●			●										●	●									●	
1230/PC RS-232 Applications	S43R101	205																				●									
2782/PC Utility	S26UT00	*3																					●								
EMI Prequalification	S26EM00	230																						●							
General RF Applications (GRASP)	S26RF00	230																						●							
Remote Site Monitoring (RSM)	S26RM00/01	230																						●							
WaveWriter Waveform Generation	S75WVWR	348									●														●	●	●				
370 Device Test	S48P401	*3																											●		
370 Utility	S48P104	*3																											●		
371 Utility	S48P105	*3																												●	

The 2510 TestLab Analyzer writes waveform data to an integral MS–DOS formated 3 1/2 inch flexible disk. The PC Utility software provided with the analyzer converts the data into various formats that are compatible with PC resident analysis programs including WKS format for spreadsheets and:

**1 ASCII format with specific header information for input to DADiSP and SPD Menu.*

**2 ASCII format without header information.*

**3 Contact your local sales engineer for details.*

MS-DOS TEKWARE™ AT A GLANCE

PRODUCT NAME	PRODUCT NUMBER	Page Reference	APPLICATIONS: Audio Tests	Board Test	Component Test	EMI Test	Laser/ ESD, Hi Voltage Transients	Remote Site Monitoring	Service/Troubleshooting	System/Subsystem Test	Telecommunications Tests	FEATURES: Waveform Creation	Front Panel Control	GPIB Communication	RS-232 Communication	Pulse Parameters	Waveform Analysis	Extended Graphics	Test Procedure Generator	Test Program Generator	Data Logging	ADIF Format	PROGRAMMING LANG. SUPPORT: Interpretive BASIC	IBM BASIC Compiler	Microsoft QuickBASIC	C Language	Pascal	Fortran	MicroSoft Windows	HARD-COPY: Printer	Plotter (HC100/HPGL)	Color Copier (TEK 4693)
Test Management System (TekTMS)	S3FT100	347		●	●				●	●			●	●	●	●	●	●	●	●	●	●							●	●		
EZ-TEST	S45F030	349			●				●	●			●	●		●		●	●	●	●	●			●							
GURU II+	S3FG100/110	352	●							●			●	●		●			●		●	●	●	●	●				●	●		
GPIB Interface	S3FG120/121/122	352												●									●	●	●	●			●			
Signal Processing & Display (SPD)	S3FG130	353																														●
ASYST & Drivers	S47P305/S42P301/302	350			●					●		●	●	●	●	●	●	●			●									●	●	
ASYSTANT GPIB	S42P311	350										●	●	●		●	●	●			●									●	●	
LabWindows	S3FG910/912	351											●	●			●	●		●					●	●				●	●	
DADiSP Signal Analysis	S3FG916/918	354																														
i-Pattern™	S47P107	355		●	●					●	●		●	●	●	●		●			●				●	●				●		●
Template/Waveform Processing Program	S47P110	355		●	●					●	●	●		●				●			●									●		●
11000 Series DSO Utility	S47P108	356											●	●	●			●			●				●					●	●	●
11302A Utility	S47P103	356										●	●	●	●						●				●					●		
7854 Time & Amplitude	S42P202	356			●							●	●	●		●	●	●			●									●		
7854 Communications & Control	S42P101	356												●										●						●		
DITS ANSI/CCITT	S37J101/102/103	455									●		●	●			●	●			●	●								●		
TGEN	S37T100	*1	●	●	●	●				●	●	●		●			●	●			●	●				●			●	●		
EZ-TEK 2400	S38A101	*1			●	●				●			●	●		●			●		●	●								●		
2402 TekMate DSO Util.	S37UT01	357			●	●							●	●		●	●				●	●			●	●				●	●	
Program Development Pkg	S37UD01	357				●		●		●	●	●	●	●		●	●				●	●			●	●				●	●	
Integrated TeleServicing	S41TSS1	358						●	●		●				●						●									●		
2220/2221/2230 Instrument Utility	S49Z201/202/203	*1						●		●	●			●	●								●		●		●					
Interactive Meas. S/W for RTD 710A Digitizer	S45D010	*1											●	●		●	●	●		●	●			●						●		
DCS Acquisition, Graphics and Analysis	062-9859-00	*1			●	●	●						●	●		●		●			●	●								●	●	
DCS01 Functional Library	S58DC01	*1			●	●	●			●															●	●	●	●				
1230/PC RS-232 Applications	S43R101	205			●	●	●						●	●					●		●	●										
MUX Option 10/11/13/15 DCS MUX04/16		*1							●	●			●		●																	
2782/PC Utility	S26UT00	*1											●	●			●	●			●				●					●		
EMI Prequalification	S26EM00	230				●	●							●				●			●			●						●		●
General RF Applications (GRASP)	S26RF00	230			●	●				●				●				●			●			●						●		
Remote Site Monitoring (RSM)	S26RM00/01	230			●			●		●			●	●			●	●			●		●	●						●		
WaveWriter Waveform Generation	S75WVWR	348	●	●	●					●	●	●		●		●						●							●			
370 Device Test	S48P401	*1						●		●			●	●			●				●		●							●		
370 Utility	S48P104	*1											●	●				●	●		●				●						●	
371 Utility	S48P105	*1											●	●				●	●		●				●						●	

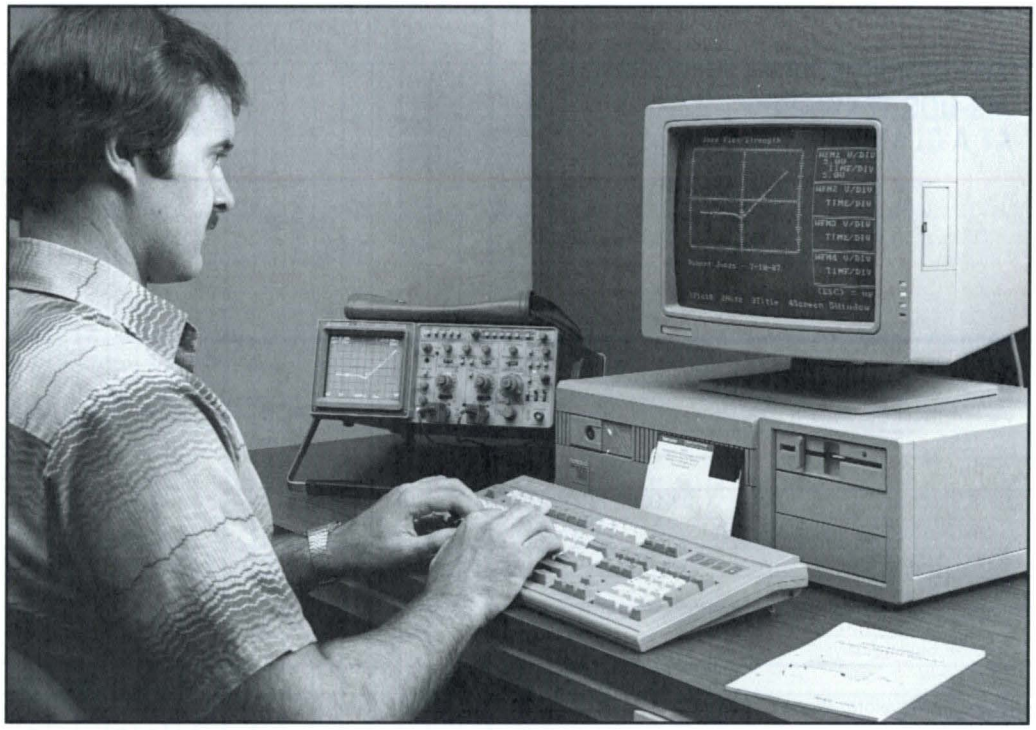
*1 *Contact your local sales engineer for details.*

Technical Assistance Services (TAS)

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

ORDERING INFORMATION

TAS Order – 068-9080-00. **$125/hr.**
Availability is limited. Please contact your local Tektronix Sales Engineer for more information and availability in your area.



When your systems development program calls for informed, on-site assistance, Tektronix can keep you in touch with some of the best in the world

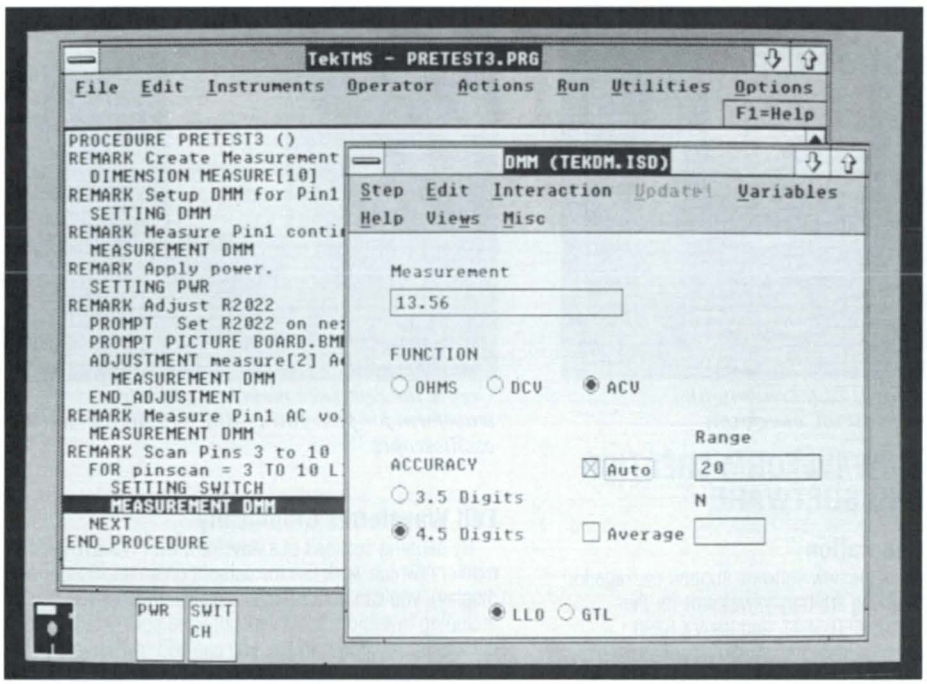
With Tek Application Engineers, you enjoy a resource that you can draw on to help you derive maximum benefit from Tektronix system components.

Tektronix Application Engineer consultation is designed specifically to optimize the operation of Tek instruments and SOFTWARE

We suggest that customers may first want to avail themselves of Tek's excellent documentation and regular customer training programs prior to requesting our Technical Assistance Services.

Typical Consulting Services Include:

- **Installation assistance**
  This may include pre-installation counseling, assistance in installing hardware or software, and installation validation.
- **Familiarization training**
  This usually takes the form of a brief introduction (individuals or groups) of hardware basics, system interaction, and software utilization. Other training modules may present specific operational aspects of a product.
- **Custom training**
  You may require that unique training modules be designed and presented to meet an unusual application, environmental or personnel need.
- **Problem definition and debugging assistance**
  Application Engineers can help you trace and debug problems within a hardware/software system.
- **Interfacing assistance**
  We can assist you with unusual interfacing challenges requiring intimate knowledge of Tek hardware and software.
- **Application assistance**
  You can obtain expert consultation in signal acquisition, specific test and measurement tasks, integrating Tek hardware and software within an existing process, and in other application-specific areas. Technical Assistance service is available in one hour increments.



Instrument Front Panels show instrument states in your test procedure and in hardware.

TEKTRONIX TEST MANAGEMENT SYSTEM (TEKTMS)

TekTMS provides a highly productive software package for test development and execution in manufacturing, repair/rework, and prototype development testing applications

Interactive Procedure Generator

The Interactive Procedure Generator (IPG) provides easy-to-use dialog menus to simplify test development and eliminate syntax errors. Instrument control steps are as easy to create as pushing a button on an instrument software front panel. The IPG editor creates an "Outline View" of the test program with steps chosen from the Instruments, Operator, or Actions menus.

UUT Graphics Displays

Display component locations diagrams and schematics for your operator to see on-screen during test execution. TekTMS handles graphics pictures created with bit-map drawing software running in Microsoft Windows, such as PC Paintbrush.

UUT Adjustment Step Displays

An adjustment step display simplifies operator assisted calibration adjustments to the UUT. A real time display of the adjustment moves a measurement cursor as the operator makes the physical adjustment.

Waveform Acquisition, Processing, and Display

TekTMS acquires waveforms as unique waveform variables with scaling and timebase information built in. Waveform arithmetic and math functions automatically handle all elements of waveforms. Pulse parameter analysis provides time and amplitude characterization of complex pulse waveforms.

VXI and GPIB Instrument Front Panels

Instrument Front Panels create instrument procedure steps without hardware and manipulate on-line instruments for interactive development sessions. Use the mouse to set up instrument controls for a test step. Instrument front panels may be placed on screen as icons and enlarged to full size when needed. Choose Instrument Front Panels from two libraries. The libraries provide a software file and context sensitive help for each instrument .

Develop Your Own Front Panels Quickly

Develop instrument front panels in only hours with the TekTMS Instrument Script Language and Help Editor. Use these tools together to build interactive instrument front panels with context sensitive help.

Instrument I/O Tracing

TekTMS simplifies program debugging with the I/O trace window. The trace window shows all instrument message traffic during test procedure execution.

Tektronix VXIbus Support

TekTMS runs on the Tektronix VX5530 D size and VX4530 C size VXIbus System Controllers. TekTMS controls GPIB interfaced VXIbus instruments with the Tektronix VX1500 mainframe configured with a VX5520 Slot 0 Resource Manager. These VXIbus configurations control up to 256 logical VXI instrument devices which comply with the VXI Standard for Word Serial Message Protocol or Shared Memory Protocol.

Tektronix Test Management System (TekTMS)

- *Easy-to-Use Outline View of Test Program.*
- *VXI and GPIB Instrument Front Panel Libraries.*
- *Program Instruments with Interactive Instrument Front Panels.*
- *Provides Powerful Time and Amplitude Waveform Processing for Complex UUT Signals.*
- *Displays UUT Component Layouts and Schematics.*
- *Adjustment Display Provides Realtime Feedback of Manual UUT Adjustments.*
- *Controls Instruments on the VXIbus, GPIB Bus, and RS-232 COM Ports.*
- *Develop Instrument Front Panels with Instrument Script Language and Help Editor.*
- *Familiar Microsoft Windows Interface Makes Getting Started Easy.*

SYSTEM ENVIRONMENT

Tek VX5530 or VX4530 VXIbus System Controllers, Tek PEP series of System Controllers, or IBM AT compatible computer with Tek GPIB interface, 640 kBytes RAM, one 1.2 MByte or 1.44 MByte floppy disk drive, 20 MByte Hard Disk, and Hercules or IBM CGA, EGA, or VGA graphics adapter or equivalent.

MS-DOS 3.0 or later version and Microsoft Windows 286 or 386 version 2.03 or later version with Microsoft Mouse or equivalent.

ORDERING INFORMATION

S3FT100 – TekTMS Interactive Procedure Generator	**$2,500**
S3FT200 – TekTMS VXI Instrument Front Panel Library	**$495**
S3FT300 – TekTMS GPIB Instrument Front Panel Library	**$495**

WaveWriter™ *WAVEFORM CREATION AND EDITING SOFTWARE*

WaveWriter™

Arbitrary Waveform Generation Software WaveWriter simplifies the creation and editing of waveforms for arbitrary waveform and oscilloscope templates.

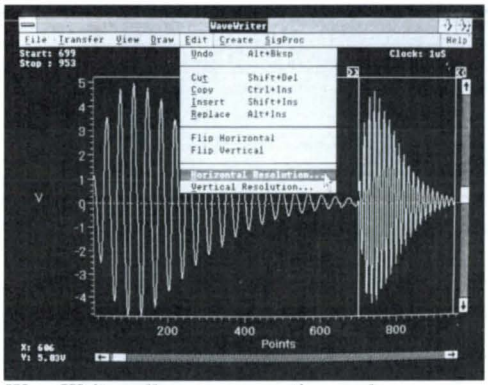
- ***Create and Modify Waveforms for AFG 5101/ 5501, VX5790, etc.***
- ***Use WaveWriter Stand-Alone or Integrated into TekTMS.***
- ***See What You Are Doing As You Go.***
- ***Create Waveforms by Drawing Them (Freehand or with Autolining between Selected Points), by Editing Standard Functions, by Writing Equations, or by Capturing Them with a Scope.***
- ***Edit Waveforms by Cut and Paste Methods; or Invert, Add, Subtract, Multiply, or Divide Whole Waveforms or Portions.***
- ***WaveWriter Automatically Deals with Record Size, Resolution, etc., of Target Instruments.***
- ***Microsoft Windows-Based User Interface.***

ORDERING INFORMATION

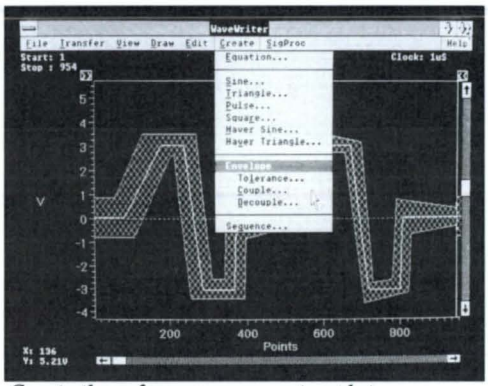
WaveWriter is provided on both 1.2 MByte 5 1/4" and 1.44 MByte 3 1/2 " diskettes.

S75WVWR – Tektronix WaveWriter System Software **$1,695**

WaveWriter is a Trademark of Tektronix



WaveWriter allows easy creation and modification of custom waveforms.



Create the reference memory template waveform for pass/fail testing on 2400 series oscilloscopes.

WaveWriter WAVEFORM CREATION AND EDITING SOFTWARE

Waveform Generation

WaveWriter™ is the new software support package for creating and modifying arbitrary waveforms for the Tektronix AFG 5101, AFG 5501, and the VX 5790 Arbitrary Waveform Generators. 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 work on its own, or as an integral part of TekTMS test program generation software.

Automatic Output 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 Tek AFGs, digitizers and scopes, and users can add instruments by responding to on-screen queries.

Create Custom Waveforms

Define waveforms by:

- Entering equations and limits,
- Drawing them freehand,
- Selecting endpoints of straight line segments,
- Editing standard functions, including sines, 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.

Oscilloscope Template Generation

WaveWriter also supports the 2400 series line of digital storage oscilloscopes with template generation for the Save-On-Delta feature. Therefore, with WaveWriter, the user can create the exact tolerances or templates with which to capture a differentiated signal or identify a failure.

System Environment

WaveWriter works on any 80286- or 80386-based computer with 640K of RAM that is capable of running Windows. This includes Tek's VX5530 or VX4530 VXIbus System Controllers, Tek's PEP series of System Controllers, or a suitably configured IBM PC AT or clone.

WaveWriter requires MS DOS or PC DOS 3.0 or later, and Microsoft Windows 286 or 386, Version 2.03 or later, with a Microsoft Mouse or equivalent.

EZ-TEST TEST DEVELOPMENT SOFTWARE

A Complete Development and Test Runtime System

EZ-TEST is a software productivity tool used to create and run test software for manufacturing, service repair and rework, metrology, and prototype evaluation.

EZ-TEST is for non-programmers or programmers who prefer to concentrate on testing rather than software coding chores.

The EZ-TEST software system provides all the software necessary to develop and run test system programs. Figure 1 shows the major elements of EZ-TEST:

- Generator program to create, debug, and execute the test procedure.
- Translator program to convert the procedure to Microsoft QuickBASIC code and then compile and link it, resulting in a complete standalone test program.
- Test Execution Scheduler to run sequences of compiled tests and gather test data.
- Microsoft QuickBASIC editor, compiler, linker and manuals.
- GPIB interface software for QuickBASIC.

Run Tests with TekMate

EZ-TEST comes complete with runtime libraries to produce compiled test programs which run on the TekMATE 2402 with a 2400 Series Digital Sampling Oscilloscope.

Test Functions

EZ-TEST provides a simple means to specify high-level test functions using instruments on-line. Create test procedures with these functions:

- Instrument control commands.
- Instrument measurement.
- PASS/FAIL limits for measurements, controls procedure process flow.
- UUT adjustment steps, measurement shown on screen with cursor moving relative to nominal and limits values for easy operator adjustment.
- Waveform acquisition and pulse parameter analysis with PASS/FAIL limits.
- Disk file transfers to and from instruments.
- Procedure WAIT states for instrument or UUT settling.
- Automatic Stimulus/Response testing.
- Graphical screens for operator instructions created with PC Paintbrush software from Microsoft.
- SRQ Interrupt handlers.
- Status BYTE acquisition.

Instrument Support

EZ-TEST supports Tektronix instruments with high-level functions for instrument setup and special measurement acquisitions.

- TM 5000 family of general purpose test instruments.
- Waveform acquisition and pulse parameter measurements for digitizers and digital oscilloscopes (7000, 11000, 2400, and RTD series).
- TSI 8150 Test System Interface configuration utility for fixture switch matrix programming.
- Instrument settings queries and standard measurements are supported for the full line of Tektronix GPIB instruments which feature the Tek Codes and Formats Standard for Programmable Instruments, including spectrum analyzers and logic analyzers.

EZ-TEST also supports generic setup and measurement capabilities for IEEE-488.1 compatible instrument with any combination of talker and listener capabilities.

Instrument driver software modules may be written in QuickBASIC and installed into EZ-TEST to provide additional instrument support.

EZ–TEST

Test Development Software

- *No Programming Required*
- *Develops and Runs Automated Tests with GPIB Instruments*
- *Generates Application Test Code in Microsoft QuickBASIC*
- *Reduces Test Development Time*
- *Executes Compiled Test Programs*
- *Runs on Tek PEP Instrument Controllers and IBM XT/AT Compatible with Tek GPIB Interface*
- *Generator Program to Create, Edit, Debug, and Execute the Test Procedure*
- *Translator Program to Convert the Test Procedure to QuickBASIC Code, then Compile and Link*
- *Test Executive Program to Schedule and Run Compiled Test Procedures*
- *Microsoft QuickBASIC Editor, Compiler, and Linker Software Package*

SYSTEM ENVIRONMENT

EZ-TEST PC runs on the Tektronix PEP Series of system controllers or on any IBM PC/AT or compatible computer configured with the Tektronix GPIB interface card (S3FG100 or S3FG120), and with 640 kBytes RAM, 5 1/4" or 3 1/2" DSDD floppy drive, hard disk and MS-DOS 3.0 or higher. A CGA graphics monitor (or better) and adapter is recommended for graphics displays.

ORDERING INFORMATION

S45F030 – EZ-TEST	**$1,795**
Opt. 06 – Delete Microsoft QuickBASIC (required for international orders)	**–$100**

NEW

ASYST™ ASYSTANT™ GPIB

SCIENTIFIC ACQUISITION, ANALYSIS, AND GRAPHICS SOFTWARE

ASYST

- *Automatic Graphics With Modifiable Defaults*
- *High Resolution and Color-Graphics Support*
- *Comprehensive Data Analysis*
- *Integrated GPIB/IEEE Standard 488 Hardware Support*
- *Built-in Functions Plus Full Programmability*

NEW ASYSTANT GPIB

- *Menu Driven*
- *Statistical and Numerical Analysis*
- *Waveform Processing*

ASYST SCIENTIFIC SOFTWARE

ASYST is a fully integrated software tool that provides you with the most commonly used data acquisition, statistical, graphing, and analysis capabilities required in engineering and scientific applications. Operating on the IBM PC/XT/AT, ASYST is designed so novice users can start carrying out complicated operations with a minimum of introduction, while allowing the advanced user to take full advantage of a powerful programming language that supports all the features of the IBM PC.

Most mathematical or graphics operations can be performed by using a single predefined word describing that operation; e.g., MATRIX.INV, FFT, INTEGRATE.DATA, 2WAY.ANOVA, or Y.AUTO.PLOT. New words can be defined to perform any sequence of actions.

```
:PLOT.IT!
PRESSURE
TEMPERATURE
XY.AUTO.PLOT;
```

PLOT.IT! now automatically plots two data arrays when invoked: PRESSURE and TEMPERATURE.

The Analysis module contains most of the common operations used to treat experimental data. These include for example, integration, differentiation, base-line correction, peak finding, digital smoothing, FFT, IFT, matrix manipulation, and Eigen system analysis.

Instrument-specific application programs such as the 7000-Series Driver Software for ASYST are also available. Written in the ASYST language, this driver provides you with a function-key-driven program that allows for the acquisition and storage of waveforms, storage and retrieval of settings or programs, zoned pulse-parametric analysis (max, min, mid, p-p, rise time, fall time, overshoot, undershoot, pulsewidth, period, and crossing levels) and frequency-domain analysis. Data may be acquired from the Tektronix 7D20, 7854, 7912AD, 7912HB, RTD-710, 7250, 2230, or 2430A. There is a similar driver for the Tektronix 11000-Series Oscilloscopes and DSA-600 Series Digitizing Signal Analyzers.

Module 1 and 2 Highlights

Base System – Array-based operations. Different number types, and multi-dimensional arrays.

Access Utilities – File conversions to/from ASCII, BASIC, packed binary, and Lotus 1-2-3 files. DOS shell. Language interface to Microsoft C and Fortran.

System Utilities – Easy-coder, menu-driven utility. Menu-driven setup. Text editor. Array and command line editors. Error tracer. On-line help.

Analysis – Basic math including trigonometry, exponentiation, and logarithms.

Waveform Processing – Waveform arithmetic. Fast Fourier Transform (FFT). Inverse FFT. 2-DFFT, 2-DIFFT. Smoothing. Convolution. Filtering. Peak detection. Integration. Differentiation.

Curve Fitting – Goodness-of-fit reporting. Correlation Matrices. R2 (cross-correlation). Weighted and non-weighted fits. User-defined and non-linear fits. Least square regressions (multilinear, logarithmic, polynomial, and exponential).

Polynomial and Matrix Math – Matrix inversion. Determinants. Diagonalization. Orthogonalization. QR factorization, Eigen systems. Simultaneous Equations. Polynomial math and shifting. Root extractions.

Statistics – Basic statistical functions. Distributions. Sorting. Random number generation. ANOVAs. Histograms.

Graphics – Automatic and customizable plots. User definable graphics windows, plot types, and colors. Superimposition of multiple plots. Axonometric and contour plots. Zoom-in feature.

RS-232-C Interfacing – Multiple logical devices. Foreground/background data reception. Variable mode parameters.

ASYSTANT GPIB ACQUISITION AND ANALYSIS SOFTWARE

ASYSTANT GPIB is a powerful PC software package for data acquisition, analysis, and graphics that's designed specifically for scientific and engineering applications. It gives you the power to control your IEEE Standard 488 instruments, acquire and analyze data, and create graphics. And with ASYSTANT GPIB, you have the best of both worlds: programmability plus an easy-to-use menu-driven interface.

With this menu-driven interface, you just supply the bus and device commands and let your instrument do the rest of the work. Displaying acquired data can be as simple as choosing a single menu option. Complex analysis, such as calculating an FFT, is another simple menu choice.

Now you can use your instrument more effectively. And, you can integrate basic graphics and analysis with instrument control so you can observe events as they occur.

Then, you can create routines that can save and execute at any time. This means repetitious tasks can be executed with the minimum number of keystrokes and with consistent results.

When you combine all of ASYSTANT GPIB's IEEE Standard 488 interface capabilities with its analysis and graphics functions, you have a powerful and flexible tool. A tool available at any time. A tool that provides easy setup, a natural user interface, effortless graphics, and simple-to-use math functions.

ORDERING INFORMATION

S42P301 – ASYST Scientific Software. Includes: Software Modules 1, 2, and 4 on 5 1/4" DS/DD disk and manuals. ☎ **$2,095**

S42P302 – Driver Software for ASYST Requires S42P301 or equivalent software. Includes: Software source on 5 1/4" DS/DD disk, hardware driver for Tektronix 7D20, 7854, 7912AD, 7912HB, RTD-710, 7250, 2230, and 2430A; and manual (070-6189-00). ☎ **$435**

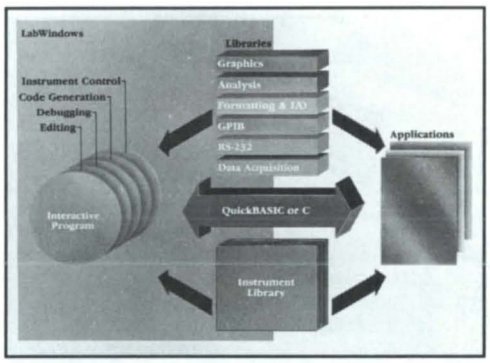
S47P305 – 11000-Series DSO Driver for ASYST. Requires S42P301 or equivalent. Includes: Software source on 5 1/4" DS/DD disk, hardware driver for Tektronix 11201A, 11400 Series, 11800 Series, CSA 803, and DSA 600-Series and manual (070-7759-00). ☎ **$410**

Opt. 01 – 5 1/4" disk **NC**

S42P311 – ASYSTANT GPIB Includes: Software and manuals. ☎ **$695**

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

ASYST, ASYSTANT is a trademark of Asyst Technologies, Inc.



LABWINDOWS™ STANDARD PACKAGE

The LabWindows software system is a complete set of development tools for creating and executing computer-based engineering and scientific applications.

The LabWindows Standard Package provides the user with an interactive development environment (QuickBASIC and C) and supportive libraries to quickly develop, prototype, and operate test and measurement applications. The libraries include routines for data acquisition from GPIB and RS-232 interfaces instruments. In addition, the libraries can be used outside of the interactive environment to extend the capability of QuickBASIC and C to include data acquisition, analysis and presentation.

The LabWindows Interactive Program uses pull-down menus and optional mouse for simple and direct access to many editing and debugging functions. Debugging tools include breakpoints, single-stepping and the ability to view and edit program variables and data when running a program.

The LabWindows Interactive Program has a special interface, called a function panel, for accessing the LabWindows libraries. A function panel is an intuitive, full-screen interface that lets you execute library functions without the tedious process of typing and editing program code. The parameters for a library function are represented by pictorial controls directly on the function panel. The parameters are selected or entered using these controls. The function panel can be used to interactively test the function and then to copy the working tested function directly into the program.

The LabWindows Instrument Library eliminates the low-level programming details of instruments by providing intuitive, high-level QuickBASIC or C function calls. For example, the function *read.waveform (1, wave)* might query a GPIB oscilloscope for the waveform from channel 1, read the raw data, convert the data to real numbers, and place the numbers in an array named wave. The LabWindows Instrument Library includes ready-to-use modules for many Tektronix instruments. Support for over 50 popular industry instruments is available.

The LabWindows Graphics Library is a flexible set of functions for displaying and documenting program results. Specific functions include: two-dimensional color plots; line, connected point, scatter, bar charts; linear, log, semi-log; single and multiple curve plots; all integer and floating point data types; full control of graph appearance including use of color, labeling, scaling, grids, point styles and positioning; multiple graphs on screen; flexible use of stroked text fonts; storage and retrieval of graph files; hardcopy support of dot-matrix printers and HP-GL compatible plotters.

The LabWindows Analysis Library automatically checks for the presence of a numeric coprocessor and when present takes full advantage of the performance capability. The standard LabWindows Analysis Library includes: one-dimensional and two-dimensional array addition, subtraction, multiplication, division, linear evaluation, and maximum/minimum values; sub-array extraction; scalar/one-dimensional complex addition, subtraction, multiplication, division, and rectangular-to-polar and polar-to-rectangular conversion; mean; standard deviation; histogram, sort; clear, set, and copy array; dot product; cross product; matrix inversion; transpose, and determinant.

LABWINDOWS ADVANCED ANALYSIS LIBRARY

The LabWindows Advanced Analysis Library product includes: Real and complex FFTs, inverse FFTs; FHT and inverse FHT; integration; differentiation; power spectrum; convolution; correlation; array reversal; shift array; clip array; pulse parameters; generation of pulse, ramp, sine, impulse, triangle, uniform distributed, white noise and Gaussian noise; digital filters: Butterworth, Chebyshev; linear fit; exponential curve fit; polynomial curve fit; variance; RMS; moments about the mean; median; linear equations; summation of array elements; and one-dimensional/two-dimensional polynomial evaluation and scaling.

LabWindows™

- ***Interactive Program Development***
- ***Automatic Code Generation Reduces Coding Effort***
- ***Extensive Libraries for Programming IEEE-488 (GPIB) and RS-232***
- ***Interactive, High-Level Instrument Libraries Simplify Analyzing and Presenting Data***
- ***Uses Standard Programming Languages–Microsoft QuickBASIC and C***

SYSTEM ENVIRONMENT

Tektronix PEP 30X controller or IBM PC XT/AT with 640K bytes of memory; 1 hard disk and 1 floppy drive; IBM Color Graphics Adapter (CGA)/Enhanced Graphics Adapter (EGA), MS-DOS 2.0 and above with a Tek GPIB Interface Board

ORDERING INFORMATION

S3FG910 – LabWindows Standard Package	☎ **$595**
Opt. 01 – 5 1/4" disk Requires Tektronix S3FG100 or S3FG120	**NC**
S3FG912 – LabWindows Advanced Analysis Library	☎ **$895**
Opt. 01 – 5 1/4" disk Requires S3FG910	**NC**

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

LabWindows is a registered trademark of National Instruments.

GPIB USER'S RESOURCE UTILITY HARDWARE AND SOFTWARE

GURU II+

- *Store/Recall Waveforms*
- *Calculate Waveform Parameters*
- *Library of Commonly Used Subroutines*
- *Source Code Provided for Most Programs*
- *Graphics Capability*
- *GPIB Tutorial Manual*
- *Instructional GPIB Programming Examples*

SYSTEMS ENVIRONMENT

GURU II runs on Tektronix PEP controllers, an IBM PC, PC XT, Portable PC, PC AT or compatible. Minimum requirements: 256K memory and either 2 floppy-disk drives or 1 floppy and 1 hard disk. On IBM PCs, GURU II also requires one of the following graphics-display card combinations:

1. IBM Color/Graphics Adapter (or compatible card) and the IBM Color Display, or a composite video monitor (color or monochrome), or EGA or VGA.
2. Hercules Graphics Card and IBM Monochrome Display.

GURU requires IBM PC DOS 2.0 or higher with Advanced BASIC (BASICA), or MS-DOS 2.02 or higher with BASICA Microsoft QuickBASIC 1.0 through 4.5, IBM BASIC Compiler 1.0/2.0. The IBM Graphics Printer or equivalent (e.g., Epson RX/FX family) is suggested.

GPIB
Interface Hardware and Software

- *Cost-Effective GPIB Hardware and Software*
- *Example Programs in Interpreted BASICA*
- *Interface Orderable Separately for Compiled BASIC and C Languages*

ORDERING INFORMATION

S3FG100 – GURU II + Package ☎ **$995**
Includes: Software/manual plus PC2A board; cable; software on 5 1/4" and 3 1/2" floppy diskettes.

S3FG110 – GURU II – Software **$495**
and documentation only. For users with existing PC2/PC2A board and cable.

S3FG120 – GPIB Interface. ☎ **$495**
Includes: Manual, GPIB interface card, and software on 5 1/4" and 3 1/2" diskettes.

S3FG121 – GPIB Compiled **$150**
BASIC Interface. Includes: Manual, 5 1/4" and 3 1/2" diskettes.

S3FG122 – GPIB C Compiler **$150**
Interface. Includes: Manual and 5 1/4" diskette.

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

GURU II+

Tektronix GURU II (GPIB User's Resource Utility) is a low-cost hardware and software package for instrument control, waveform acquisition, and display. GURU II supplies the important communication link between an IBM PC (or compatible) and GPIB (IEEE Standard 488) instrumentation.

The GURU II software is written in IBM's Advanced BASIC (Microsoft's BASICA) language. BASICA source code is provided for maximum flexibility to customize for a specific application. Languages supported include BASICA/GW-BASIC, IBM BASIC Compiler 1.0/2.0 and Microsoft QuickBASIC 1.0/2.0/3.0/4.0. GURU II saves data to disk in a format compatible with many popular programs (LOTUS 1-2-3, Framework 11, etc.)

The software includes a TEST PROCEDURE GENERATOR (TPG), a useful tool for users who want fast results but do not want to learn to write their own test software. The TPG is a self-explanatory menu-driven program.

GURU II also includes a waveform acquisition and pulse-analysis program (DIGPULSE) that supports most Tek digitizers. This program allows waveform segmenting, graphics, and storage. The pulse parameters include rise time, fall time, pulse width, max. and min. voltages, and others.

Library of Commonly Used Subroutines

This library contains subroutines to do low-level communications with GPIB devices, store/recall waveforms on a disk, calculate waveform parameters, and graph the waveform. The subroutines are written in assembly language to facilitate maximum performance when sending or receiving commands or data. Waveform-acquisition performance is further enhanced by the DMA transfer of waveforms to the controller's memory.

Tutorial Manual

The User's Manual is a valuable GPIB reference. It includes many GPIB program examples, which are useful when interfacing to various types of new GPIB instrumentation.

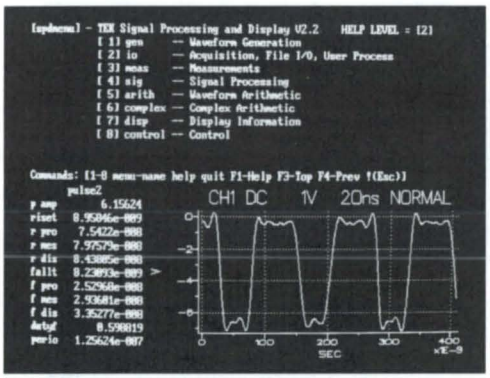
GURU II software functionally integrates your IBM PC compatible controller and GPIB test and measurement instruments. GURU II+ adds a GPIB interface board and a GPIB cable to the GURU II package.

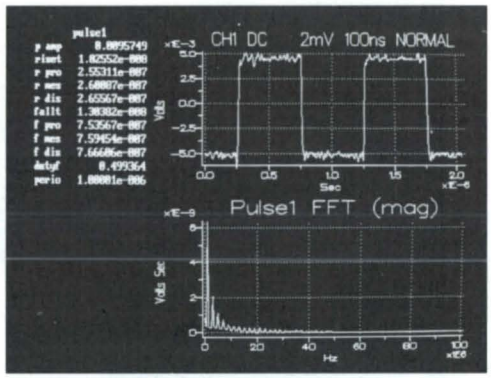
GPIB INTERFACE HARDWARE AND SOFTWARE

The GPIB Interface (S3FG120) provides the minimum software and hardware to allow an IBM PC/XT, PC/AT or compatible to control GPIB instruments. Included are diagnostic utilities, an interactive control program and language interface for BASICA (BASIC interpreter) and manual.

The Compiled BASIC Interface (S3FG121) includes software for both IBM BASIC Compiler 1.0/2.0 and Microsoft QuickBASIC 1.0 through 4.5. The software link provided permits users of the GPIB interface to program their applications in compiled BASIC.

The C Compiler Interface (S3FG122) links programs compiled in 3.0 to 5.1, Quick C, or Lattice C (version 1.0/2.0/3.0) with the GPIB interface.





Signal-Processing and Display Software

SPD simplifies the acquisition, processing, measurement, storage, and display of waveforms from Tektronix digitizers for scientific and engineering applications.

The SPDMENU program provides an easy-to-use interactive menu to perform SPD functions without writing programs. Getting started is easy with extensive on-line help.

The SPD Function Libraries provide software modules for programmers who are writing applications with Microsoft C or QuickBASIC.

Acquisition Library

The Acquisition Library acquires waveforms from Tektronix digitizers and formats them for use by other SPD functions. Waveform acquisitions from digitizers can be achieved with a single menu selection or function call. The library supports these Tektronix digitizer products:

2220	5223
2221	7D20
2224	7854
2230	7912 AD/HB
2232	11401/11402/11403
2430	11801/11802
2430A	RTD 710
2432	RTD 710A
2440	DSA 601/DSA 602

Signal Processing Library

The Signal Processing Library provides time and frequency domain signal processing functions for arbitrary length waveforms. These functions include:

- Arithmetic
- Integration and Differentiation
- Pulse Measurements
- Statistics
- Convolution and Correlation
- Forward and Inverse Fast Fourier Transforms (FFT)
- Interpolation and Decimation
- Standard Waveform Generation (SINE/SQUARE)
- Finite Impulse Response (FIR) Filter Generation
- Waveform File Input and Output

Waveform Graphics Library

The Waveform Graphics Library provides device-independent waveform graphics using the GSS*CGI device drivers from Graphic Software Systems. These drivers support a wide range of printers and plotters, and support high resolution display up to 800 x 600 pixels. The Waveform Graphics Library allows the user to create waveform displays and control these attributes:

- Log or Linear Axes
- Auto or Manual Scaling
- Titles and Axes Labels
- Multiple Curves per Graph
- Multiple Line Styles
- Full Color Control

SPDMENU Program Process Menu

The SPDMENU program functions can be extended with the Process Menu option. This feature makes it possible to access user written programs from the SPDMENU program. Writing these custom programs is simplified with the example programs provided in SPD.

SPD C and QuickBASIC Language Support

The SPD libraries are intended for software professionals who must develop comprehensive applications written in the Microsoft C 5.1 or QuickBASIC 4.5 languages.

Software debugging is simplified with SPD functional prototype include files to catch errors at compile time rather than at runtime. The SPD software functions maximize use of memory by accessing all available standard memory for waveform data.

Signal-Processing and Display Software

- *Convenient Interactive Menu Interface*
- *Software Libraries for Application Software Development*
- *Comprehensive Set of Functions for Acquisition, Processing, Measurement, Storage, and Display of Waveforms from Tektronix Digitizers*

SYSTEM ENVIRONMENT

Tektronix PEP Controller, or IBM PC/AT or compatible computers with a graphics display monitor and adapter, 640 kbytes memory, a 5 1/4" or 3 1/2" inch diskette drive and a hard disk drive, and Tektronix GPIB interface (GURU II or equivalent) DOS 2.1 or later version.

A wide variety of graphics displays, printers, and plotters are supported by the GSS*CGI (Graphics Software Systems, Inc.) drivers supplied with the SPD package.

SPD supports the Tektronix HC100 plotter and the 4693D or 4696 printers .

Math co-processors are supported, and will improve the execution speed of SPD.

ORDERING INFORMATION

S3FG130 – SPD Signal Processing and Display Software Includes: Software on 5 1/4" and 3 1/2" diskettes, SPDMENU function key overlay, and manuals. ☎ **$995**

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

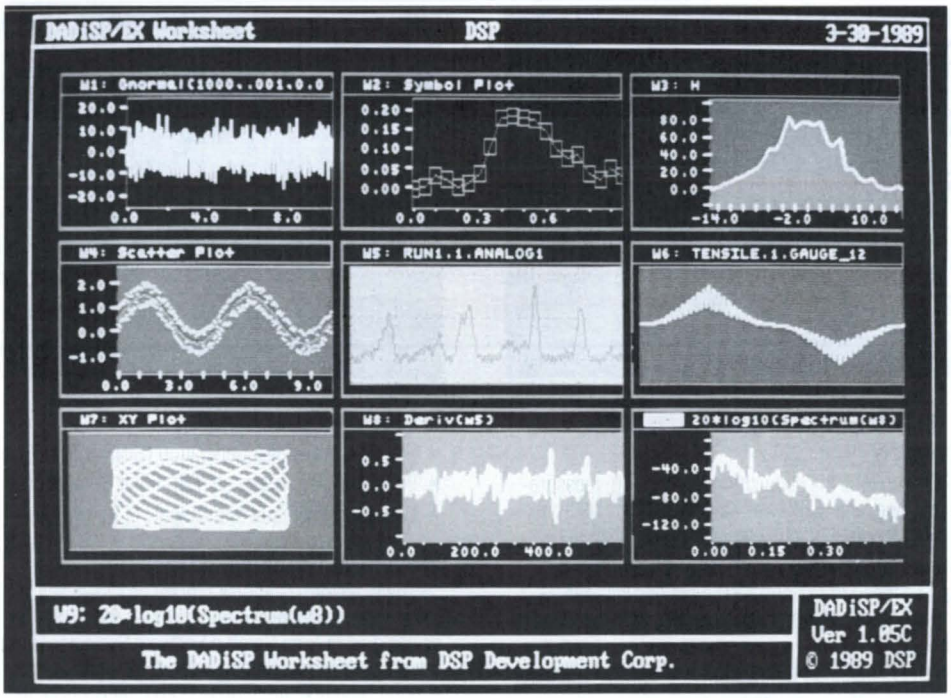
DADiSP™ *SCIENTIFIC DATA ANALYSIS SOFTWARE*

DADiSP™

- ***Over 200 Data Analysis Functions***
- ***Process Signal of Any Length Using Virtual Memory Management Techniques***
- ***Macro Definition Facility Allows User Defined Functions***
- ***Execute User Written Programs***

SYSTEM ENVIRONMENT

Tektronix PEP system controller or IBM PC XT/AT with 640 kbytes of memory, 8087 or 80287 Co-Processor, 1 hard disk and 1 floppy drive, IBM Color Graphics Adapter (CGA)/Enhanced Graphics Adapter (EGA), MS-DOS 2.0 and above with a Tek GPIB Interface Board.



DADiSP

DADiSP is a graphic tool for scientific data analysis. DADiSP provides a unique spreadsheet-like, menu driven environment for displaying and analyzing digital waveforms. Signals and their mathematical relationships appear graphically in windows, dramatically simplifying complex digital signal processing and waveform analysis tasks.

DADiSP is designed exclusively for data analysis of waveforms generated in applications like laboratory research, electronic test and measurement, physiological monitoring, and digital signal processing. DADiSP combines menu driven analysis tools and windowed graphics to tackle complex tasks like mathematical problem solving, "what-if" gaming, scientific and technical data analysis and management, and graphic analysis of sampled information. Unlike traditional number-based spreadsheets, DADiSP enables scientists and technicians to convert data from graphic windows into number, a process that more closely mirrors the scientific method.

DADiSP eliminates the need for programming, since individual analysis steps occur as commands are typed into DADiSP "Worksheet" windows. Worksheets enable a user to build a custom library of analysis templates. In short, the DADiSP Worksheet does for scientists and engineers what financial spreadsheets have done for business users.

A chain of processing steps is set up simply by typing in formulas; the results of each step are displayed in sequence, window by window.

New data can be loaded in DADiSP windows for instant re-evalutaion of the entire spreadsheet. DADiSP spreadsheets can be saved, reloaded, and applied to new tasks, enabling you to build up your own library of analysis templates to support specific needs.

DADiSP offers over 200 data manipulation and analysis functions including signal arithmetic and calculus, signal editing, waveform generation, FFTs and peak finding. Users can create their own functions using DADiSP's user-defined macros. DADiSP supports real and complex arithmetic and carries engineering units through compound calculations.

The **DSP PIPELINE** boosts the power of DADiSP substantially by allowing external programs (such as your own analysis or filtering algorithms and third-party data acquisition software) to be executed directly from within the DADiSP environment.

MENUS allow the user to generate simple or complex applications through the use of customized pull-down menus.

PANELS produces reporting panels to permit easy selection of indicated operations and/or display the results.

DADiSP/EX is a version of the DADiSP system that operates in protected mode on 80286 and 80386, giving the user access to full 16 MB addressability. The DADiSP system includes device driver macros for many popular Tektronix instruments.

The Tektronix 2510 TestLab system can also output files in the DADiSP format. This allows the user of the TestLab to do more extensive and personalized analysis and reporting on the waveforms.

ORDERING INFORMATION

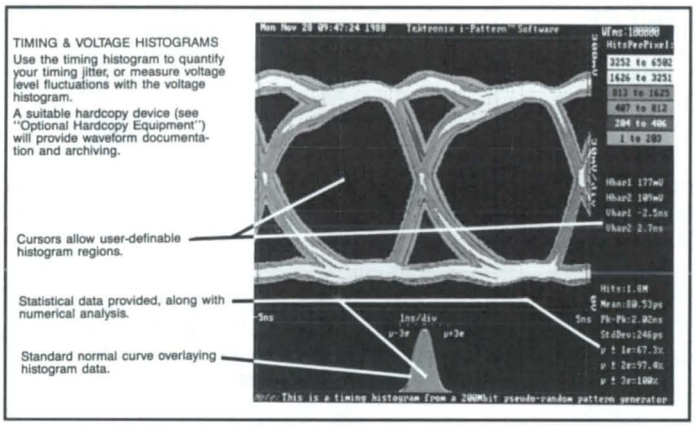
S3FG916 – DADiSP/PC Worksheet for Signal Analysis	**$895**
Opt. 01 – 5 1/4" Media Requires Tektronix S3FG100 or S3FG120	**NC**
S3FG918 – DADiSP/EX*1 Extended Mode Version	**$1,395**
Opt. 01 – 5 1/4" Media Requires Tektronix S3FG100 or S3FG120	**NC**

*1 *DADiSP/EX requires a minimum of 2 Mbytes of Extended Memory*

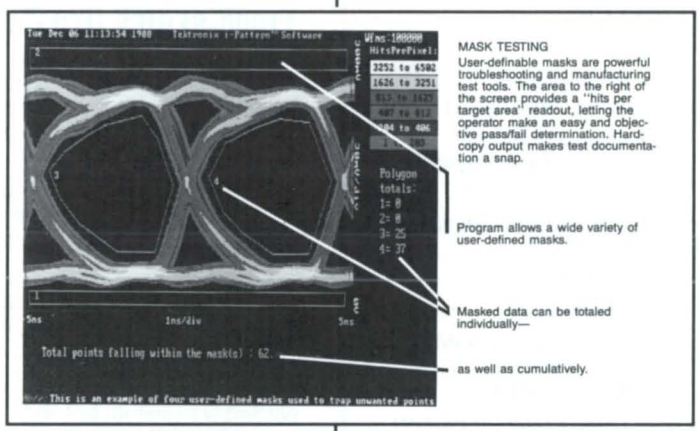
DADiSP is a trademark of DSP Development Corporation.

SIGNAL CHARACTERIZATION AND MASK TESTING SOFTWARE

i-PATTERN™ TWPP NEW



i-Pattern™ Timing and Voltage Histograms



i-Pattern™ Mask Testing

i-PATTERN SIGNAL CHARACTERIZATION AND DOCUMENTATION SOFTWARE

The i-Pattern Software provides a way to statistically measure and visually examine signal noise and signal timing jitter. The dynamic memory of a PEP 301 controller or other PC-compatible computer is used to store real-time waveform data. A region of the waveform can then be selected with cursors, analyzed, and compared to a normal distribution.

In addition to the cursor readouts, the following information is provided: number of waveforms acquired, number of hits (samples within the user-selected region), mean value, standard deviation and peak-to-peak value in the selected region, and the percentage of hits within 1, 2, and 3 sigma (standard deviation) of the mean value. Measurements can be made using either voltage or timing histograms.

Thirteen pulse parametric parameters are automatically calculated, with user-definable tolerances selectable for Pass/Fail testing.

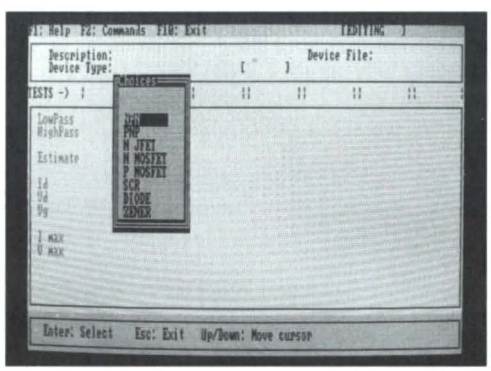
The software supports all Tektronix 11000-Series and 2400-Series Oscilloscopes, the Tektronix DSA 600-Series Digitizing Signal Analyzers, the Tektronix 2230 Portable DSO, plus the Tektronix 7D20 and Sony/Tektronix RTD 710 programmable waveform digitizers.

TEMPLATE/WAVEFORM PROCESSING PROGRAM

The Template/Waveform Processing Program works with all 11000-Series Oscilloscopes, and runs on the Tektronix PEP301, IBM® PC, CGA, and EGA graphics modes are supported. The program and scope communicate over the IEEE Standard 488 (GPIB) bus.

The Tektronix Template/Waveform Processing Program (TWPP) provides two primary functions: waveform template editing and act-on-delta processing. The template editor creates and modifies waveform templates. The act-on-delta function compares a test waveform with the template, then performs one or more user-specified operations, depending on whether the waveform passes or fails the template comparison. Typical uses include signal monitoring, communications testing, and pass/fail waveform-shape testing.

A template is a mask consisting of upper and lower boundaries. A waveform is compared against the template by comparing each point in the digitized waveform with the corresponding point in the upper and lower boundaries. If each and every waveform point is above the lower boundary and below the upper boundary, the waveform "passes". If any point falls outside the template boundaries, the waveform "fails".



Template with "passing" test waveform.

i-Pattern

- *Voltage Timing Histograms*
- *Real-Time Display*
- *User Definable Masks for Telecom Testing/Monitoring*
- *Multiple Digitizer Support*

Template/ Waveform Processing Program

- *Autogeneration of Starting Template*
- *Template Editor*
- *Act-on-Delta Processing*

ORDERING INFORMATION

S47P107 – i-Pattern software Includes: Software Operator Manual (070-7340-00)	**$850**
Opt. 01 – 5 1/4" flexible disk	**NC**
Opt. 02 – 3 1/2" micro disk	**NC**
Demo Disk – 42W-7389	**NC**
S47P110 – Template/Waveform Processing Program Includes: Software Operator Manual (070-7423-00)	**$395**
Opt. 01 – 5 1/4" flexible disk	**NC**
Opt. 02 – 3 1/2" single-sided micro disk	**NC**

DOCUMENTATION AND DATA-LOGGING SOFTWARE

11000-SERIES UTILITY SOFTWARE

- *Archival Storage of Waveforms and Settings*
- *Automated and Manual Logging of Measurement Data*
- *Measurement Data Graphs and Histograms*
- *GPIB and RS-232-C Instrument Control*
- *Waveform Acquisition and Display or Template Waveform Creation*
- *Hard Copy (Printer or Plotter)*
- *BASIC Source Code*

TekMAP

- *Graphics*
- *Archival Storage*
- *Pulse Parametrics*
- *Delay-Time Measurements*
- *Hard Copy Captures*
- *Menu Driven*

ORDERING INFORMATION

S47P108 – 11000-Series DSO IBM PC Utility Software. Includes: Software Operator Manual (070-7394-00).	**$450**
S47P103 – 11300-Series/IBM PC Utility Software. Includes: Software Operator Manual (070-7423-00).	**$470**
Opt. 01 – 5 1/4" flexible disk	**NC**
Opt. 02 – 3 1/2" micro disk	**NC**
S42P202 – 7854/IBM PC Time and Amplitude Measurement Software. Includes: SoftwareOperator Manual (070-6565-00).	**$550**
Demo Disk – 42W-7212	**NC**
S47H211 – 11400-Series/HP Series 200/300 Time and Amplitude Measurement Software. Includes: Software Operator Manual (070-6897-00).	**$950**
S42P101 – TekMAP 7854/IBM PC	**$500**
Opt. 01 – 5 1/4" flexible disk	**NC**

11000-SERIES UTILITY SOFTWARE

The 11000-Series Utility Software packages provide complete GPIB or RS-232-C control of the Tektronix 11302A Oscilloscope, the 11000-Series Oscilloscopes, CSA-803, or the DSA-Series Digitizing Signal Analyzers from your IBM PC.

These utility software packages allow you to use the full GPIB or RS-232-C programmability of the 11000-Series Oscilloscopes without ever having to write a single line of code.

You get the simplest possible access to the measurement system power through each menu-driven package.

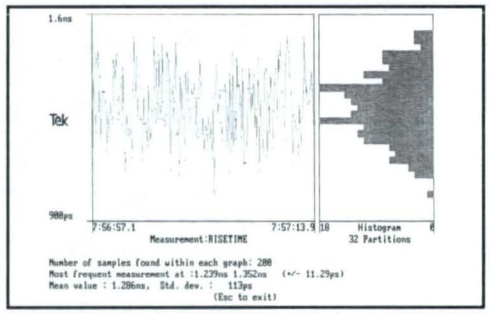
All of the major commands and functions are directly executed from the PC's function keys. You choose what you want to do from the first-level, main menu–acquire measurement data, copy settings, send GPIB interface commands, etc. Then a second-level menu appears, allowing you to select the specific functions or options for the operation or to enter controlling parameters or file names. Required entries from the keyboard are always prompted and are in a simple "fill-in-the-blanks" format.

No matter what you select or enter, the utility software packages will perform thorough error checking to help ensure the job is done correctly. Also, if there is any ambiguity or error in entries, the packages provide automatic prompting for immediate on-line correction.

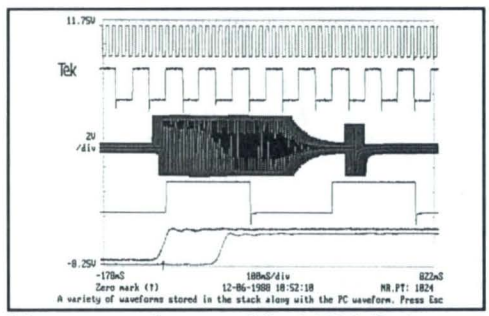
If there is ever any question about program operation, simply press F9. This provides complete on-screen help from any menu.

Basic Hardware Configuration

Tektronix PEP Controller; IBM PC, XT, or AT; or DOS 2.0 or above – compatible with 640K memory; dual floppy drive or one floppy and one hard disk; graphics card; National Instruments IBM PC GPIB card (for GPIB operation); GPIB cable or a 9-wire RS-232-C cable.



Multiple waveforms can be acquired and displayed on the PC screen and output to a plotter or dot-matrix printer.



Measurement features of the 11000- Series DSOs are available through the menus and are supported by measurement logging, statistics, and screen graphics.

TEKTRONIX MEASUREMENT APPLICATION PROGRAMS

The TekMAP (Tektronix Measurement Application Programs) library of software products supports the Tektronix 11400-Series Oscilloscopes and 7854 GPIB Programmable Digitizers in automated engineering or research environments.

TekMAP software extends the versatility of Tektronix digitizers by integrating them with Tektronix PEP controllers, IBM PCs, or HP-Series 200/300 technical computers.

Extended measurement capabilities, such as 14 automated pulse-parameter analysis, Fast Fourier transformation, and propagation-delay measurements, are provided by the Time and Amplitude Measurement Software (TekMAP) products.

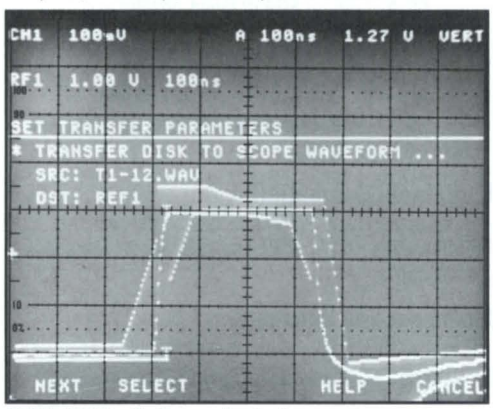
Please contact your local Tektronix Sales Engineer or representative regarding hardware configuration requirements and current software offerings.

DSO UTILITY SOFTWARE

DSO-UTILITY 2402 TEKMATE, A 2400-SERIES DIGITIZING OSCILLOSCOPE AND SOFTWARE: A COMPLETE STAND-ALONE TEST STATION

DSO-Utility Software operates on all Tektronix 2400-Series Digitizing Oscilloscopes. It provides routines to:

- save scope waveforms to disk
- load disk waveforms to scope
- log data upon a waveform pass/fail test failure, a scope trigger, or at the end of a test sequence
- perform waveform math including add, subtract, multiply, divide, integrate, differentiate, and Fast Fourier Transform
- generate waveshape templates
- make direct hardcopies on HPGL, IBM Graphic, Epson, PostScript, and compatible devices.



DSO-Utility Software includes routines to create waveshape templates, compare live signals against the templates for automatic pass/fail tests, and archive waveform and measurement data.

PROGRAM DEVELOPMENT SYSTEM

WRITE CUSTOM TEST PROGRAMS EFFICIENTLY WITH LIBRARY FUNCTIONS AND SUBROUTINES.

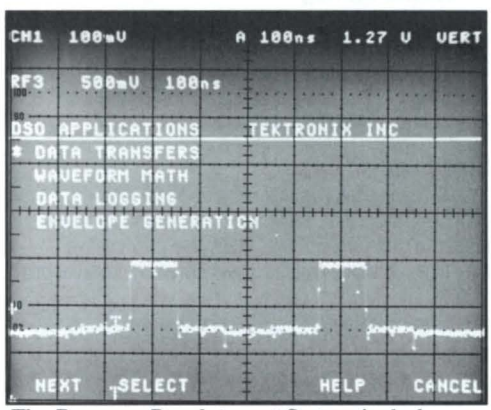
The Program Development System (PDS) software package saves time and cuts programming costs. Use an IBM-compatible computer, such as the Tektronix PEP 301, to develop your test routines with PDS. Then transfer these programs to the 2402 TekMate Instrument Extension for execution with a 2400-Series Digitizing Oscilloscope. Other GPIB-programmable devices can be controlled as well.

Three powerful libraries are included to help write custom test programs in Microsoft QuickC or QuickBASIC:

1. Menu Development System Library
   - create main menus and submenus
   - display text strings
   - create and use help files
2. Waveform Math Library
   - create data arrays from waveforms and waveforms from data arrays
   - add, subtract, multiply, divide, integrate, differentiate
   - perform min, max, and standard deviation
   - perform FFTs, correlation
   - convert to polar coordinates
3. GPIB Control Functions Library provides control routines for:
   - IEEE 488.2 Control Sequences
   - IEEE 488.2 Protocol Commands
   - High Level Language Extensions

The PDS also provides miscellaneous functions including:

- disk drive management
- disk directory and file management
- reading scope settings and display messages



The Program Development System includes routines to create menus and display text on the oscilloscope screen.

The DSO-Shell program provides the operating system environment, including the basic disk, directory and file management functions. It operates only with 2400-Series Digitizing Oscilloscopes and uses their menu-select buttons and display screen for operator interaction with the TekMate.

The Program Development System also includes over 250 example programs and the Microsoft QuickC and QuickBASIC programming languages.

DSO Utility

Software packages save test development time and money

- *Unattended Monitoring*
- *Off-Site Testing*
- *Waveform Storage*
- *Pass/Fail Test Execution*
- *Complex Waveform Analysis (FFT, Correlation, Differentiation, Integration)*
- *Template Creation and Storage*
- *Data Logging*

Program Development System

- *Menu Development System Library*
- *Waveform Math Library*
- *GPIB Control Functional Library*

ORDERING INFORMATION

S37UT01 – DSO-Utility Software (Also available as part of 2402 Option 01.)	**$775**
Opt S9 – Software Subscription (U.S. only) extends software upgrades and product support to one full year	**+$155**
Opt 1S – Software Subscription (International only) extends software upgrades and product support to one full year	**+$155**
Opt 3S – Software Subscription Renewal (International only)	**+$155**
S37UD01 – Program Development System	**$1,295**
Opt S9 – Software Subscription (U.S. only) extends software upgrades and product support to one full year	**+$260**
Opt 1S – Software Subscription (International only) extends software upgrades and product support to one full year	**+$260**
Opt 3S – Software Subscription Renewal (International only)	**+$260**

Integrated TeleServicing Software for Digital Storage Oscilloscopes

- *Data Communications, Data Management, and Waveform Graphics in One Package*
- *Standard Phone Line and RS-232-C Link-up*
- *Easy-to-Use Windows and Pop-up Menus*
- *Built-in Phone Directory with 20 User-Definable Automatic Dialing Entries*
- *Easy Creation of Reference Libraries*

ORDERING INFORMATION

S41TSS1 – Integrated Tele-Servicing Support Software ☎ **$295**
Includes: Software (on 5 1/4" and 3 1/2" diskettes)
User manual (070-7466-00)
Training videotape (068-0296-04)
Software subscription
☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

INTEGRATED SOLUTION

Tek's new integrated TeleServicing Software is the first commercial teleservicing software package to integrate data communications, data management, and waveform graphics in a single package.

With Tek TeleServicing Software, you can connect a Tek 2232 digital storage oscilloscope (DSO) to an IBM PC-compatible system over an RS-232-C interface and standard telephone modems. The data communications function permits configuration of PC communication port, modem initialization, and direction of data to and from a remote scope or PC. Data management functions include file capture, storage, and retrieval. For example, you can retrieve waveform data from a remote DSO and store it to disk or transfer it to a local DSO for display and analysis. With waveform graphics, you can plot multiple waveforms on a PC display, annotate them with user information, and direct graphic or numeric output to a printer.

Field Service Efficiency

Tek TeleServicing Software provides field-service technicians with immediate, low-cost access to expert consultation in the service center. With the 2232's 26K of extended waveform storage, you can create libraries of new or known-good waveforms for reference in troubleshooting applications.

Direct Monitoring

Remote monitoring of equipment in distant or hazardous sites is also facilitated with Tek TeleServicing Software. At the site, a technician can set up a scope in babysitting mode, connect it to a PC in the home office, and monitor problems from there.

Data Logging

Tek TeleServicing is ideal for such data logging applications as trend analysis. It allows you to create reference waveform libraries, schedule preventative maintenance visits, and facilitate equipment installations.

With an IBM PC-compatible system on one end and a Tek 2232 DSO on the other, Tek TeleServicing Software efficiently brings solutions to a broad range of applications.

Required Equipment

- Personal computer IBM PC XT or AT (or equivalent) with MS-DOS (V2.0 or later)
- 640 k RAM
- Hard disk (or two 1.2 MB 5 1/4" or 760 k 3 1/2" floppy disk drive)

Tek's new TeleServicing Software combines data communications, data management, and waveform graphics in one affordable, integrated package.

- IBM MDA, CGA, or EGA graphics adaptor and compatible monitor
- Hayes-compatible 300/1200-baud modems
- Tek DSO with option 12 (RS-232-C interface)
- RS-232-C Cables (e.g., P/N 012-0911-00 DB25-DB25 straight-through)

Instrument Compatibility

Tek TeleServicing Software is compatible with the Tektronix 2221, 2224, 2230, and 2232 Digital Storage Oscilloscopes.

Licensing and Warranty

- License: Break-the-Seal, single installation
- Warranty: 90 days distribution media and encoding (only)

Product Updates

Purchase price includes one-year software update subscription service at no additional charge. This subscription entitles the customer to free software upgrades for the first 12 months after purchase.

TEKTRONIX SYSTEMS EXPERIENCE

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

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

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

Tektronix implemented Tektronix Standard Codes and Formats for its GPIB instruments soon after IEEE 488.1 became a standard. This internal standard has evolved into the current IEEE 488.2.

A SYSTEMS COMPONENT SUPPLIER

Today's GPIB systems come in many sizes, from small PC based systems to large systems incorporating computers, instrumentation and DUT switching.

Efficient test and measurement systems also include test generation, instrument control and results processing software. Tek offers a variety of control hardware such as the PEP, 286/386-based controller or Test System Interface 8150, and software such as Tek TMS, SPD and GURU to make tailoring on automated test systems relatively easy and cost effective.

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

Custom Systems

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

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

Although single vendor solutions can provide enhanced ease of use and supportability, getting optimum performance for test requirements from a single vendor's system components is difficult. Consequently, many GPIB and VXI systems are quiltworks of components from different vendors–with the resulting software problems.

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

VXIbus Standard

Tektronix continues to innovate in the areas of instrumentation and test systems architecture with its strong leadership involvement in the new VXIbus standard. VXI, which stands for VME Extensions for Instrumentation, provides an open architecture for development of card-based computers and instrumentation.

The standard specifies electrical, mechanical and communication characteristics to enhance development of products which are interoperable in a single chassis.

The VXIbus standard provides a multitude of instrumentation resources such as triggering, clocking and module interconnects to address many of the problems associated with the established rack and stack approach. Systems based on VXIbus can achieve a high degree of test repeatability as well as tight synchronization of the instruments within the system. Also, being based on VMEbus, the instrument control and data transfer speeds can be many times faster than GPIB communications. Due to the absence of external cabling for functional instrument interconnects, such as trigger and clock lines, systems can be configured rapidly in software using the signals housed within the rigid backplane.

The open architecture of the VXIbus will also allow users to select instruments, interface cards, and computers from various manufacturers to develop the best card modular test systems for their needs. Both military and industrial users can look forward to the benefits of equipment downsizing, tighter time coordination between instruments, and a wider variety of solutions from which to choose.

Tektronix, as one of the founding members of the consortium which developed the VXIbus standard, is at the leading edge of VXI technology and innovation, offering its first VXI products in 1988 and continuing to broaden its portfolio this year. And, as with our GPIB instrumentation, Tek sells not just VXIbus products, but total systems solutions using combinations of VXI and GPIB products.

HANDSHAKE *™ is a quarterly newsletter published by the Test and Measurement Group of Tektronix, Inc. It provoides new product and application information on test and measurement instruments and techniques. This covers all aspects of analog and digital measurements including the acquisition, processing, storage, and display of digital signals. Specific types of instruments covered include manual and programmable oscilloscopes, digital storage oscilloscopes, transient digitizers, spectrum analyzers, logic analyzers, stimulus and measurement instruments, instrument controllers, and the software that makes them work.*

For a free subscription to HANDSHAKE™: Complete and mail the reply card in the back of the catalog--simply write "Handshake Subscription" as the information requested.

SOFTWARE PACKAGES

- **GURU II**
  – Control of GPIB (IEEE Standard 488.1) electronic instruments from an IBM PC (or compatible).
  – Menu-driven Test Procedure Generator to speed applications programming.
- **SPD**
  – Supports 196 processing, analysis, and data-to-display functions using Tek digitizers in conjunction with an IBM PC, PC/XT, or PC/AT.
- **TekMAP**
  – Supports the Tektronix 7000 Series GPIB programmable digitizers in automated engineering or research environments.
  – Extends the versatility of Tektronix digitizers by integrating them with Tektronix controllers, IBM personal computers, or HP Series 200 technical computers.
- **EZ-Test PC**
  – Automates generating GPIB test and measurement software.
  – Automatic code generation often cuts development time by 60 to 80 percent.
  – EZ-TEST PC works with Tektronix and other manufacturer's instruments. Code generation is Microsoft QuickBASIC source files that the user can use as is, or optimize into stand-alone programs.
- **Tek TMS**
  – Provides test program generation and execution for GPIB, GPIB/VXI, and VXI only environments.
  – Front panels for Tek GPIB instrumentation, VXI system components, and a facility for development of additional instrument support.
- **i-Pattern**
  – Timing-jitter and noise analysis for Telecom and other time domain signals.
  – Runs on 2200, 2400, 7000, 11000, and RTD digitizing scopes.

GOING BEYOND THE BASICS–TEK STANDARD CODES AND FORMATS

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

Tektronix offers 488.2 compatibility with some of its products. IEEE 488.2 was carefully designed to work with a wide variety of existing GPIB products. Instruments designed to the Tektronix *Standard Codes and Formats* will fully function in systems that employ 488.2 instruments.

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

In addition, because most controllers accept ASCII input directly, Tektronix GPIB instrument commands are coded in ASCII. This procedure eliminates the need for error-prone data conversions or byte-by-byte coding.

To make your job even easier, Tektronix *Standard Codes and Formats* also specifies messages that are to be common to all Tektronix programmable instruments. For example, you can program your system to learn the current settings of any Tektronix GPIB instrument by sending the instrument the SET? message. Any GPIB-compatible instrument from Tektronix–whether it is a waveform digitizer, a programmable power supply, or a function generator–interprets SET? the same way.

CONTROLLERS AND SOFTWARE–KEY FACTORS

The controllers and software of a test system give that system test execution control and determine:

- Measurement performed.
- Data analysis, logging and reporting.
- Operator access and interface.
  Software gives the system the personality its user sees.

Tektronix offers controller-software packages to meet varying system needs. The PEP family of Instrument Controllers are complete GPIB controller packages based on the Intel 80286 and 80386 microprocessor. GURU II software and a GPIB interface card are standard.

TEKTRONIX PROVIDES SYSTEMS SOLUTIONS

Tektronix has remained at the leading edge of development of automated test and measurement systems, providing a full range of products and services to ensure total system solutions to test and measurement problems.

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

- Test and Measurement Modular Instruments
- VXI Card Instrumentation Systems
- Custom Systems
- Semiconductor Testers

TEKTRONIX SUPPORT FOR YOUR TEST SYSTEM

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

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

A PARTNERSHIP DEDICATED TO EDUCATIONAL EXCELLENCE

THE LOGICAL CHOICE

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. One reason is they are easy to learn and use. Secondly, Tek products meet stringent testing standards which insure that they are rugged, student-proof, and safe. Finally, the Tektronix products your students train on are the same high quality instruments and systems used in industry, providing a smooth transition from education to their chosen careers.

Tek has also developed a broad range of learning materials to supplement your curriculum. Offered in a variety of formats, these materials are comprehensive, covering both operations and concepts. In addition, the level of complexity ranges from information geared for inexperienced students to materials for advanced students.

A BROAD RANGE OF PRODUCTS

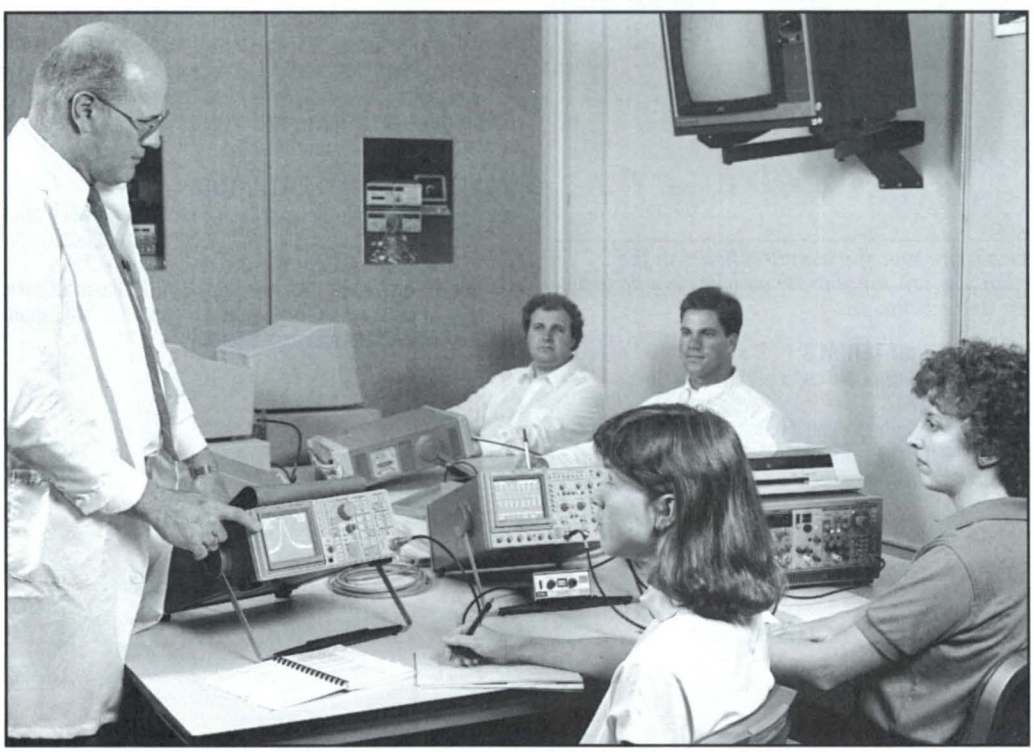
Tek offers the best selection of test and measurement equipment in the industry. Whether you're buying for a vocational center, community college or major university, you'll find we have everything you need.

The Tektronix test and measurement product line includes analog and digital oscilloscopes, logic analyzers, spectrum analyzers, function generators, power supplies, automatic stimulus and measurement tools for board production testing, modular instruments, and a full line of accessories. From basic to advanced laboratory and bench instrumentation, our products will meet your needs in electronics, physics, and mechanical engineering courses. We also provide a variety of modular and fully programmable instrumentation to fill the requirement for learning semi- and fully-automated test systems.

We also give you flexibility in the way you buy. You can either order instruments individually, or combine them in complete lab-station packages.

And in every Tek 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 Tek 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: Tek.



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.

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.

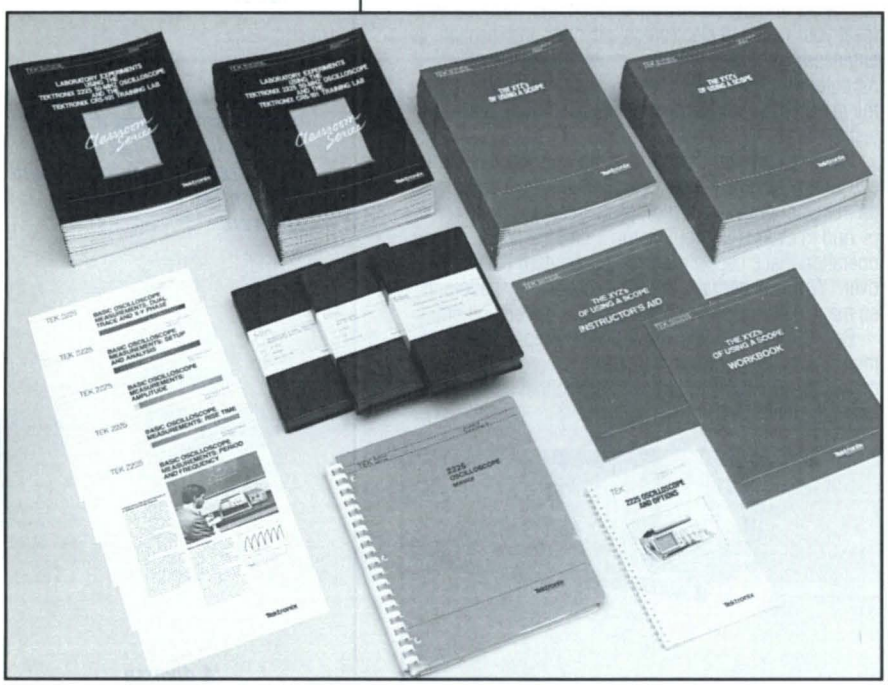
We are giving eligible non-profit organizations discounts of 15% on all of Tek test and measurement equipment, and 50% on Tek developed software.

'A diverse environment demands an extensive selection'

'Learning by leaps and bounds often occurs step by step.'

COURSEWARE AND TRAINING

The broad range of Tektronix test and measurement products is complemented by a variety of educational support programs specifically designed for the classroom. Tektronix learning materials, written and designed by education professionals, are presented in a variety of formats, e.g., videotapes, workbooks, instructor guides, seminars and self-study packages. These materials are designed to both supplement and complement your classroom curriculum.



Tek's 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.

LEARNING MATERIALS:

- Contain fundamental concepts and operating instructions
- Designed for beginning through advanced students
- Written by educators and instructional designers
- Professionally produced

For ordering information on self-study and QuickStart packages as well as the videotape and literature offerings, see page 364.

SELF-STUDY PACKAGES

Realizing the need for individuals to learn at their own pace, Tek 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, Tek has created these aids so that students can come prepared to apply their understanding of the equipment to the challenges of the curriculum.

Each self-study course includes a detailed video instruction tape and a workbook. Materials cover instrument operations as well as concepts and applications, from basic through advanced test and measurement techniques. Discussions include:

- Basic Instrument Concepts
- Major Product Features and Operation
- Applications
- Probe Compensation and Usage
- Measurement Techniques
- Controller Integration
- Communication Interfaces
- Display and Output Concepts

QUICKSTART PACKAGES

These specially designed packages provide detailed hands-on instruction and application examples. Each package provides step-by-step workbooks, video-tapes and specially designed signal generation boards to help the user get up and running in no time at all. These packages are designed for self-paced use or integrated into the classroom curriculum.

VIDEO TAPE AND LITERATURE

Tek 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, Tek's 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.

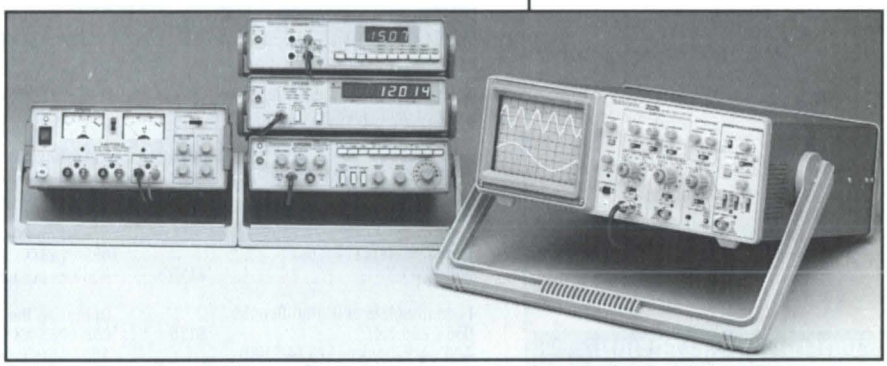
RUGGED AND SAFE

In both design and test, we ensure our products meet stringent standards for EMI, humidity, temperature, electro-static shock, and vibration. Tektronix products are also third-party certified by UL, CSA and VDE. 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

Tek's highly trained sales engineers, applications engineers, and education representatives stand ready to offer you both curriculum and technical support. Our curriculum support materials and seminars will help you keep up-to-date. And, we offer standard warranties as well as a variety of extended warranty 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.

However, the chances are good that you'll never have to take advantage of our service network, because all Tek equipment is built to the highest standards of mechanical and environmental durability.



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 300 and 301) join a 50 MHz dual-trace oscilloscope (page 138) as a popular setup for basic lab stations.

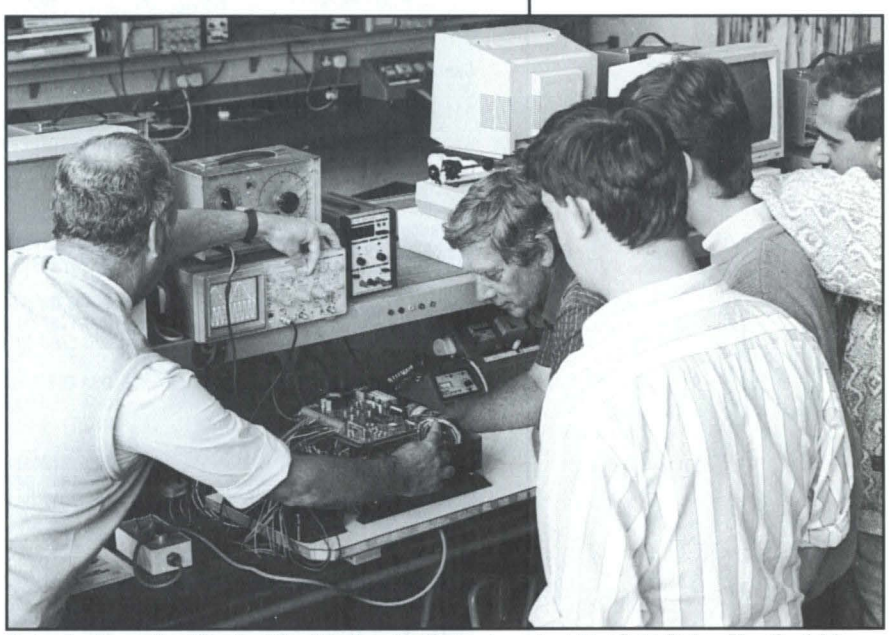
BUDGET SOLUTIONS

At Tektronix we understand the dilemma that many educators face - you have a need for industry proven, up-to-date equipment, but your budgets don't always allow for funding. Therefore, we offer a line of low-cost basic electronics equipment 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.

'It's easy to justify owning the best when the best costs less.'

Tek cameras and printers make lab documentation easy. Teks SCOPE-MOBILE® carts free up valuable bench space and make sharing of equipment between students convenient.



Peter Jackson, the Head of the Electronics Department at Hatfield Poly., Hertfordshire, England, purchased Tektronix' 2225 scopes for use by their students. John Aitken, the Head of Division, states "The 2225 fulfilled our technical requirements, and ....offers good value for the money".

VIDEO TAPE SELECTION GUIDE

Note: "XX" is to be replaced by one of the following:

NTSC format (used in USA)
00 = 3/4" 01 = BETA I
02 = BETA II 03 = BETA III
04 = VHS

PAL format 06 = VHS/PAL
SECAM format 07 = VHS/SECAM

ORDERING INFORMATION

SELF-STUDY PACKAGES

Each self-study course includes a detailed video instruction tape and a workbook.

Fundamentals of Analog Scopes $115
068-0270-XX
Add'l workbooks - $25 (4/$100)

Fundamentals of Probes $115
068-0269-XX

Fundamentals of Digital Scopes $115
068-0268-XX
Add'l workbooks - $25 (4/$100)

Fundamentals of GPIB $115
068-0260-XX
Add'l workbooks - $25 (4/$100)

Fundamentals of RS232 $115
068-0259-XX
Add'l workbooks - $25 (4/$100)

Using the PC as a Controller $145
068-0301-XX
Add'l wookbooks $25 (4/$100)

Fundamentals of Logic Analyzers $115
068-0291-XX
Add'l workbooks - $25 (4/$100)

Operating the 2201 $60
068-00290-XX
Add'l workbooks - $25 (4 $100)

Operating the 2205 $60
068-0289-XX
Add'l workbooks - $25 (4/$100)

Operating the 2210 $115
068-0274-XX
Add'l workbooks - $25 (4/$100)

Operating the 2213A/2215A $115
068-0278-XX
Add'l workbooks - $25 (4/$100)

Operating the 2220 $125
068-0273-XX
Add'l workbooks - $25 (4/$100)

Operating the 2221 $115
068-0272-XX
Add'l workbooks - $25 (4/$100)

Operating the 2225 $115
068-0279-XX
Add'l workbooks - $25 (4/$100)

Operating the 2230 $125
068-0271-XX
Add'l workbooks - $25 (4/$100)

Operating the 2235 $115
068-0277-XX
Add'l workbooks - $25 (4/$100)

Operating the 2236 $115
068-0276-XX
Add'l workbooks - $25 (4/$100)

Operating the 2245/2246A $115
068-0275-XX
Add'l workbooks - $25 (4/$100)

Operating the 2430A $145
068-0267-XX
Add'l workbooks - $25 (4/$100)

Operating the 2432 $145
068-0266-XX
Add'l workbooks - $25 (4/$100)

Operating the 2440 $145
068-0265-XX
Add'l workbooks - $25 (4/$100)

Operating the 2445A/2465A $145
068-0262-XX
Add'l workbooks - $25 (4/$100)

Operating the 2445B/2465B/2467B $145
068-0261-XX
Add'l workbooks - $25 (4/$100)

Operating the 11301A/11302A $145
068-0264-XX
Add'l workbooks - $25 (4/$100)

11401/11402 Waveform Measurement $145
068-0302-XX
Add'l workbooks - $25 (4/$100)

Operating the 1230 $115
068-0288-XX
Add'l workbooks - $25 (4/$100)

QUICKSTART PACKAGES

Each package provides step-by-step workbooks, videotapes and specially designed signal generation boards.

2400 Series Digital Oscilloscopes QuickStart Package $199
020-1679-00 U.S. power
020-1681-00 European power

2402 TekMate QuickStart Pkg. $199
020-1747-00
020-1748-00

11403 QuickStart Package $199
020-1767-00 (U.S.)
020-1768-00 (European)

DSA 600 QuickStart Package $199
020-1769-00 (U.S.)
020-1770-00 (European)

2232/2224 QuickStart Package $199
020-1812-04 (VHS/NTSC)
020-1812-06 (VHS/PAL)

2211 QuickStart Package $199
020-1811-04 (VHS/ NTSC)
020-1811-06 (VHS/PAL)

VIDEO TAPES

Oscillo-what? What is an Oscilloscope? Discusses the display, vertical, horizontal and trigger sections and introduces digitizing oscilloscopes. $60
068-0218-XX

Oscilloscope Primer Practical Scope How to use a scope, acquire a trace, select suitable vertical and horizontal scale factors, and how to use the special features on the Tektronix 2225 oscilloscope. $60
068-0227-XX

Operating the 2232/2224 $60
068-0309-XX

Operating the 2211 $60
068-0308-XX

Advanced 2200 Series Operation $60
068-0151-XX

CDM250 Video Tape $60
Digital multimeter training
068-0254-XX

CFC250 Video Tape $60
Frequency counter training
068-0253-XX

CFG250 Video Tape $60
function generator training
068-0252-XX

CPS250 Video Tape $60
Power supply training
068-0251-XX

The Vital Link - Probe and Signal Concepts $75
068-0229-XX

LITERATURE

Lab Bench Equipment Orientation Instructor guide and workbooks for CFC250, CFG250, CDM250 and CPS250. (50 workbooks, 1 guide) $50
062-9511-00

Lab Bench Equipment Video Tape Exercises (video tape(s) required); instructor guide and workbooks for CFC250, CFG250, CDM250, CPS250. (50 workbooks, 1 guide) $50
062-9474-00

2225 Oscilloscope XYZs Primer Covers horizontal, vertical and trigger functions, controls, use of probes, terminology, and theory of waveforms and measurement techniques. (50 primers, 1 guide, 1 workbook) $120
062-9322-00

2213A Oscilloscope XYZs Primer (50 primers, 1 guide, 1 workbook) $135
062-6731-00

An Introduction to Digital Storage $120
062-9465-00
(50 Primers)

2225 Technique Briefs *1
062-9475-00
(50 Primers)

ABCs of Probes $120
062-9471-00
(50 primers)

*1 *Contact your local sales representative.*

Contents

New 2510 TestLab™ Multi-channel Analyzers 365
New 2520 TestLab™ Multi-channel Analyzers 365
New 2622 Fourier Analyzers 368
2630 Fourier Analyzers 368
New 2640 Fourier Analyzers 368

2510/2520 TestLab™

- ***Simultaneous Multi-Channel Acquisition: 2 to 24 Channels and Optional Signal Conditioning.***
- ***Long Record Lengths, High Resolution: up to 256K Samples per Channel, 10 and 12 Bit Capabilities.***
- ***Worry Free Data Management with TestLab's ™ TestSheet Files.***
- ***Measure in Engineering Units.***
- ***Integrated Data Analysis from Powerful Visual Analysis to Custom User Entered Formulas.***
- ***Data Transfer to PC's TestLab ™ Files are Stored in MS-DOS ® Format***
- ***Portability: A Flat Panel Display and 12VDC Power Make 8 Channel Acquisition Truly Portable with the 2510S2 –under 37 Pounds.***

TestLab™, a new test strategy for physical measurements. Up to 24 channels with 2520 (left) or 8 channels with the portable 2510S2 (right)

TestLab™ MULTI-CHANNEL ANALYZERS

The 2510 and 2520 TestLab™ Multi-Channel Analyzers present a new test strategy to engineers and technicians who make measurements on physical phenomenon. TestLab™ integrates acquisition characteristics of transient recorders, such as chart recorders, oscillographs and digital oscilloscopes, with a powerful data management, storage and display capability unknown until now in a portable or rackmount instrument.

Research, development, and manufacturing will benefit immediately from TestLab's™ integrated capabilities. Applications with transient, single shot phenomena, such as mechanical prototype testing, process verification, automotive component and subsystem testing, materials testing, and power quality testing all need the efficient, cost effective, performance of TestLab™.

MULTI-CHANNEL ACQUISITION

Up to eight internal channels in 2510 and 24 channels in 2520 with varying sample rates, record lengths, and high resolutions for viewing and measuring a variety of test parameters. Quick setup of multiple channels is possible with Autoset feature that automatically sets input controls on all active channels. TestLab™ mainframes are card modular. The 2510 mainframes accept up to 2 acquisition cards. The 2520 mainframe accepts up to 6 acquisition cards. System software is identical and allows sharing of files between different mainframes.

GENEROUS RECORD LENGTH, HIGH RESOLUTION

Records up to 256 K point in length allow measurement of transient or continuous events over periods ranging from milliseconds to hours. High vertical resolution allows you to see otherwise indiscernible detail in your acquisitions.

UNPRECEDENTED DATA MANAGEMENT

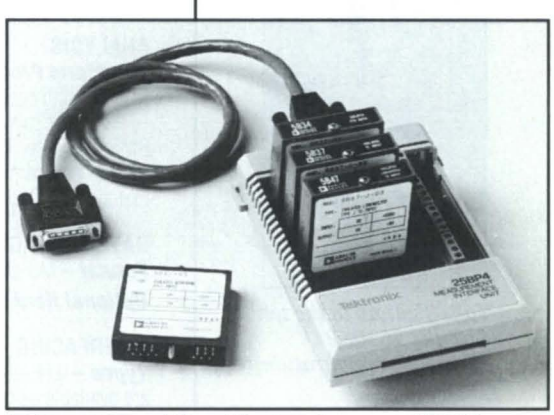
A special spreadsheet-style database, "TestSheet", contains not only acquired data, but also acquisition dates and times, hardware settings, and comments. TestLab™ easily handles the abundant data typically associated with complex physical measurements. Information stored in these files helps you acquire new data using known instrument settings, or retrieve historical data for further analysis or comparison with new data.

INTEGRATED DATA ANALYSIS

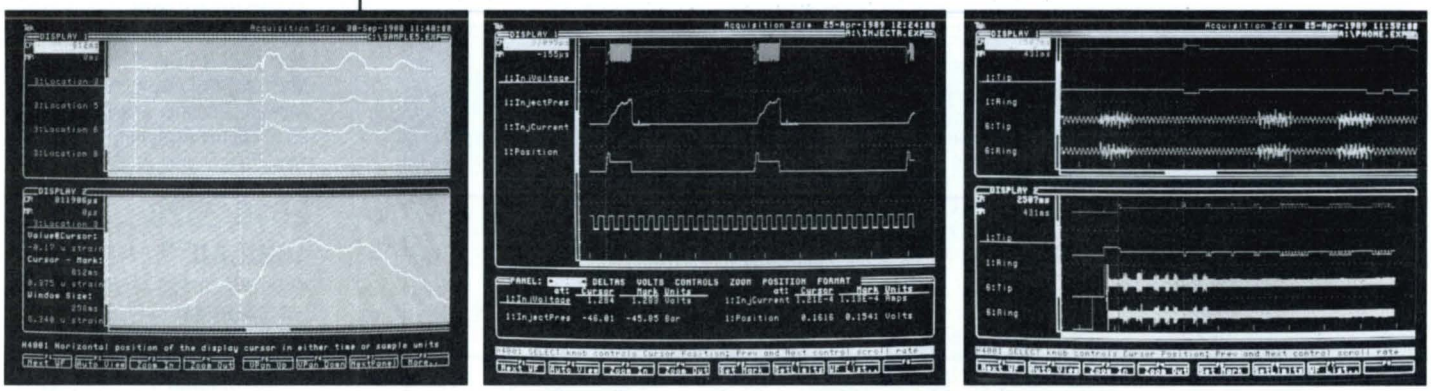
Built-in math functions, on their own or as part of a formula, allow you to analyze as well as acquire on a single instrument. Visual analysis of new data, old data, and results of analysis, is possible with powerful display capabilities.

DATA TRANSFER TO PC

Test files are stored in MS-DOS format on floppy or optional hard disk. Files easily transfer to any PC-compatible system. There, you can incorporate them into reports or analyze them using application software like Lotus 1-2-3, DADiSP, and Tektronix SPD. TestLab™comes complete with PC-resident utility software that converts your test data to standard formats for these and other popular PC software.



Optional Signal Conditioning Accessory 25BP4



Powerful display system allows user configured formats for different applications – without writing software.

Take TestLab to the test with the 2510S2 Portable Configuration.

PORTABILITY

With its flat-panel display, 12 V dc power, and compact size, the 2510S2 goes from bench top to field van to test bay to lab – wherever you need to measure and analyze physical data.

CHARACTERISTICS

DISPLAY

Choice of multisync color monitor or folding electroluminescent flat-panel (2510 only).

Resolution – 640 x 400 pixels.

Waveform Display – Two independent display windows, each with up to eight Y-T waveforms, four X-Y waveforms, or seven Ys against a common X axis.

Cursors – A cursor and a mark in each display window provide cursor measurements on each displayed waveform, and may be independent, linked together, or linked between the two display windows.

ACQUISITION MODES

Single Shot, Repeat Mode, Roll Mode, and an Auto-Store mode where data can be automatically saved to disk at the end of each acquisition cycle.

ANALYSIS

Waveform Processing Functions – Formulas can be written using combination of the following operators: +, –, *, /, Raise to a Power, Absolute Value, Peak to Peak, RMS, Sin, Cos, Tan, Differentiate, Integrate, Log base 10, Natural Log, Minimum, Maximum, Mean, Square Root, Exponential, Cycle Ave., and X-Y Area.

DATA STORAGE

Format – MS-DOS® 3.5-inch floppy disk, 720 kbytes.

Optional Hard Disk – Internal, 20 Mbytes.

INTERFACING

Types – IEEE-488 (GPIB) RS-232-C, and parallel printer are available using COMM Pack plug-in modules. Interfaces share a common port and can only be used one at a time.

Files – ASCII, Lotus 1-2-3® (.WKS), and DADiSP. Format translations can be performed on a PC with PC utility translation program provided.

ACQUISITION CARD

25AA1 – 100KS, 12 bit, 4 channel, 256 K

Vertical Amplifiers: Four dc coupled analog inputs with independent sample and hold for simultaneous acquisition, single-ended or differential.

Input Impedance – 1M Ω, 26 pF.

Input Ranges – ±100 mV full scale (49 μV per quantization level) to ±10 V full scale (4.9 mV per quantization level) in a 1, 2, 5 sequence.

Maximum Input Voltage – ±30 V

Offset: ±15 V independent of range, maximum of ±15 V usable input including offset.

Analog Bandwidth – 50 kHz (–3 dB).

VERTICAL RESOLUTION – 12 bit, 0.024% of full scale (1 part in 4096).

CMRR – At least 1000: 1 (60 dB) at 1 kHz.

Channel Isolation – At least 100:1, (40 dB) at 1 kHz.

Record Length – Up to 256k samples one channel; 64k samples, four channels.

Sample Rate – 12.5 S/s to 100 kS/s one channel, up to 29 kS/s 4 channels.

External clock – Up to maximum sample rate (see chart below).

Trigger Level Range – 100% of full scale. Independent trigger level for each channel.

Trigger Level Resolution – 0.5% of full scale (1 part in 200).

Trigger Slope – +, –, Either, and Off.

Programmability – Logical OR combination of individual trigger criteria from each acquisition channel.

Pre-Trigger Range: – 0% to 100% of record length.

TestLab™ SIGNAL CONDITIONING

25BP4 Measurement Interface Unit provides a simple signal conditioning solution for 25AA1. The Unit accepts up to four standard Analog Devices Series 5B signal conditioning modules to interface directly to Thermocouples, RTDs, Voltage sources and Bridge circuits (such as strain gauges). Power is provided by the 25AA1 Acquisition Card through the single, 15-pin cable connection.

ACQUISITION CARD

25AA2 – 12.5 MS, 10 bit, 2 channel, 2 x 64 K
Vertical Amplifiers: Two ac or dc coupled, single ended, analog channels with independent A/D converters for simultaneous acquisition.

Input Impedance – 1 MΩ, 35 pF.

Input Ranges – ±100 mV full scale (200 µV per quantization level) to ±10 V full scale (98 mV per quantization level) in a 1, 2, 5 sequence.

Maximum Input Voltage – ±400 V (dc + peak ac)

Analog Bandwidth – 5 MHz (– 3 dB).

Vertical Resolution – 10 bit, 0.1% of full scale (1 part in 1024).

Record Length – 10 to 65535 samples per channel, continuously variable.

Sample Rate – 200 samples/sec. to 12.5 MS/sec per channel.

Trigger Level Range – 100% of full scale. Independent trigger level for each channel.

Trigger Level Resolution – 0.5% of full scale (1 part in 200).

Trigger Slope – +, –, Either, and Off.

Programmability – Logical OR combination of individual trigger criteria from each acquisition channel.

Pre-Trigger Range – Variable from 2 samples to (Record Length – 8) samples.

POWER REQUIREMENTS

2510 Mainframe (Include Flat-Panel Display): 110 or 220 Volts ac, 50/60 Hz, 500 VA max. 11 to 20 Volts dc, 30 A max. 12 V dc lead-acid battery recommended for dc power source.

2520 Mainframe: 110 V or 220 V ac 50/60 Hz, 975 VA typical.

Color Monitor – 110-125/200-240 V ac, 50/60 Hz, 85 watts.

MECHANICAL AND ENVIRONMENTAL

2510S2 with Two Acquisition Cards

Size – 203 x 455 x 432 mm (8 x 17.9 x 17 inches).

Weight – Approx. 37 lbs.

2520 with Six Acquisition Cards

Size – 260 x 425 x 600 mm (10.25 x 16.8 x 23.5 inches)

Weight – Approx. 53 lbs. .

Both 2510 and 2520

Temperature Range: Operating: ac Power, 4°C to 50°C (40°F to 122° F); 12 V dc battery, 4°C to 40°C (40°F to 104°F). Non-Operating: – 40°C to 60°C (– 40° to 140°F). After storage in extreme cold, allow instrument to warm up to ambient temperature before restoring power.

Relative Humidity – Up to 95% RH, non-condensing. Hard disk limited to 26°C (78°F) maximum wet bulb temperature.

Altitude, Vibration, Shock and Bench Handling – Meets MIL-T-2880C, Type III, Class 5. Excludes hard disk.

ACQUISITION PARAMETERS VS. CHANNEL COUNT

Active Channels	Maximum Record Length	Maximum Sample Rate	Minimum Sample Rate	Duration at Maximum Record Length
25AA1				
1	262,144 S	100 kS/s	12.5 S/s	2.6 s to 5.8 hr
2	131,072 S	55 kS/s	12.5 S/s	2.4 s to 2.9 hr
3	87,381 S	38 kS/s	12.5 S/s	2.3 s to 1.9 hr
4	65,536 S	29 kS/s	12.5 S/s	2.2 s to 1.4 hr
25AA2				
1 or 2	65,535 S	12.5 MS/s	200 S/s	5.2 ms to 5.46 min

S=samples, kS=kilosamples, MS=megasamples, ms=milliseconds, s=seconds, min=minutes, hr=hour

ORDERING INFORMATION

TestLab™ is ordered in the configuration of your choice to fit your application. The configuration consists of a mainframe and display selection plus any combination of acquisition cards, any mix.

2510S1 TestLab™ Standard Configuration **$8,500**
Includes: 2 card mainframe, software, color monitor, parallel printer COMM Pack, and operator's manual. Requires at least one acquisition card to acquire data (order separately).

2510S2 TestLab™ Portable Configuration **$9,250**
Includes: 2 card mainframe, software, flat-panel display powered from mainframe, parallel printer COMM Pack, soft-sided case, and operator's manual. Requires at least one acquisition card to acquire data (order separately).

2520 TestLab™ Six Card Mainframe **$9,500**
Includes: Software, color monitor, parallel printer Comm Pack and operator's manual. Requires at least one acquisition card to acquire data (order separately).

INSTRUMENT OPTIONS

Opt. 03 – Add RS-232C Remote Control Comm Pack and manual. **+$750**
Opt. 10 – Add IEEE-488 (GPIB), COMM Pack and manual. **+$850**
Opt. 12 – Add 20 Mbyte internal hard disk and controller. **+$1,000**
Opt. 15 – Add color monitor to 2510S2. **+$695**

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**

ACCESSORY OPTIONS

Opt. B1 – Service Manual. *1
Opt. 1T – Transit case with wheels for 2510S2. **+$550**
Opt.1R – Rackmount for 2520 main-frame. **+$400**
Opt. 2R – Color monitor rackmount for 2510S1. **+$400**

ACQUISITION CARDS

25AA1 – 100KS, 12 bit, 4 channel, 256K. **$3,400**
25AA2 – 12.5MS, 10 bit, 2 channel, 2 x 64K. **$4,700**

OPTIONAL ACCESSORIES

25BP4 Four-channel measurement interface unit includes cable for connection to 25AA1 acquisition card. Accept any mix of four of the following modules (order separately): **$285**

119-3524-00 – (Analog Devices 5B34-01) Linearized 2, 3, or 4-wire RTD Input, 100 Ω platinum. Input: –100°C to +100°C. Output 0°C to + 5 V. **$150**
119-3527-00 – (Analog Devices 5B34-04) Linearized 2, 3, or 4-wire RTD Input, 100 Ω platinum. Input: 0°C to 600°C. Output: 0 to + 5 V. **$150**
119-3533-00 – (Analog Devices 5B38-02) Full bridge input, 10 V excitation (Strain gage application). Input: 300 Ω to 10 kΩ. Output: ± 5V. **$180**
119-3536-00 – (Analog Devices 5B40-01) Wide bandwidth, millivolt input. Input: ± 10 mV. Output: ± 5V. **$150**
119-3542-00 – (Analog Devices 5B47-J-02) Linearized thermo-couple input, J-type. Input: – 100°C to 300°C. Output: 0 to + 5 V. **$205**
119-3543-00 – (Analog Devices 5B47-K-04) Linearized thermo-couple input, K-type. Input: 0°C to 1000°C. Output: 0 to + 5 V. **$205**
119-3546-00 – (Analog Devices AC 1367) One to one non-isolated voltage feed-through, internally fused. Input: ± 10 V DC, Output: ± 10 V DC. **$39**
Soft-sided Carrying Case – for mainframe with flat panel or no display (included in 2510S2 configuration). Order 016-0909-00 **$100**
Hard-sided Transit Case – with wheels for mainframe with flat panel display or no display (also available as Opt. 1T on 2510S2 configuration). Order 016-0994-00 **$600**
C14 14 inch Color Multisync Monitor – (included with 2510S1 and 2520 or as Opt. 15 on 2510S2 configuration). Order 118-0744-04 *1
30F12 – 20MB Hard Disk Kit – also available as Opt. 12. **$1,200**
30F01– Flat panel display kit for 2510S1 (standard accessory on 2510S2). **$2,000**
P6115– 1.5 m, 1X, 42 V probe for 25AA1 only. **$32**
P6103 – 2.0 m, 10X probe. **$40**
P6007– 6 ft., 100X probe. **$140**

WARRANTY INFORMATION

The various products included in TestLab™ are covered by a one year warranty covering all parts and labor. Warranty Service is available through your local Tektronix Service Center.

**1 Contact your local sales representative.*

NEW

2622/2630/ 2630MS/2640 PERSONAL FOURIER ANALYZERS

Advanced Analysis of Analog Signals in the Time and Frequency Domains, from dc to 200 kHz

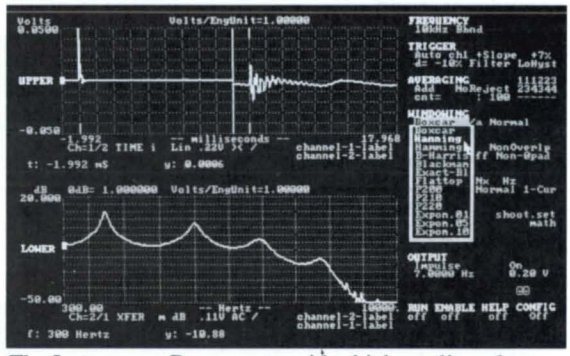
NEW 2622
NEW 2630MS
NEW 2640

- *Realtime 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, Swept Sine Measurements, Waveform Math, and More.*
- *Easy-to-Learn Pull-Down Menus.*
- *Up To Four Input Channels.*
- *Optional Built-in Signal Generator with Periodic, Random, and Arbitrary Analog Signal Generation.*

PC INTEGRATED

Personal Fourier Analyzers from Tektronix provide the most advanced architecture in bench-top instrumentation available today. From their inception, Personal 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 Personal Fourier Analyzer is a combination of precision signal acquisition hardware and RAM based microprocessors specifically designed for high performance signal processing. Connected to a common PC, the Personal 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.



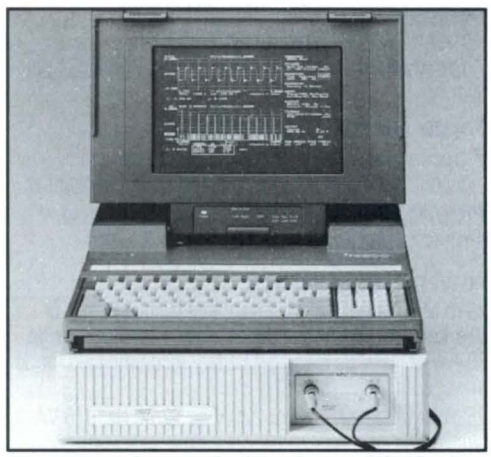
The Instrument Program provides high-quality color graphics and easy-to-learn pull-down menus for data analysis and acquisition control.

FLEXIBLE

The Instrument Program (IP) supplied with the Personal Fourier Analyzer is the critical link between the analyzer and the PC. When executed from the PC, all of the Personal Fourier Analyzer's instructions are down loaded into the analyzer's internal RAM, providing the latest features and capabilities. IP then uses the PC's display to generate the Personal 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 can access a wide variety of analysis functions and data presentations. Standard functions include:

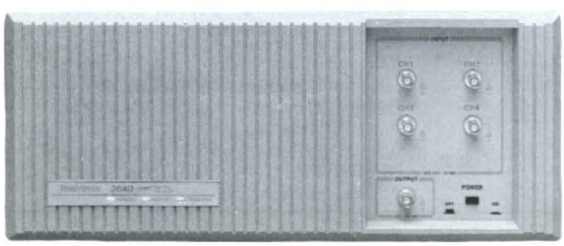
- Time record (waveform)
- Orbits (lissajous)
- Auto- and cross- correlation
- Power spectrum for each channel
- Frequency response functions between any two channels
- Impulse response
- Real, imaginary, magnitude, phase, and Nyquist displays
- Advanced data cursors



The 2622, when used with a laptop PC (Option 20), becomes a lightweight system that easily travels with you.

2622 Personal Fourier Analyzer. DC-20 kHz

2630 Personal Fourier Analyzer. DC-20 kHz

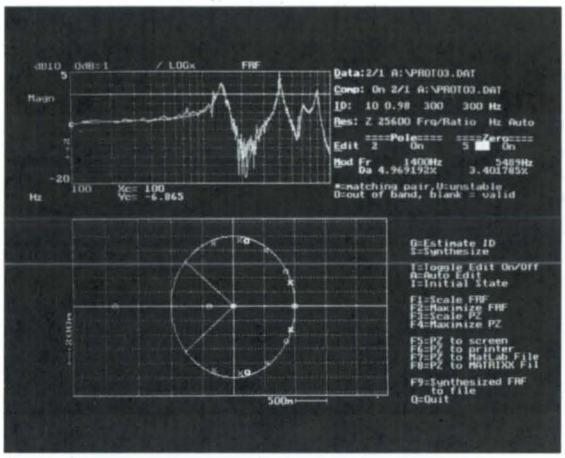


2640 Personal Fourier Analyzer. DC-200 kHz

SELECTION GUIDE

	2622	2630	2640
Frequency Range	20 kHz	20 kHz	200 kHz
Max Input Chan.	2	4	4
Max Realtime BW	5 kHz	10 kHz	10 kHz
Dynamic Range	75 dB	75 dB	75 dB
Channel Match	±0.2 dB, ±0.5	±0.2 dB, ±0.5	±0.2 dB, ±0.5
Spectral Lines	25 to 800	25 to 1600	25 to 1600
Zoom	Opt. 2H	Opt. 2H, 3H	Opt. 2H, 3H
Signal Generator	-	Opt. 4H	Opt. 4H
Digital Rec/Playback	-	Opt. 5H	-
Weight	12 lb. (5.5 kg)	17 lb (7.7 kg)	26 lb (11.8 kg)
Price Begins At:	**$7,950**	**$10,250** (2-Ch)	See note below (2-Ch)

For additional information on a specific model, or a complete list of options and accessories, contact your Tektronix sales engineer, or call (408) 374-6464 (in the U.S., call 1-800-234-1256).



One of many accessory software packages, the RLS System Identification software produces pole/zero system models from measured stimulus/response data.

ADVANCED SOLUTIONS

In addition to the Instrument Program, optional accessory programs extend the capabilities of the Personal Fourier Analyzer – providing everything from advanced tools to complete solutions for a variety of applications.

Production Test Automation

The Production Test Manager is a series of programs designed to dramatically reduce the development time for creating automated production tests using Personal Fourier Analyzers. Using the LIMITS program, test limits can be defined quickly using a table of values, previously measured data, or rubber-band 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 System Identification program (shown in photo above) analyzes time 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™.

For measurement conditions requiring optimum measurement signal-to-noise, the optional Swept Sine program can be used with a Personal Fourier Analyzer's signal generator to provide classic swept sine testing.

Acoustics

When monitoring acoustic signals, the optional Third Octave program provides 1/3 octave analysis of up to four signals simultaneously.

Modal Analysis

For advanced structural analysis, the 2630MS Modal Analysis System provides a complete, turn-key system including PC, 2630, STAR*MODAL* modal analysis software, and the TekSTAR Modal Acquisition Manager for attaching point and direction to data files. (For information on hammer kits and transducers, see page 430.)

General Analysis

For general purpose waveform manipulation, the optional Waveform Math program allows time and frequency domain data to be modified using 17 standard and advanced math operators.

Digital Record/Playback

If you need to capture an event or series of events for later analysis, the 2630's Option 5H, Digital Record/Playback streams digitized input signals directly to the host PC's RAM, RAM disc, or hard disk. Once recorded, the data can be sent back to the 2630 for analysis. Transfer rates up to 51.2K samples/s are achievable.

ORDERING INFORMATION

2622 Personal Power Analysis	**$7,950**
Opt. 2H – 2-Ch Zoom	**+$1,000**
2630 (2-Ch Standard)	**$10,250**
Opt. 1H – 4 Input Channels	**+$3,700**
Opt. 2H – 2-Ch Zoom	**+$1,000**
Opt. 3H – 4-Ch Zoom	**+$2,000**
Opt. 4H – Signal Generator	**+$2,300**
Opt. 5H – Dig Rec/Playback	**+$3,000**
2640 (2-Ch Standard)	*1
Opt. 1H – 4 Input Channels	*1
Opt. 2H – 2-Ch Zoom	*1
Opt. 3H – 4-Ch Zoom	*1
Opt. 4H – Signal Generator	*1
2630MS Modal System	**$25,250**

For a complete list of options, accessories, and optional software programs, contact your Tektronix sales representative or call (408) 374-6464 (in the U.S., call 1-800-234-1256)

MINIMUM PC REQUIREMENTS

Personal 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: 512 kBytes - IP only, 640 kBytes - IP + optional software

One 3 1/2 or 5 1/4" floppy drive (hard drive recommended)

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)*

*1 *Contact your local sales representative.*

2630MS Modal Analysis System

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SUMMARY OF TEK PRODUCTS

- ***Category 1 – Extending Electronic Test and Measurement Tools into the Optical Regime***
  - *Optical "Front Ends" or Tektronix Instruments*
  - *Stand-Alone Optical "Front Ends"*
- ***Category 2 – Stand-Alone Optical Test and Measurement Instruments***
- ***Category 3 – Laser Diode Sources and Automated Laser Diode Testing***

SOLUTIONS OFFERED

Tektronix opto-electronic product offerings fall into three categories. The first contains instruments extending electronic test and measurement tools into the optical regime. This allows users to minimize their personal and financial investment in special purpose instruments while bringing powerful and familiar electronic solutions to their optical test and measurement problems. Within this category are two kinds of instruments: (1) opto-electronic "front end" plug-ins for current and future Tektronix oscilloscope products, and (2) stand-alone opto-electronic units and modules used to convert optical to electrical inputs for use by other test and measurement instruments made by both Tektronix and other manufacturers.

The second category of product offering contains stand-alone instruments dedicated to solving specific optical and related test and measurement problems. These instruments span high speed fiber optic data communications, radiometry, and fiber optic telecommunications applications. Instruments for fiber optic cable testing and related applications appear in the Telecommunications section of this catalog.

The third category of products contains solid state semiconductor laser components and related hybrid circuit modules, as well as an optical component test system. This test system provides automated performance characterization of packaged laser diode optical sources.

DISTINCTIVENESS OF SOLUTIONS

When it comes to making time domain optical waveform measurements, no one exceeds Tektronix' capability. Tektronix products offer a wide range of bandwidths and sensitivities for making those tough measurements on optical components such as high speed LEDs and laser diodes. As an example, the Tektronix P6701 Optical to Electrical Converter Probe is ideal for measuring the rise and fall times of short wavelength LEDs as well as lasers used in the optical data storage industry. Also, the P6703 Optical to Electrical Converter Probe with its 1 GHz optical bandwidth and DC coupling, is a powerful tool to use when characterizing high speed 1300 nm transmitters conforming to the FDDI specification.

CUSTOMER OPTO-ELECTRONIC TEST AND MEASUREMENT NEEDS

The instruments appearing in the following Opto-Electronic section of this catalog are primarily intended for use in service, research, design and development, as well as manufacture of opto-electronic systems, modules, and components. These instruments have a wide variety of uses in the engineering test and measurement processes attendant to characterizing both the optical and electrical properties and response of these components, modules and systems.

The rapid growth in reliance on solutions using optical fiber based sensing and communications equipment has extended test and measurement needs into the optical realm. Tektronix is dedicated to both moving its applicable existing test and measurement tools into the optical regime, as well as offering new solutions to meet the needs of customers requiring optical waveform measurements.

Not all of Tektronix' optically related solutions are contained in this catalog section. For those involving test and measurement dealing with fiber optic based communication equipment installation, operation or maintenance, the Telecommunication section of this catalog should be consulted.

The SD-42 Optical to Electrical Converter Head coupled with a Tektronix 11800 Series oscilloscope is an excellent choice for measuring the characteristics of long wavelength laser transmitters such as is found in the SONET based communication systems. If an even faster response is needed, the new SD-46 Optical to Electrical Converter Head provides the fastest time domain photodetector performance on the market. This unit's 20 GHz bandwidth allows measurements to be made on even the fastest fiber optic communication links. Only Tektronix offers such a complete solution for test and measurement jobs needing an integrated optical to electrical conversion capability.

A powerful, flexible, and cost effective optical waveform measurement tool is produced by coupling the opto-electronic products shown on the following pages to the unparalleled waveform and acquisition and processing capabilities provided on-board the Tektronix 11000 Series oscilloscopes. This instrument combination provides an unmatched capability to easily and accurately measure such optical waveform parameters as:

- Pulse rise and fall times
- Waveform abberations
- Minimum, maximum, mean, and peak power levels.

This combination is made even more powerful when used in conjunction with Tektronix waveform processing software such as the Template Waveform Processing Program™ (TWPP) and i-Pattern Software™. Running independently on a Tektronix PEP 300 Series controller or other PC compatible computer, these software packages provide a powerful optical waveform analysis capability for such applications as FDDI specification template testing and time domain eye pattern analysis of digital communications links. Only Tektronix offers such a powerful set of time domain waveform measurement solutions.

PRODUCT DESCRIPTION

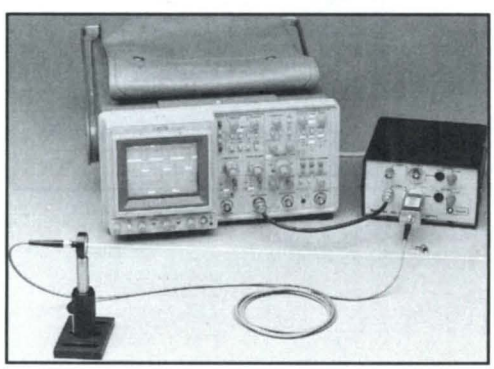
The Tektronix P6701/P6702/P6703 are optical probes that allow the user to receive optical signals and convert them to electrical signals for convenient analysis on Tektronix oscilloscopes equipped with the TEKPROBE ™*1 interface or any other oscilloscope when used in conjunction with the Tektronix 1103 TEKPROBE ™*1 interface power supply. The conversion is linear, DC coupled, calibrated, and of high bandwidth.

Use of the 11000-Series Oscilloscopes TEKPROBE ™*1 interface allows the oscilloscope to supply power to the probe, automatically determine and display the proper scale factor (in milliwatts of optical power) and set the input termination to the required 50 ohms. An oscilloscope-controlled calibrated offset of 0 to 1 mW is also available through this interface.

The P6701/P6702/P6703 provides a calibrated means of analog analysis of optical signals in the wavelength range 450 to 1050 nm (P6701), 1000 to 1700 nm (P6702) and 1100 to 1700 nm (P6703) thus combining the functions of an optical power meter with the high-speed analog waveform analysis capability of an oscilloscope in one instrument. The user has the capability of acquiring, displaying and analyzing mixed analog and digital, optical and electrical signals simultaneously.

Each probe is contained in an oscilloscope probe-size compensation box and mounts directly to an 11000 series oscilloscope plug-in, thus requiring no bench space. Optical signal input is through a standard SMA or optional FC or ST fiber optic cable connector mounted on the front of the converter.

The P6751 Spatial Input Head is a tunable lens system for sampling optical energy from any collimated source and delivering it via a fiber optic cable to the P6701/P6702/P6703 optical to electrical converter. The P6751 is easily mounted using standard optical bench fixtures. The Spatial Input Head can be adjusted (500 to 1500 nm) by the user to optimize the amount of optical energy sampled and delivered to the P6701/P6702/P6703. The P6751 has a standard SMA fiber optic cable connector. Also available are a series of fiber optic jumper cables for interfacing the P6701, P6702, P6703 and P6751 with other industry standard optical fiber connectors.



P6701 with 1103 Power Supply and a 2440 Portable Oscilloscope

P6701, P6702, P6703, and 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 P6701/P6702/P6703 type coupled with two 11A34 amplifier plug-ins and an 11000-series oscilloscope can be configured as an 8-channel optical oscilloscope!

CHARACTERISTICS

	P6701	P6702	P6703
Wavelength Response	450 to 1050 nm	1000 to 1700 nm	1100 to 1700 nm
Bandwidth	DC to 700 MHz	DC to 500 MHz	DC to 1 GHz
Risetime	≤700 ps	≤1000 ps	≤500 ps
Conversion Gain	1 V/mW at 850 nm	1 V/mW at 1300 nm	1 V/mW at 1300 nm
Calibrated Offset	0-1 mW	0-1 mW	0-1 mW
Max Input Optical Power	2 mW	2 mW	2 mW
Noise Equivalent Power	≤1 μW(RMS)	≤1 μW(RMS)	≤1μW(RMS)

P6701

450 to 1050 nm, DC to 700 MHz

P6702

1000 to 1700 nm, DC to 500 MHz

NEW P6703

1100 to 1700 nm, DC to 1 GHz

P6751

Spatial Input Head

- *Optical Oscilloscope*
- *Average and Pulse Power Meter*
- *Calibrated Output*

ORDERING INFORMATION

P6701 Optical-to-Electrical Converter ☎ **$2,000**
Includes: Standard SMA input connector; carrying case (016-0156-03); and instruction manual (070-6465-00).
Opt. 01 – FC input connector **NC**
Opt. 02 – ST input connector **NC**

P6702 Optical-to-Electrical Converter ☎ **$2,095**
Includes: Standard SMA input connector; carrying case (016-0156-03); and instruction manual (070-6466-00).
Opt. 01– FC input connector. **NC**
Opt. 02– ST input connector **NC**

P6703 Optical-to-Electrical Converter ☎ **$2,750**
Includes: Standard SMA input connector; carrying case (016-0156-03); and instruction manual (070-7496-00).
Opt. 01 – FC input connector **NC**
Opt. 02 – ST input connector **NC**

P6751 Spatial Input Head ☎ **$350**
Includes: Adjustment tool and instruction sheet.

OPTIONAL ACCESSORIES

Cables – (2 meters) 100/140 micron (SMA to SMA) Order 174-0879-00 **$280**
(SMA to Diamond 3.5) Order 174-0877-00 **$330**
(SMA to FC) Order 174-0878-00 **$295**
(SMA to Biconic) Order 174-0880-00 **$250**
(SMA to ST) Order 174-0876-00 **$250**
(SMA to Diamond 2.5) Order 174-1303-00 **$280**
1103 TEKPROBE™*1 Interface **$375**
Power Supply. Refer to page 428 for additional information.

**1 TEKPROBE is a trademark of Tektronix, Inc.*

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

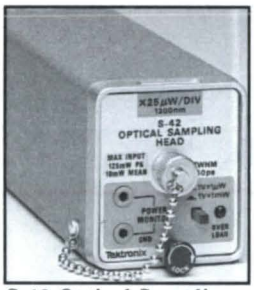
OPTO-ELECTRONIC CONVERTERS

S-42
Optical Sampling Head
- *55-ps Optical Pulse Response (max. FWHM)*
- *DC-6.4 GHz Optical Bandwidth*
- *1000 nm - 1700 nm Spectral Response*
- *Mean Optical Power Monitor Function*

NEW SD-42
Optical to Electrical Converter
- *55-ps Optical Pulse Response (max. FWHM)*
- *DC-6.4 GHz Optical Bandwidth*
- *1000 nm - 1700 nm Spectral Response*
- *Mean Optical Power Monitor Function*

NEW SA-42
Optical to Electrical Converter
- *50-ps Optical Pulse Response (max. FWHM)*
- *DC-7 GHz (–3 dB), to 15 GHz (–25 dB)*
- *1000 nm - 1700 nm Spectral Response*
- *Ultra Low Noise*

NEW SD-46
Optical to Electrical Converter
- *18 ps Optical Pulse Response (max. FWHM)*
- *DC-20 GHz Optical Bandwidth*
- *1200 nm - 1700 nm Spectral Response*
- *Mean Optical Power Monitor Function*



S-42 Optical Sampling Head

SD-42 Optical to Electrical Converter

SA-42 Optical to Electrical Converter

SD-46 Optical to Electrical Converter

S-42
The S-42 is an optical to electrical sampling head for use with Tektronix 7000 series oscilloscopes equipped with 7S11 or 7S12 sampling plug-ins. The optical to electrical conversion is linear up to 25 mW peak input with a calibrated deflection factor from 50 µW/Div to 5 mW/Div at 1300 nm.

SD-42
The SD-42 is an optical to electrical converter for use with the Tektronix 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 at 1300 nm. This unit has a 55 ps optical pulse response (max. FWHM) with the SD-24 and SD-26 Sampling Heads and 60 ps optical pulse response (max. FWHM) with the SD-22 Sampling Head.

SA-42
The SA-42 is a stand-alone optical to electrical converter for general purpose, high frequency use. It is principally for use with the Tektronix Spectrum Analyzers. The optical to electrical conversion is linear up to 25 mW peak input with a calibrated conversion gain of 25 µW/mV at 1300 nm.

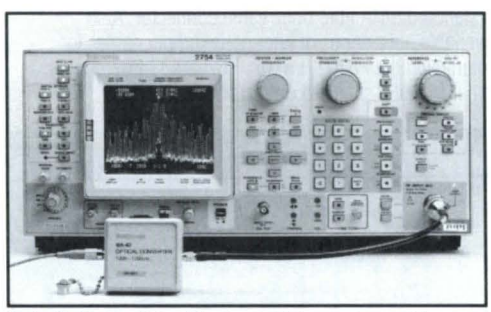
SD-46
The SD-46 is an optical to electrical converter for use with the Tektronix 11800 Series Sampling Oscilloscopes equipped with an SD-22, SD-24, or SD-26 Sampling Head. The optical to electrical conversion is linear up to 25 mW peak input with a calibrated deflection factor from 50 µW/div to 5 mW/div at 1300 nm. This unit has a 25 ps optical pulse response (max. FWHM) with the SD-24 and SD-26 Sampling Head.

The S-42, SD-42 and the SD-46 also have a Mean Power Meter Function with selectable 1 V/nW and 1 V/µW ranges.

The S-42 Optical Sampling Head, SD-42 Optical to Electrical Converter and the SD-46 Optical to Electrical Converter can be plugged into the sampling unit or attached by a sampling head extender for remote use. The S-42 head extender comes in either 3 foot (012-0124-00) or 6 foot (012-0125-00) options. The SD-42 and SD-46 head extenders come in either 1 meter (012-1220-00) or 2 meter (012-1221-00) options. Refer to page 50 for SD-42 and SD-46 head extenders.

Optical signal input on the S-42, SA-42, SD-42, and the SD-46 are through a standard FC fiber optic connector, other connector types can be accommodated by use of fiber optic jumper cables.

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 S-42 Optical Sampling Head, SD-42 Optical to Electrical Converter, and the SA-42 Optical to Electrical Converter offer DC to 7 GHz bandwidth performance for wavelengths from 1000 nm to 1700 nm. The SD-46 Optical to Electrical Converter gives researchers optical waveform measurement capability from DC to 20 GHz in the 1200 nm to 1700 nm wavelength range. Measurements such as risetime, aberration, optical power vs drive current and voltage, modulation bandwidth, and sensitivity can now be made at high bandwidth accurately and easily.


SA-42 Optical to Electrical Converter with Tektronix 2754 Spectrum Analyzer

CHARACTERISTICS

PULSE CHARACTERISTICS

	S-42	SA-42	SD-42	SD-46
Pulse Response	55 ps Max. (FWHM)	50 ps Max (FWHM)	55 ps Max. (FWHM)	18 ps Max (FWHM)
Bandwidth	DC-6.4 GHz Optical	DC-7.0 GHz Optical	DC-6.4 GHz Optical	DC-20 GHz Optical
Spectral Response	1000 to 1700 nm	1000 to 1700 nm	1000 to 1700 nm	1200 to 1700 nm
Noise Equivalent Power	≤125 µW	≤2.5 µW*1	≤3.8 µW*1 ≤33 µW*2 ≤10 µW*3	≤5.2 µW*1 ≤45 µW*2 ≤16 µW*3
Linear Response Range	≤25 mW Peak Power ≤5 mW Peak Power	≤25 mW Peak Power ≤5 mW Peak Power	≤25 mW Peak Power ≤5 mW Peak Power	≤25 mW Peak Power ≤5 mW Peak Power
Aberrations	≤30% p-p*4	≤15% p-p*4	≤15% p-p*4	±10%≥40 ps from pulse

*1 *Into 50 Ω*
*2 *System specification with SD-24/SD-26*
*3 *System specification with SD-22*
*4 *Within the first 400 ps following a pulse input*

POWER METER

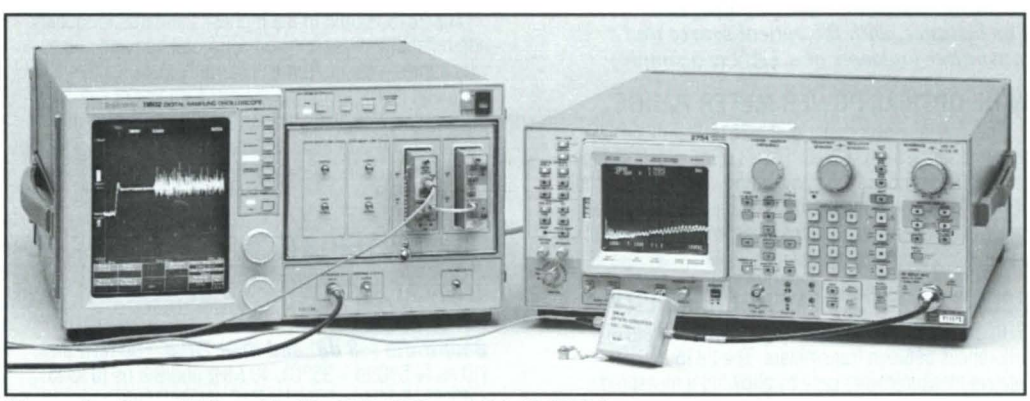
	S-42	SA-42	SD-42	SD-46
Dynamic Range	5 nW to 5 mW (60 dB)	NA	5 nW to 5 mW (60 dB)	5 nW to 5 mW (60 dB)
Sensitivity		NA		
Range 1	1 V/mW ±10%		1 V/mW ± 10%	1 V/mW ± 10%
Range 2	1 V/µW±10%		1 V/µW ± 10%	1 V/µW ± 10%
Bandwidth	DC-100Hz	NA	xxxx	xxxx

ENVIRONMENTAL

Operating Temperature Range – 0°C to 50°C.

PHYSICAL CHARACTERISTICS

	S-42		SA-42		SD-42		SD-46	
Dimensions	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**
Width	46	1.8	80	3.1	25.4	1.0	25.4	1.0
Height	51	2.0	59	2.0	76.2	3.0	76.2	3.0
Depth	152	6.0	25	1.0	101.6	4.0	101.6	4.0
Weight	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**
Net	0.4	0.9	0.125	0.3	0.2	0.44	0.2	0.44
Net (with opt.)	0.9	2.0	0.9	2.0	0.7	1.54	0.7	1.54



Measuring Laser Noise with SD-42/11802 and SA-42/2754

ORDERING INFORMATION

S-42 Optical Sampling Head **$6,040**
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); instruction manual (070-7191-00).

SD-42 Optical to Electrical Converter **$3,400**
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 manuals (070-7463-00, 070-7464-00, 070-7465-00).

SD-46 Optical to Electrical Converter **$8,500**
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 manuals (070-7730-00, 070-7731-00, 070-7732-00).

SA-42 Optical to Electrical Converter **$3,250**
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).

OPTIONAL ACCESSORIES

Fiber Optic Cables – 2 meter, 8/125 µm, single mode.
(FC to Diamond 3.5)
Order 174-1385-00. **$480**
(FC to Diamond 2.5)
Order 174-1497-00. **$475**
(FC to ST)
Order 174-1386-00. **$615**
(FC to FC)
Order 174-1387-00. **$350**
(FC to Biconic)
Order 174-1388-00. **$450**

Sampling Head Extender Cables –
(3 ft) Order 012-0124-00 (S-42) **$550**
(6 ft) Order 012-0125-00 (S-42) **$630**
(1 m) Order 012-1220-00
(SD-42 and SD-46) **$585**
(2 m) Order 012-1221-00
(SD-42 and SD-46) **$665**

10 kHz to 21 GHz DC Block, "N" Type – Order 015-0509-00 **$310**

SMA to N type adapter –
Order 015-0369-00 **$49**

INTERNATIONAL POWER PLUG OPTIONS (SA-42 ONLY)

Opt. A1 – Universal Euro **NC**
220 V, 50 Hz. 161-0104-06

Opt. A2 – United kingdom **NC**
240 V, 50 Hz. 161-0104-07

Opt. A3 – Australian **NC**
240 V, 50 Hz. 161-0104-05

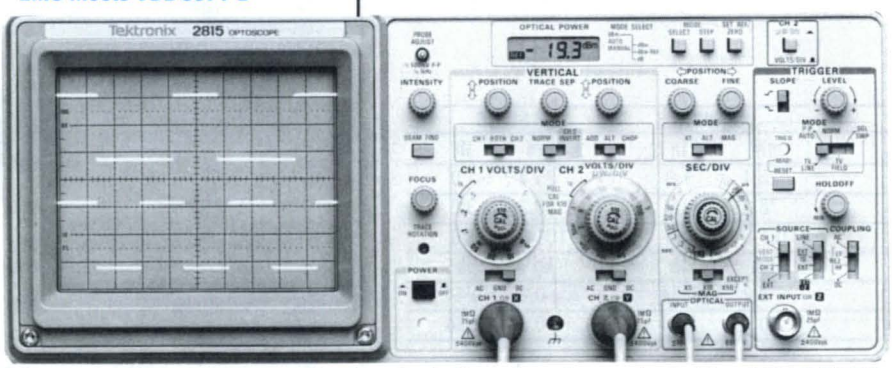
Opt. A4 – North American **NC**
240 V, 60 Hz. 161-0104-08

Opt. A5 – Switzerland **NC**
220 V, 50 Hz. 161-0167-00

2815 *35 MHz, 850 nm, OPTICAL OSCILLOSCOPE*

The First Fully Integrated Opto-Electronic Oscilloscope for Field and Bench

- *Dc to 50 MHz Electrical Bandwidth*
- *Dc to 35 MHz Optical Bandwidth*
- *200 nW/div Optical Sensitivity*
- *500 μV/div Electrical Sensitivity*
- *Calibrated at 850 nm*
- *Operational from 450 nm to 1050 nm*
- *Integrated Optical Power Meter*
- *– 60 dBm Power Meter Sensitivity*
- *Ext Modulatable 850 nm LED Source*
- *Electrical Output of O/E Converter*
- *5 ns/div Maximum Sweep Rate*
- *Flexible Triggering System*
- *3-Year Warranty; Five-Year Optional*
- *UL Listed, CSA Certified*
- *EMC Meets VDE 0871-B*



The 2815 addresses many applications including education, optical video, LED P-I/P-V testing, and local area network service. For instance, with the optical source and external modulation input, diagnosing transmitter problems in a LAN is a simple operation.

A NEW CONCEPT IN TECHNOLOGY

The Tek 2815 OPTO-Scope™ represents a new concept in oscilloscope performance. Designed for testing and maintaining optical communication systems, the OPTO-Scope™ displays both electrical and optical signals simultaneously. It includes a fully featured optical power meter for precise and sensitive measurement capability, plus an optical output source for use as a stimulus signal.

TWO MEASUREMENT INSTRUMENTS IN ONE

Depressing a single push button permits easy conversion from two 50 MHz electrical channels to one electrical and one (35 MHz) optical channel. The result is a simultaneous real time display of both electrical and optical waveforms. With this capability, you can easily compare the optical and electrical response of a receiver or transmitter using only one instrument.

EQUALLY AT HOME ON THE BENCH OR IN THE FIELD

The 2815 is a self-contained portable scope which is equally well suited for measurements in field or at the fiber optic test bench. Fully operational at 450 nm to 1050 nm wavelengths, the 2815 satisfies your measurement needs with economy and ease of use, providing accurate, reliable, and repeatable results.

WIDE OPTICAL POWER METER RANGE

The optical power meter of the 2815 features a dynamic range from -60 dBm to +3 dBm, plus a choice of operating modes. You can read power levels in either dBm or Watts from the backlit LCD display. The power meter is functional at all times, even when you are not using the optical display channel.

RELATIVE MEASUREMENT CAPABILITY

In dB mode, you can test loss in optical fibers or differences between transmitters. The 2815 makes relative measurements easy by allowing a measured value to be saved for later use or as a reference level. When you are making a difference measurement, the meter automatically displays the difference between the dBm Ref value and the current measurement.

AUTO AND MANUAL RANGING

The 2815 OPTO-Scope™ features an auto-ranging Watts mode for making fast and easy power measurements. The dynamic range is from 0.1 nW to 1.999 mW for measurements requiring wide range and optimum resolution. Manual ranging is also available for applications where fast response time or maximum resolution, e.g., repetitive power level measurements, are required.

OPTICAL OUTPUT SOURCE

The 2815's optical source can be used for stimulating an optical system and for checking the optical channel. It provides 10 μW of mean power (850 nm) at 10 kHz with a 10 ns rise time, and may be externally modulated with TTL signals from dc to 10 MBits/sec.

O/E CONVERTER ACCESS

Access is provided to the optical-to-electrical converter, which offers an output calibrated at 10 mV/div from dc to 35 MHz for driving external equipment such as bit error rate testers, frequency counters, and digitizers.

APPLICATION VERSATILITY

The 2815 OPTO-Scope's versatility spans a wide range of applications. It's an ideal tool to use when servicing and installing low-speed communication systems, including local area networks, optical RS-232, and Ethernet. You'll find that troubleshooting tasks are much easier when you provide a known stimulus to isolate a transmitter and then observe the systems, electrical and optical response.

INTEGRATION MEANS LOW COST

Total integration minimizes the need for separate equipment and cabling, a benefit on the test bench, in manufacturing, and in the classroom. An excellent one-unit lab tool with designed-in ergonomics, the 2815 is affordable and easy to use. The low price makes it an attractive alternative to purchasing separate pieces of equipment for any optical/electrical application.

QUALITY AND RELIABILITY

The 2815 is built to the highest standards for quality and reliability. It is UL listed, CSA certified and comes with a three-year instrument warranty that includes all parts and labor, including the crt. A choice of five practical service plans further reduces your cost-of-ownership by extending coverage beyond the basic three years.

CHARACTERISTICS

VERTICAL SYSTEM

(2 Electrical Channels)

Bandwidth (–3 dB) and Rise Time – 50 MHz and 7.0 ns (+ 5°C to + 35°C); 40 MHz and 8.8 ns (0°C to + 40°C). 5 MHz ±20% for X10 vertical mag.

Deflection Factor and Accuracy – 5 mV/div to 5 V/div, ±3%. 500 μV to 0.5 V/div, ±5% with X10 vertical mag. Variable 2.5:1.

Vertical Operating Modes – CH 1, CH 2, CH 2 Invert, ADD, ALT, CHOP, X10 vertical mag.

CMRR – ≥ 10:1 at 20 MHz.

Channel Isolation – ≥ 100:1 at 20 MHz.
Input R and C 1 MΩ, 27 pF.

Max Input Voltage – 400 V (dc peak ac) or 800 V p-p.
(Optical Channel)

Bandwidth (–3 dB) and Rise Time – 35 MHz and 10.0 ns (+ 5°C to +35°C); 30 MHz and 12.0 ns (0°C to + 40°C). 5 MHz ±20% for X10 vertical mag.

Maximum Input for Linear Display – 2 mW.

Noise ≤ 50 nW RMS at 35 MHz bandwidth measured at the Receiver Output BNC.

Wavelength – Calibrated at 850 nm, usable from 450 nm to 1050 nm.

Coupling – DC or AC for settings 1 µW to 200 µW/div, AC for settings 200 nW and 500 nW/div.
Input Fiber - 200/230/0.4NA (internal)

Other Characteristics – As specified for electrical channels.

HORIZONTAL SYSTEM

Sweep Speeds – 0.5 s/div to 0.05 us/div. X5, X10, X50 MAG to a maximum of 5 ns/div.

Accuracy – X1: ±3%; X5 & X10: ±4%; X50: ±5% (all +15°C to + 35°C).

Horizontal Operating Modes – X1 (main only), ALT (main sweep and mag sweep), MAG (magnified sweep only), X-Y.

Magnifier Registration – Expansion occurs at center vertical graticule.

TRIGGER SYSTEM

Trigger Sensitivity – Internal: 0.3 div at 5 MHz, 1.0 div at 50 MHz. External: 40 mV at 5 MHz, 150 mV at 50 MHz. TV Field: 1.0 div of composite sync.

Trigger Operating Modes – Peak-to-Peak Auto (also for TV Line), Norm, TV Field, Single Sweep.
Trigger Source CH 1, CH 2, Vert Mode, Line, Ext, Ext/10.

Trigger Coupling – AC, DC, HF Rej (attenuates above 30 kHz), LF Rej (attenuates below 30 kHz).

Variable Holdoff – At least 8:1.

X-Y OPERATION

Deflection Factors and Accuracy – Same as vertical system. Y-Axis ±3%, X-Axis ±5% (0°C to + 40°C).

Bandwidth – X-Axis: ≥ 2 MHz. Y-Axis: same as vertical system.

Phase Difference – ±3° from dc to 150 kHz.

OPTICAL POWER METER

Wavelength – Calibrated at 850 nm, usable from 450 nm to 1050 nm.

Range – – 60 dBm to +3 dBm (dBm mode), 0.1 nW to 1.999 mW (Watts mode).

Accuracy – ±0.5 dB 0 to – 50 dBm, ±1 dBm – 50 dBm to – 60 dBm (at + 25°C).

Resolution – 0.1 dB (dBm mode), 0.001 X full scale (Watts mode).

Power Meter Operating Modes – dBm, dBm Ref, dB, Auto-ranging Watts, Manual-ranging Watts (199.9 µW, 1.999 µW, 19.99 µW, 199.9 µW, 1.999 mW).

Display Type – Backlit 3 1/2 digit, 8 mm LCD.

OPTICAL SOURCE

Output Power – ≥ 10 µW mean. (measured from 100/140/0.3NA test fiber at + 25°C). Pulse Format 10 kHz, 50% duty cycle nominal.

External Modulation Input – TTL levels dc to 10 MBits/sec.

Output Rise/Fall Time – ≤ 10 ns maximum.

Extinction Ratio – ≥ 10 minimum.

Wavelength – 850 nm ±30 nm, LED

Output Fiber – 62.5/125/0.2NA (internal)

RECEIVER OUTPUT

Electrical Output of Optical Signal – 10 mV/div of displayed signal on CRT.

Bandwidth (–3dB) – dc to 35 MHz, 50 Ω termination.

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 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.

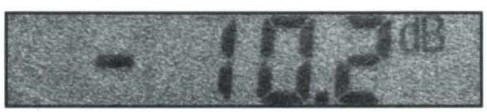
Maximum Power Consumption – 70 W (80 VA)

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Height	138	5.4
Width (with handle)	380	15.0
Depth (without front cover)	440	17.3
Weight	**kg**	**lb**
Net	7.6	16.8
Shipping	9.5	20.9

ENVIRONMENTAL CHARACTERISTICS

See page 142.



The 2815's dB mode can be used to display the difference between a dBm measurement and a stored dBm reference measurement.

The 2815's optical power meter has a wide dynamic range with sensitivity to 0.1 nW. For improved response time, it can also be manually ranged.

ORDERING INFORMATION

2815 OPTO-Scope™ 35 MHz - 850 nm Optical Oscilloscope **$3,995**
Includes: Two 10X Voltage probes (P6103); SMA Optical connectors (standard); Operators Manual (070-7236-00); User's Ref. Guide (070-7238-00); Front Panel Cover (200-3397-02); Accessory Pouch (016-0677-02).

INSTRUMENT OPTIONS

Opt. 26 – FC Optical Connectors *1
Opt. 27 – ST Optical Connectors *1
Opt. 1R – Rackmount Kit +$160

ACCESSORY OPTIONS

Opt. 17 – P6408 Logic Probe +$350

WARRANTY-PLUS SERVICE PLANS

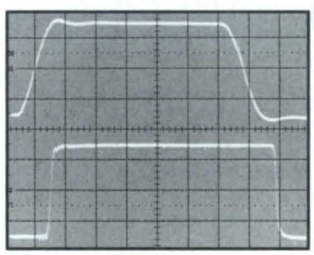
Opt. M2 – 2 years service +$194
Opt. M3 – 2 years service + 4 cals +$514
Opt. M4 – 5 calibrations +$375
Opt. M5 – 2 years service + 9 cals +$864
Opt. M7 – 2 calibrations +$160
Opt. M8 – 4 calibrations +$320

ACCESSORIES

Service Manual – Order 070-7237-00 $25
Optical Cables – 2 Meters 100/140 µm fiber
(SMA to SMA) Order 174-0879-00 $280
(SMA to FC) Order 174-0878-00 $295
(SMA to ST) Order 174-0876-00 $250
(SMA to Biconic) Order 174-0880-00 $250
Spatial Input Head – P6751 $350
16 Bit Logic Probe – P6408 $350

See page 383 for more accessories.

**1 Contact your local sales representative.*



The 2815 OPTO-Scope™ can display an optical signal simultaneously with an electrical waveform, facilitating transmitter and receiver analysis tasks. Signal parameters such as +peak, –peak, peak-to-peak power, frequency, and rise/fall times can be measured. Moreover, you can verify signal quality for aberrations, offsets and waveshape, all of which can only be performed with just one instrument.

NEW

OCP5002/OCP5502 OIG502

OPTO-ELECTRONIC CONVERTERS/ SOURCES

OCP 5002
2 GHz Optical Converter/ Power Meter 1100 to 1700 nm, DC to 2 GHz

OCP 5502
2 GHz Optical Converter/ Power Meter 1100 to 1700 nm, DC to 2 GHz

- *2 GHz Bandwidth*
- *Extinction Ratio Measurements*
- *Low DC Drift*
- *TEKPROBE™ Interface*
- *LED and Laser Characterization*

GPIB IEEE-488 *

OIG 502
Optical Impulse Generator 1300 nm, 40 ps Laser Impulse Source

- *Calibration for High Speed Photodiodes*
- *Impulse Source for High Resolution Optical Time Domain Reflection Measurements*
- *Fiber Bandwidth/Dispersion Measurements*

ORDERING INFORMATION

OCP 5002 2 GHz Optical Converter/Power Meter *1
Includes: Instruction manual (070-7817-00).

OCP 5502 2 GHz Optical Converter/Power Meter *1
Includes: Instruction manual (070-7817-00).

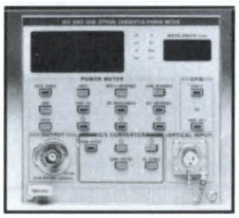
OIG 502 Optical Impulse Generator *1
Includes: Instruction manual (070-7818-00).

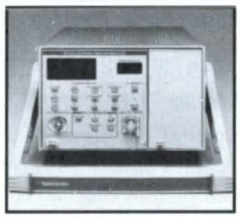
OPTIONAL ACCESSORIES

Cables – (2 m) 100/140 micron
(SMA to SMA)
Order 174-0879-00 **$280**
(SMA to Diamond 3.5)
Order 174-0877-00 **$330**
(SMA to FC)
Order 174-0878-00 **$250**
(SMA to Biconic)
Order 174-0880-00 **$250**
(SMA to ST)
Order 174-0876-00 **$250**
(SMA to Diamond 2.5)
Order 174-1303-00 **$280**

*1 *Contact your local sales engineer*

**The OCP 5002 and OCP 5502 complies with IEEE Standard 488.1-1987 and Tektronix Standard Codes and Formats*





OCP 5002/OCP 5502

The OCP 5002 is an optical to electrical converter with an integral average reading optical power meter, and is a plug-in compatible GPIB controllable unit for the Tektronix TM 5000 Series Power Supplies. The OCP 5502 is a functionally equivalent instrument packaged as a stand-alone monolithic unit with integral power supplies. The OCP 5002 and the OCP 5502 operate over the 1100 nm to 1700 nm spectral range. These units meet or exceed their specified performance over the DC to 2 GHz frequency range.

The power meter can display power in Watts, dB and dBm. The dB reference setting can be from a signal on the power meter or can be set manually.

1 V/mW conversion gain is very useful for measuring optical inputs from LED and laser sources. The user will be able to measure fiber based optical signals up to 2 GHz from either source.

TYPICAL APPLICATIONS

Optical digital communication tests such as SONET and FDDI will be made easier with the TEKPROBE™ Interface and the 2 GHz bandwidth. The 2 GHz bandwidth coupled with the Tektronix 11000 Series Oscilloscopes and specialty measurement software, will give the user a fast response, high resolution, communications measurement capability. Some of the software available include: Tektronix "Template & Waveform Processing Package" and the Tektronix "i Pattern" software. For further information on this software see page 354.

LED characterization, Laser characterization and other component measurements will be made simpler and more repeatable by using OCP 5000 Series Instruments.

CHARACTERISTICS

O/E Converter	OCP 5002/OCP 5502
Wavelength Response	1100-1700 nm
Bandwidth	DC - 2 GHz
Risetime	260 ps
Conversion Gain	1V/mW ± 8% at 1300 nm
Calibrated Offset	0 - 1 mW ± 1%
Max Input Optical Power	2 mW offset at 1 mW 1 mW no offset
Noise Equivalent Power	≤1 µW
Power Meter	
Dynamic Range	+7 dBm to –60 dBm
Accuracy*1	≤ 5% at 1300 nm

*1 *With FC/PC Connectors*

OIG 502

The OIG 502 Optical Impulse Generator is a laser impulse source that operates at 1300 nm. The user may select either internal or external triggering. The trigger level can be adjusted from ±4 volts. This unit is compatible with either the Tektronix TM 500 or TM 5000 Power Supplies.

The internal triggering repetition rates are 10 kHz, 100 kHz or 1 MHz. These options are selectable with front panel switches. The output is stabilized in order to provide repeatable output signal levels.

The OIG 502 has two user selectable output pulse modes: High Power or Fast Pulse. In the High Power mode, the unit provides an optical impulse up to 15 mW with pulse widths ≤300 ps (FWHM). In the Fast Pulse mode, the unit produces an optical impulse up to 5 mW with pulse widths ≤40 ps (FWHM). The OIG 502 has a 60 ps pre-trigger for easy viewing of the impulses on a variety of oscilloscopes.

TYPICAL APPLICATIONS

The OIG 502 is very useful in many applications. These will include photodiode risetime testing, high resolution optical time domain reflectometry, and dispersion and bandwidth testing on optical fiber. The extremely fast pulse and the stabilized output provide performance in these areas never before achieved.

With pulses of ≤ 40 ps width, the user will be able to directly measure the performance of photodiodes whose impulse response characteristics have previously been available only indirectly by a deconvolution computation. The narrow pulse widths achieved will allow centimeter level resolution on OTDR measurements. This permits measurements of reflections in optical systems that were not obtainable before the OIG 502.

The stabilized output will also insure repeatable measurements for all the previous applications. This repeatability has been very difficult to insure before the OIG 502. The tests were complicated and time consuming to insure stable levels on the test signals. Now with the OIG 502, the stability is specified.

CHARACTERISTICS

Wavelength	1300 nm
Pulse Width	
Fast Pulse	≤ 40 ps
High Power	≤ 300 ps
Max Output Optical Power	
Fast Pulse	5 mW
High Power	15 mW

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

LASER DIODE TEST SYSTEM LTS 2000

NEW

The LTS2000 is a fully automated, PC-based laser diode test system designed to deliver comprehensive characterization of laser diodes and laser diode modules. This turnkey system provides the ability to test these optoelectronic devices over a user specified temperature range. Test results are displayed in easy-to-understand color graphics or in tabular format. By comparing up to three measurement parameters in a single three-dimensional plot, anomalies are immediately recognizable and data analysis time is greatly reduced.

Typical test parameters measured and displayed include:

- Light vs. Current vs. Temperature (3-D Plot)
- Monitor Current vs. Forward Current vs. Temperaure (3-D Plot)
- Forward Voltage vs. Forward Current
- Thermoelectric Cooler Current vs. Temperature
- Thermoelectric Cooler Voltage vs. Temperature
- Photodetector Dark Current vs. Temperature

Additional parameters calculated and displayed: Threshold Current at each Temperature, Laser Efficiency, Front-to-Back Ratio, and Power Measurements. Additionally, user defined parameters derived from functional combinations of the measurement data as well as derivatives computed from the measurement data can be displayed and plotted.

Test results are displayed in tabular or graphic formats on the PC screen. Hard copy output is obtained with the Tektronix HC100 Four-Color Plotter. Measurement data is organized into data logging arrays, including: Forward Current, Light Output, Temperature, Monitor Current, Dark Current, TE Cooler Current and Voltage, or user-specified parameters. These arrays can be used in any combination for displaying 2-D or 3-D plots, linking to a central database, or used in building special purpose test routines.

The LTS2000 features a custom interactive programming language. This easy to use, yet flexible and powerful interface puts the user in complete control of the entire test operation.

The system's operating software is C language based, thus making it easy for users to build test programs or network other systems for expanded testing, storage, or data analysis.

The LTS2000 Laser Diode Test System includes:

- Tektronix PEP 301 System Controller with GPIB interface
- LTS2000 System Software
- PC Parallel Interface Card and Cable
- LTS2000 Stimulus/Measurement Module
- LTS2000 Device Test Module.

To avoid excessive noise typically associated with PC-based measurement systems, the LTS2000 is optically isolated from the PC Controller. A temperature sensor and non-volatile calibration memory included in the system maintain calibration over temperature changes.

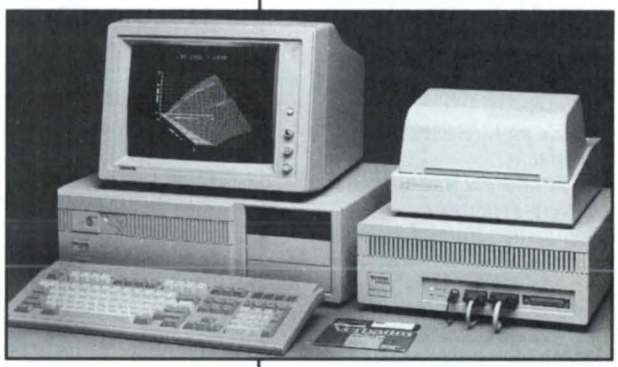
The LTS2000 test system eliminates the hassle of "rack and stack, self-built" test systems. By integrating components designed specifically for laser diode testing together with interactive software, the LTS2000 offers the user a single, integrated test system solution.

TYPICAL APPLICATIONS

The LTS2000 tests laser components manufactured for or used by fiber-optic engineers and technicians in communications, computer, aerospace and military systems. It is used for engineering evaluation and device characterization, manufacturing test, incoming quality assurance testing, as well as pre-test and post-test component burn-in comparisons.

A typical laser diode module includes a semiconductor laser diode, a monitor photo diode, a thermistor, a thermoelectric (TE) cooler and a fiber optic cable in an industry standard package. In a typical test sequence, the LTS2000 test system uses the module's internal thermoelectric cooler to step the temperature of the laser diode over a specified range. At each specified temperature step, the forward current of the laser diode is swept across a specified range. At any position within this forward current range laser power, forward voltage, monitor diode current, TE current and TE voltage are measured. The monitor diode's dark current is measured once at each temperature.

Other important laser diode parameters can be computed automatically from the measurement data depending upon the user's needs. Because of this flexibility and the resulting value offered, the LTS2000 is an attractive turnkey alternative to conventional laser diode testing systems.



- ***PC-Based Integrated System***
- ***Fully Automated***
- ***Test Over Temperature***
- ***Superior 3-D Graphics***
- ***High Accuracy***
- ***Built-In Safety Features***

CHARACTERISTICS

LASER DIODE COMPATIBILITY

Wavelength – 850 to 1550 nm
Package – 14 Pin DIP Standard
Connector Type – Biconic, SMA, AT&T, FC NEC D3, NEC D4, Bare Fiber

LASER CONTROL

Forward Current
Range – 0 to 250 mA.
Forward Voltage – 0 to 5 V (Compliance)
Noise – 8.5 μA.
Transient Voltage (turn-on) – ≤ 2 mV

LASER DETECTOR POWER

Range – 0 to 10 mW
Resolution – 0.15 μW
Accuracy – ±0.6 μW

THERMAL CONTROL

Thermistor Resistance
Range – 0 to 100 k Ohms @ Temperature
Thermoelectric Cooler Current
Range – 0 to 2 A (2.5 V Compliance)

ORDERING INFORMATION

LTS2000 Laser Diode Test System Includes: Power Cord, User's Manual, Bare Fiber Adapter, System Interconnection Cables	**$19,800**
OPTIONS	
Opt. 02 – Deletes PEP 301	**–$8,000**
Opt. 4A – UK Keyboard	**NC**
Opt. 4B – French Keyboard	**NC**
Opt. 4C – Swedish Keyboard	**NC**
Opt. 4F – Danish Keyboard	**NC**
Opt. 4G – German Keyboard	**NC**
Opt. 4I – Italian Keyboard	**NC**
Opt. 4S – Spanish Keyboard	**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, 60 Hz	**NC**
Opt. A4 – North American 240 V, 60 Hz	**NC**
Opt. A5 – Switzerland 220 V, 50 Hz	**NC**

FEATURES

- *Digital LED Readout*
- *Eight Silicon Sensor Probes Quickly Interchange Without Recalibration*
- *Accurate Spectral and Cosine Corrections*
- *Metric and US Versions Available*
- *AC or Internal Rechargeable Battery Versions*
- *Application Notes Available*

BENEFITS

- *Easy to Read in Dark Areas*
- *Rugged but Accurate*
- *Adaptable to Many Light Measurement Needs*
- *Use Anywhere*

J16 PHOTOMETER/RADIOMETER

The Tektronix J16 is a portable digital photometer/radiometer capable of making a wide variety of light measurements–in the laboratory, in the field, or on the production floor. A J16 System consists of a J16 mainframe, and one of eight detachable probes which can be either mounted on the J16 or on the end of an extension cable. All probes have a Hold switch which allows the displayed reading to be held.

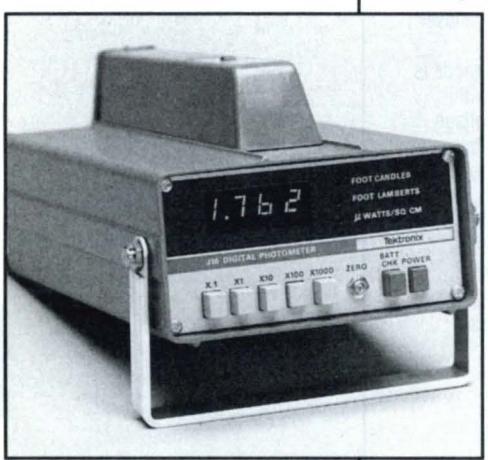
Eight quickly interchangeable probes are available for measuring illuminance, irradiance, luminance, light-emitting diode output, and relative intensity. Recalibration is not necessary when probes are interchanged. Connection of a probe to the J16 automatically selects the correct front panel units indicator. The 3 1/2 digit LED display can be easily read under low ambient conditions.

All probes use silicon photodiodes individually corrected with multi-element glass filters for maximum stability and accuracy.

The optional BCD/analog output feature (Option 07) allows the user either a BCD output of the displayed reading or an analog signal (level) proportional to the light falling upon the sensor. The J16 can be also used with Tek MI 5010/50M30 system for interface with a GPIB system.

Under normal usage, the internal rechargeable nickel cadmium batteries will operate the J16 for four hours. An ac power supply is recommended for continuous operation.

Power supplies or battery packs can be changed quickly by removing four screws on the J16's rear panel. The cabinet and probes have an internal threaded socket (1/4" x 20") for convenient mounting on a tripod or optical bench.



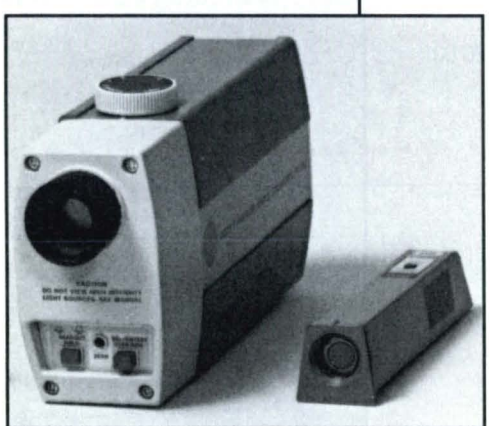
J16 with optional probe.

J16-TV PACKAGE

The J16-TV package is an excellent transfer mechanism which provides a simple, accurate method for adjustment of monitor screen color temperature. The primary colors are measured and adjusted to produce white color temperature balance.

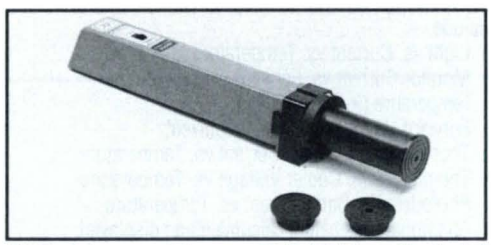
The J16-TV with optional J6503 or J6523 measures monitor screen brightness on both color and black and white monitors. Other applications include measurement of studio lighting, camera lighting, and illumination of work areas.

The 16-TV package includes: J16 Battery-Operated Photometer, J6502-A Irradiance Probe, light occluder, probe extension cable, and battery charger. See Application Note 58A-2926-1 for additional information.



J6523 *J6501* *J6502-A* *J6503* *J6504* *J6505*

J6511 (shown) *J6512-A*



LED Adapter with extra LED Holders (included with J6505) 014-0047-00

CHARACTERISTICS

J16 MAINFRAME

Display – 3 1/2 digit LED readout and three LEDs automatically indicating correct units for probe in use. Metric version readout is also available (Option 02).

Stability – ≤ 2% per year.

Linearity – ≤ 2% over entire range (enables single point calibration).

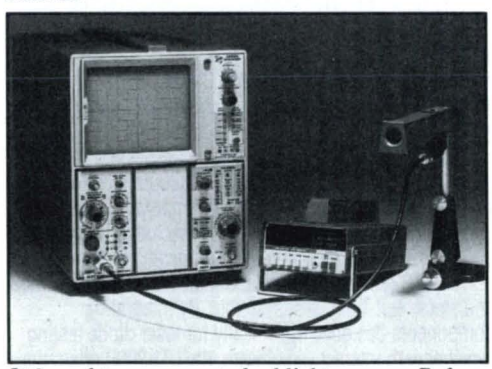
Integration Time – ≈100 ms.

Calibration – Electrical calibration of the J16 mainframe is performed with a calibrated voltage source or DVM traceable to NBS. Calibrated probes can be used with any J16 without additional calibration.

POWER REQUIREMENTS

Standard and Opt. 01 – Has internal rechargeable NiCad batteries that require 16 hours for a full charge. The J16 will operate nominally four hours continuously on a charge. For continuous-operation an ac power supply is recommended.

Opt. 03 and Opt. 04 – AC only operation, no internal batteries.



J16 used to measure pulsed light source. Refer to Application Note 58A-2702-1.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

PROBE CHARACTERISTICS

Application		Illuminance	Irradiance	Luminance		Uncorrected	Red LED	Green/Yellow LED
Probe		J6511	J6502-A/J6512-A*3	J6503	J6523	J5604	J6505	J6501
Range	US*2	0.001 to 1999 footcandles*3	0.001 to 1999 microwatts/cm²*1	0.1 to 199,900 footlamberts*1	0.1 to 19,990 footlamberts*1	Relative response only	0.001 to 1999 footcandles*1†	0.001 to 1999 footcandles*1†
	Metric (Opt. 02)	0.01 to 19,990 lumnens/m² (lux)*1	0.01 to 19,990 milliwatts/m²*1	1 to 1,999,000 candelas/m² (nits)*1	1 to 199,900 candelas/m² (nits*1	Relative response only	0.01 to 19,990 lumnens/m² (lux)*1†	0.01 to 19,990 lumnens/m² (lux)*1†
Accuracy (including J16)		Within 5% of NBS standards and ±1 digit in last place. Calibrated with a 3100° tungsten light source.	Same as J6511, except calibrated with a 762 nm filter	Within 5% of NBS standard and ± 1 digit in last place. Calibrated with a 3100°k tungsten light source		Probe-to-probe accuracy ± 5% with tungsten light source	Same as J6501, except calibrated with a 656 nm filter	Within 5% of NBS standards and ± 1 digit in last place. Calibrated with a 3100° tungsten light source.
Spectral Response		CIE photopic curve	Flat within ± 7%*2 from 600 to 950 nm 450-600 is ± 8%	CIE Photopic curve		UV enhanced silicon spectral curve (250 to 1200 nm)	CIE photopic curve from 600 to 710 nm	CIE photopic curve
Acceptance Angle		Cosine corrected (180°)	50% sensitivity at 48° off axis	8°	1°	50% sensitivity at 48° off axis		50% sensitivity at 48° off axis
Stability and Repeatibility		Within 2% per year						
Linearity		Within 2% over entire range enabling single point calibration						

*1 *An additional decade of sensitivity is included and is usable if the J16 is carefully zeroed and used at a relatively stable temperature.*

† *0.000001 to 199.9 candelas when used with 014-0047-00 LED adapter or at 3.8 inches source-to sensor spacing. Luminous intensity readings of higher intensity light sources may be easily made at correspondingly greater distances using the formula: Footcandles x d² = candelas where d is the distance from the source to the sensor in feet. (For metric readings, use lux x ² = candelas where d is distance from the source to the sensor in meters.) Request J16 Application Note 58A-2704-1 for further information.*

*2

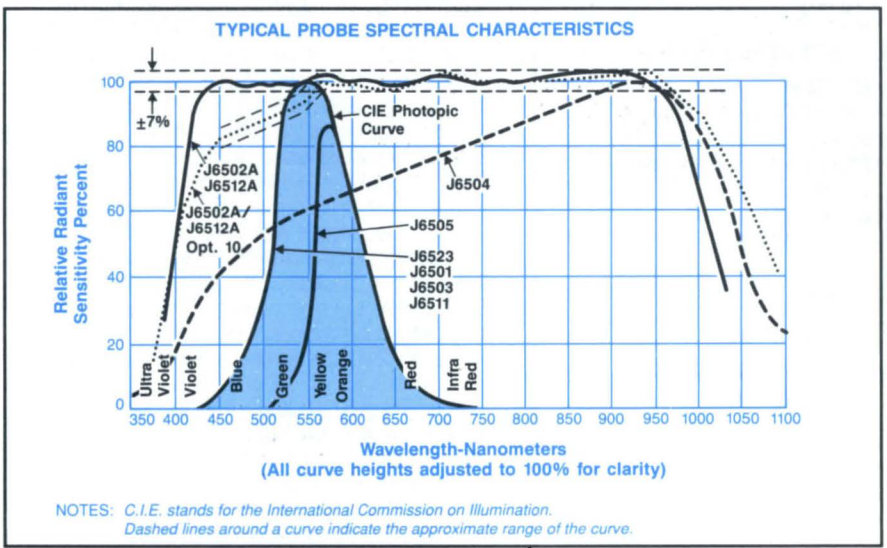
US/Metric Conversions	US to Metric	Metric to US
Illuminance	fc x 10.764 = lux	lux x 0.0929 = fc
Luminance	fl x 3.426 = nits	nits x 0.2919 = fl

NOTE: CIE stands for International Commission on illumination

*3 *Measurements in the 450 to 950 nm range can now be made to within a ±1% uncertainty traceable to NIST, formerly NBS. Using the new standard the J6502 and J6712 were no longer flat across the range, see the Spectral Characteristics Chart. The "A" version of those probes were developed to provide a flat response when measured with the new standard.*

For those who need new probes that match the characteristics of the original J6502/J6512 probes, order J6502Aor J6512A with Option 10.

IT IS NOT POSSIBLE TO UPGRADE AN ORIGINAL J6502 OR J6512 TO AN "A" MODEL BECAUSE THEY USE A DIFFERENT DETECTOR AND GLASS.



NOTES: *C.I.E. stands for the International Commission on Illumination.*
Dashed lines around a curve indicate the approximate range of the curve.

APPLICATION NOTES

Title	Literature #
Photometry/Radiometry primer, and standardizing CRT measurements	60-W-5750
Luminous intensity and visible LED measurements w/Tektronix J16 Photometer	58-A-2635
Measuring pulsed light sources with the J16 and an oscilloscope	58-A-2702-1
Radiant intensity and infrared emitting diode measurements	58-A-2704-1
Television station applications for the J16 Photometer	58-AX-2764-1
Practical lighting measurements with the Tektronix J16	58-A-2912
TV picture monitor color temperature adjustment using the Tektronix J16	58-A-2926-1
Photographic exposure measurements with the Tektronix J16	58-AX-3060-1
Measuring the luminance of small areas of light with the J16 and J6523	58-AX-3252
Optical communications measurements	58-AX-3602

PHYSICAL CHARACTERISTICS
(With Probe and Battery Pack Installed)

Dimensions	mm	in.
Width	123	4.6
Height	60	2.4
Depth	203	8.0
Weight ≈	**kg**	**lb**
Net	1.5	3.3
Domestic Shipping	2.3	5.0
Export-packed	4.5	10.0

J6511
Illuminance Probe

- *Highway Illumination*
- *Luminaries and Lamps*
- *Workstation Illumination*
- *Studio Lighting*
- *Office Lighting*
- *Lighting Equipment*

J6502-A/J6512-A
Irradiance Probes

- *Laser Research*
- *Display Color Balancing*
- *Radiant Efficiency*
- *Infrared LED Testing*

J6503
8° Luminance Probe

- *TV and Computer Display Screens*
- *Work Surface Illumination*
- *Signal Illumination*
- *Projection Screens*

J6523
1° Luminance Probe

- *Roadway Lighting*
- *TV and Computer Display Screens*
- *Photographic Equipment Testing*
- *Glare and Contrast Measurement*

J6505
Red LED Probe

- *Output of Red LEDs (600-710 nm)*

J6501
Illuminance Probe

- *For Yellow and Green LEDs*

J6511 ILLUMINANCE PROBE

The J6511 is an illuminance probe with readout in footcandles [lumens/m^2 (lux) for the J6511 Option 02]. A multi-element glass filter and silicon photo-diode ensure a close match to the CIE photopic curve (color corrected). The silicon-sensor recovery time is virtually instantaneous; low-light levels can be measured immediately after exposure to bright sunlight.

The angular response is accurately cosine corrected, simulating an ideal 180° field-of-view detector. The low-profile probe has a leveling indicator to ensure accurate measurements where a significant proportion of the illumination comes from sources at low angles to the horizon.

A 25-foot cable between the probe (J6511) and J16 allows the user to be out of the field of view while making measurements.

J6502-A/J6512-A IRRADIANCE PROBE

The J6502-A/J6512-A measure irradiance in microwatts/cm^2 (milliwatts/m^2) with Option 02). The spectral response is flat from 450 to 950 nanometers. The response is typically down 50% at 400 and 1030 nm.

An optional filter holder is available for the J6502-A to mount standard 1 inch diameter customer supplied filters of up to 3/8 inch thickness. Where high intensity sources are used (over 1990 μwatts/cm^2), neutral density filters can be used to extend the range of the J16. (An ND 1 filter has 10% transmission, and ND 2 has 1%, etc). These filters may be held with an optional filter holder.

Where the 1 sq cm sensor is not completely filled by the source, for example with a laser beam, the reading obtained represents microwatts instead of μwatts/cm^2 or milliwatts x 10^{-4} instead of milliwatts/m^2 (Option 02). Small variations in sensor uniformity may add ±5% uncertainty to this measurement.

The J6512-A has a low-profile detector head and six-foot cable.

Note: The J6502-A/J6512-A are calibrated for a flat response using the latest NBS standards. If you require probes that are compatible with the original J6502/J6512, then order Option 10 on J6502-A or J6512-A.

J6503 8° LUMINANCE PROBE

The J6503 measures luminance in foot-lamberts (candelas/m^2 (nit) with Option 02) where light scattered or emitted by a surface must be measured. The probe is pointed at the emitting surface.

The probe's response is closely matched to the CIE photopic curve, ensuring accurate results even when measuring spectrally different light sources.

The acceptance angle is approximately 8 degrees, which is determined by internal field stop aperatures. Providing that the 8 degrees field is uniformly filled, the probe can be held at any distance from the source. At 21 inches from the front of the probe, the field of view is approximately three inches in diameter. The footlambert or candelas/m^2 (nit) (Option 02) indicator automatically lights when the J6503 is connected.

J6523 1° LUMINANCE PROBE

The J6523 will measure the luminance in footlamberts (candelas/m^2 with Option 02) of a spot as small as 0.32 inch in diameter. By using commercially available 55-mm stackable close-up lenses, areas as small as 0.035 inch (+10 diopters) can be measured. These 55-mm lenses are physically similar to threaded 55 mm photography stores. (See Application Note 58-AX-3252.)

The 1 degree angle represents 0.21 inch per foot of distance from the probe to the source. Thus at 10 feet, the J6523 measures a 2.1 inch diameter spot.

The probe includes an optical sighting system with a 9 degree viewing field. The focusing range is 18 inches to infinity, closer with 55-mm close-up lenses. The spectral response is closely matched to the CIE photopic curve (color-corrected) for accurately measuring all commonly used light sources. The J6523 may be attached to the J16 or used with an optional probe extension cable. A standard 1/4 inch x 20 threaded socket allows it to be used on a tripod or an optical bench.

J6505 PROBE FOR RED LEDs

Note: For yellow or green LEDs use the J6501 probe, for infrared LEDs use the J6502-A probe.

The J6505 measures illuminance in foot candles (lumens/m^2 (lux) with Option 02), which can easily be converted into luminous intensity in candelas. (See Application Notes 58-A-2635 and 58-A-2704-1.)

An adapter supplied with the probe provides a controlled spacing between the sensor and the LED under test. The adapter excludes ambient light, and has internal baffles to prevent stray reflections during the measurement. Three inserts are supplied with the adapter to fit common sizes of LEDs (0.080 inch, 0.125 inch, and 0.200 inch diameter). These inserts are made of soft plastic that can be easily modified by the user.

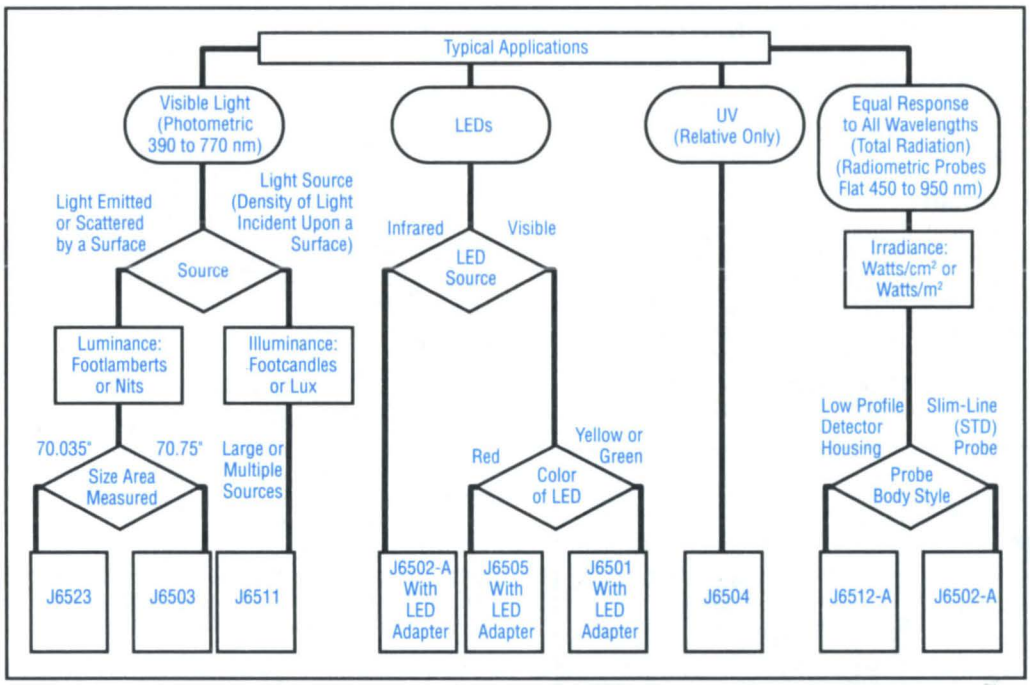
With the adapter in place, a reading of 1 footcandle of the J16 represents 100 millicandelas of luminous intensity. With a metric version of the J16/J6505 (Option 02), 1 lumen/m^2 represents 10 millicandelas.

In the J6505, the silicon photodiode-filter combination provides an excellent match to the photopic curve in the region 600 nm to 710 nm. This close match requires compromising in the 380 to 600 nm region, making this probe unsuitable for general illuminance measurements. For LED measurements in the yellow or green regions, the LED adapter must be used with the J6501, and the same conversion factor for luminous intensity applies.

J6501 ILLUMINANCE PROBE

Where cosine correction is unneccessary, the standard J6701 probe is available with the same photopic correction and units as the J6511. The J6501 can be used to measure green and yellow LEDs.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.



J6504 UV UNCORRECTED PROBE

This probe is designed for applications where only relative measurements need be made. The J6504 has the widest spectral range, and is the most sensitive probe. Use is made of a UV-enhanced silicon sensor and a UV-transmitting window rather than spectral-correction filters.

No units are indicated on the three front panel indicators when using the J6504, since it provides relative readings only. Because of this, the standard J6504 will work with either standard or metric (Option 2) J16s. No Option is required for the J6504.

An optional filter holder may be used to mount standard 1 inch diameter filters on standard-configuration probes. Ultra violet, visible, or near infrared filters can be used to select the wavelength of the interest and exclude ambient light.

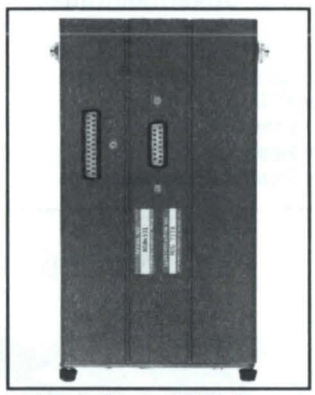
OPTION 07

Option 07 adds a 25-pin connector on the J16's top. This connector provides parallel TTL logic and BCD outputs, a "hold" input line (TTL), and a linear analog signal output 0 to – 2 V or 0 to – 6 V (depending upon the probe used), for a full-scale readout. The analog bandwidth is approximately 0.8 Hz. A cable-end connector and cover have been added to the accessories complement.

J6504
Uncorrected Probe

- *Photoresist/Photo-Processing Light Sources*
- *Comparison of UV Light Sources*

Option 07
BCD/Analog Output



J16 with Analog BCD Output (Option 07)

ORDERING INFORMATION

J16 Photometer/Radiometer Battery Version, with 115 Vac, 50 to 400 Hz — **$1,390**
Includes: Battery charger (119-0375-02); shoulder strap (346-0104-00); battery pack (016-0539-01); instruction manual (070-1879-00); or with Opt. 02 instruction manual (070-1880-00).

J16-TV Photometer/Radiometer Package for TV Color Monitor Set-Up — **$2,120**
Includes: Same as J16 plus J6502A irradiance probe; light occluder (016-0305-00); 42 inch probe extension cable (012-0414-02).

J16 OPTIONS

Opt. 01 – Battery version with 230 Vac, 50 to 400 Hz charger (119-0375-03). — **NC**
Opt. 02[*1] – Metric readout — **NC**
Opt. 03 – 115 Vac only operation, 50 to 400 Hz — **NC**
Opt. 04 – 230 Vac only operation, 50 to 400 Hz — **NC**
Opt. 07 – BCD/Analog output — **+$100**

*[*1] Opt. 02 must also be ordered for probes.*

PROBES

Actual plotted spectral curve is included with each probe.

J6501 Illuminance Probe — **$630**
J6502-A Irradiance Probe — [*4]
J6503 8° Luminous Probe — **$630**
J6504 Uncorrected Probe — **$540**
J6505LED Probe, Includes Red LED Adapter and 3 LED holders — **$650**
J6511 Illuminance Probe, Cosine corrected (with 25-ft cable) — **$650**
J6512-A Irradiance Probe (with 6-ft cable) — [*4]
J6523 1° Luminance Probe — **$1,790**

PROBE OPTIONS

Opt. 02 – Metric probes required for metric readout J16s (Opt. 02) except J6504. — **NC**
Opt. 10 – (Only for the J6502A and J6512A Probes) calibrated to match the original curves for the J6502 and J6512. (See page 379.) — [*4]

OPTIONAL ACCESSORIES

42-Inch[*2] **Probe Extender Cable** – Connects J16 to probe. Order 012-0414-02 — **$120**
Light Occluder – For TV color CRT balancing. Order 016-0305-00 — **$32**
Filter Holder[*3] – Mounts 1 in. diameter filters, of up to 3/8 in. thickness, to probes (except J6511, J6512, J6523). Order 016-0527-00 — **$31**
LED Adapter – With 3 LED holders (included with J6505). Order 014-0047-00 — **$95**
Tripod – Order 016-0253-00 — **$160**

*[*2] Longer length extender cables are availableas a modified product by contacting your local Tektronix Sales Office.*

*[*3] Filters available from vendors such as: ORIEL (203) 377-7877 or CORION CORP. (508) 429-5065 and others.*

POWER SUPPLIES

Power supplies can be quickly changed by removing four corner screws on the rear panel and sliding the power supply or battery pack out.

AC Power Supply – Allows J16 to be used without batteries. 115 Vac, 50 to 400 Hz (Included with Opt. 03) Order 119-0404-00 — **$275**
230 Vac, 50 to 400 Hz (included with Opt. 04) Order 119-0404-01 — **$255**
Spare Battery Pack – Order 016-0539-01 — **$200**

*[*4] Contact your local sales representative.*

LASER DIODE MODULES
LASER DIODE DRIVERS/CONTROLLERS

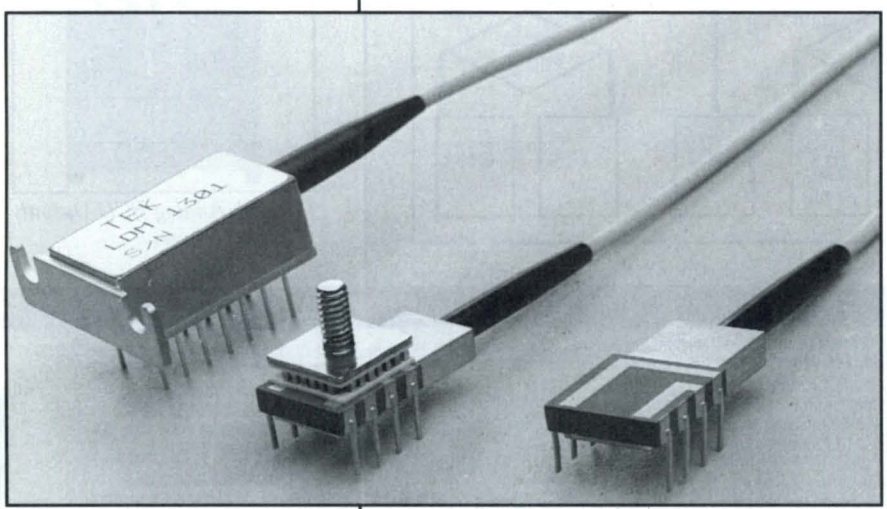
LDM 1301

LDM 1551

LDM 1301PR
Laser Diode Modules

LDC 600
Laser Driver/Controller

TYPICAL APPLICATIONS
- *Test and Measurement*
- *Military*
- *Sensors*
- *Video*
- *Communications*



LDN Series

LASER DIODE COMPONENTS

Tektronix is building a family of electro-optic standard components for the following applications: optical fiber communications, test and measurement, wavelength multiplexing, low-loss video links, R&D, and military systems.

LDM 1301

Our standard product LDM 1301 is a general-purpose, high-performance laser diode module that is a direct plug-in replacement for the 14-pin, dual-in-line, industry-standard package. This laser is ideally suited for either digital or analog applications, and features high-output 1300 nm single-mode emission through either a fiber pigtail or an optical connector. The package includes a photodiode for monitoring back-facet emission and a precision thermistor to monitor and control package temperature. It can be puchased with or without a thermal electric cooler.

LDM 1551

The LDM 1551 is one of our latest applications to the family of electro-optic products. It features high-output emission, exceptional stability, hermetic packaging and a wide operating temperature range.

The LDM 1551 is a pin-compatible, industry-standard, 14-pin DIP package. The extended operating temperature range makes it possible to operate the laser over 110°C temperature excursion. It also features high-output emission coupled into a low-bend loss, single-mode fiber. Tektronix' proprietary lensing and alignment process guarantees a continuous fiber output power of 1 mW minimum and exceptional operating stability.

LDM 1301PR

This device is ideal for a wide variety of performance and environmental applications, including test and measurement instruments, fiber gyroscopes, R&D, military systems, and optical sensors.

The LDM 1301PR is a pin-compatible, industry standard, 14-pin DIP package. It offers a true extended operating temperature range that makes it possible to operate the laser over an unprecedented 110°C temperature excursion.

The proprietary lensing and alignment process guarantees a continuous fiber output power of 1 mW minimum, with an extinction ratio of 200:1.

In addition, packages are hermetically sealed in an inert environment containing neither epoxies nor organic compounds. This assures a reliable, highly stable operating lifetime.

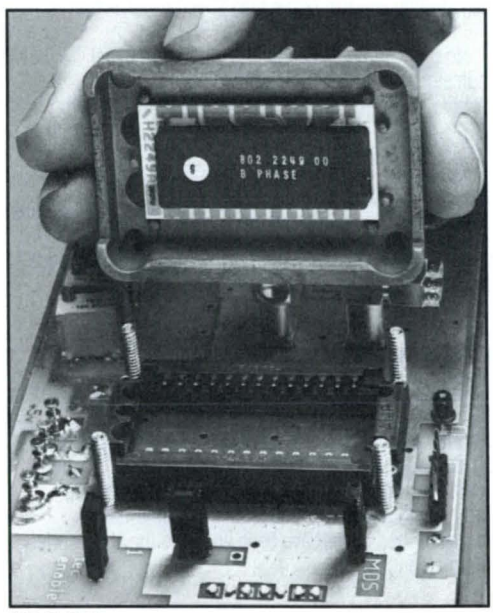
LDC 600

A microelectronics component capable of driving and controlling laser diodes at 600 MB/s.

Applications for Tektronix' LDC 600 Laser Driver/Controller include: digital fiber optic communications, digital video, local area networks (LANs), optical signal generation, and optical source testing. In addition, it can be used as a stable dc light controller.

When used in a subsystem and coupled to a compatible laser diode such as Tektronix' LDM 1301, the LDC 600 controls and maintains preset optical power while providing a current source for regulating a thermo-electric heater/cooler.

The LDC 600 laser driver/controller also features the standard interface for electrical circuits (50 ohm differential ECL inputs) required for easy incorporation into system designs, as well as slow start/stop circuitry that guards laser systems from damage that might otherwise be caused when power is suddenly turned on or off.



LDC 600

ORDERING INFORMATION

Tektronix, Inc.
Electro-Optic Products Group
P.O. Box 500 M/S13-033
Beaverton, Oregon 97077
1-800-835-0433, Ext. 100
(503) 627-4220
FAX: 503-627-4651

Whether your needs involve signal acquisition, measurement documentation, or simply physical convenience, Tektronix Accessories will complete your measurement system and expand its utility and performance.

Tektronix Accessories are indispensable tools designed to maximize the performance of your Tektronix test and measurement instruments. Tek Accessories are engineered, assembled and tested to provide the best performance link possible between those intruments and the device under test.

The accuracy and reliability of your results depends on the quality of the instruments you use. However, no test or measurement device will be more precise than the data you feed into it, or the method you use for gathering data. Tek Accessories insure that the data you acquire is accurate and reliable.

You can depend on Tek for designed-in equipment compatibility and consistently high quality.

Tek manufactures the world's largest and most respected line of probes. The Tek line includes passive voltage probes, active probes, optical to electrical converters, current probes, high voltage probes, and speciality probes – complemented by a wide assortment of probe accessories. You can select the probe, probe tip size, mounting adapter and attenuator that best fits your needs.

Documentation of test results are critical if one is to stay ahead in today's competitive world. Tek has a complete line of instrument hardcopy products and film based cameras that will enable you to communicate your test results with clarity and credibility.

The SCOPE-MOBILE carts and workstations help free up your valuable work space and make sharing and moving equipment easy while getting you closer to the device under test.

Your Tek representative will be glad to help you match your needs to our products.

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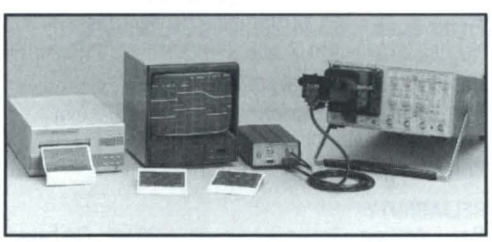
DX05 VIDEO MONITOR



DX05 Monitor used with C1002 Video Camera, HC01 Video Copier and 2400 Series Scope.

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

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

The loop-through video connection means it can be used in series with other video devices such as the HC01/HC02 Video Copiers or the C1002 CCD Video Camera.

CHARACTERISTICS

CRT

CRT – 9-inch diagonal, 90° deflection angle.

Resolution – ≥600 lines.

Phosphor – P4.

ELECTRICAL

Input Switchable Impedance – 10 kΩ/75 Ω.

Output Impedance – 75 Ω.

Video Input (NTSC) – Composite 0.5 V to 2.0 V p-p.

Sync Input – Negative.

Power Requirements – 27 W typical. Input voltage 120 V ac standard, 220 V ac, Option A1.

Line Frequency – 50 to 60 Hz.

ENVIRONMENTAL

Operating Temperature Range – 20°C to 50°C.

PHYSICAL CHARACTERISTICS

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

DX05 Video Monitor

TYPICAL APPLICATIONS

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

ORDERING INFORMATION

DX05 Video Monitor **$300**

INTERNATIONAL POWER PLUG OPTIONS

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

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.

HC100 *FOUR COLOR PLOTTER*

TYPICAL APPLICATION

- ***Documentation from Digitally Based Instrumentation for Reports or Presentations***

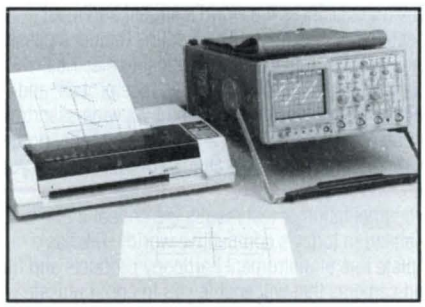
FEATURES

- ***Direct Plots from Many Tek Digitally Based Instruments Without Using a Controller***
- ***Interfaces w/Standard HC100 Centronics Parallel Interface GPIB Interface***
- ***Interfaces w/Opt. 03 Centronics Parallel Interface RS-232C Serial Interface*[1]***
- ***Four Color Pens in Three Styles***
- ***Compact Size***
- ***Handles A4 and US Letter Size***
- ***Makes Direct Plots in About 90 Seconds***

COMPATIBILITY

- ***GPIB*** – *2200 DSOs w/Opt. 10, 2430A (and above) DSO's, 7854, 7D20, 336/A w/Opt. 01, 468 w/Opt. 02, RTD 710/A, 370/A, 371, 490 and 2750 Series Spectrum Analyzers*
- ***Centronics*** – *2710 w/Opt. 09, 370/A, 371, DCS01, DCS02*
- ***RS232C (HC100 w/Opt.03)*** – *2201/11 w/Opt.12, 2220/21/24/30/32 DSOs w/Opt. 12, 7250*

[1] When the RS-232C board is in the HC100, the Centronics interface is inactive.



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 (see Instrument Compatibility Table). The HC100 connects directly to a compatible instrument. 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 HI80, Graphtec commands sets), printer (Epson RX-80 compatible), self tests (HP-GL and standard plotter). The standard HC100 is shipped in the HP-GL mode.

Plotter operation is supported by a subset of HP-GL (Hewlett-Packard Graphics Language) command compatibility on both the GPIB and parallel printer interfaces. Tek Codes and Formats are also supported on the GPIB interface.

Because the HP-GL used in the HC100 is a subset of the full HP-GL, there is no guarantee that other manufacturers' HP-GL software will result in a proper HP-GL plot on the HC100. Other modes in the HC100 such as Graphtec emulation and Epson printer mode gives it higher compatibility.

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 most of the 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 the user 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 (PEP 301 or equivalent) via Centronics interface. If the HC100 is used in a multi-controller environment on the same GPIB bus, handshaking errors will occur.

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.

Pen Movement Precision – Single Pen: 0.3 mm. Different Pens: 0.5 mm.

Pen Change Precision – Within 0.3 mm.

RELIABILITY

Pen Lifetime – Aqueous fiber pen: ≈ 200 m. Oil-based Fiber Pen: ≈ 400 m. Aqueous ball-point pen: 400 m.

RS-232C BOARD SPECS

Asynchronous –

Bit Rate: 75 BPS to 19,200 BPS
Note: HC100 Opt. 03 is set at 9,600 baud, i.e., for 2201/11
Buffer: Up to 2 kbytes (selectable)

POWER REQUIREMENTS

Line Voltage – Standard: 117 V ac ±10%. Options A1-A5: 220 V/240 V ac ±10%.

Line Frequency – 49.5 Hz to 60.5 Hz.

Power Consumption – 30 W.

PHYSICAL SPECIFICATIONS –

Outside Dimensions – 16.5" (41.5 cm) wide, 3.2" (8.1 cm) high, 10.8" (27.2 cm) deep.
Weight 13.2 lb (6 Kg).

ORDERING INFORMATION

HC100 Color Plotter ☎ **$895**
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).

OPTIONS

Opt. 01 – 1M GPIB Cable (012-0991-01) **+$95**
Opt. 02 – DB-25 M to Centronics M Cable (012-1250-00) **+$45**
(Both Opt. 01 and 02 may be ordered; the HC100 allows use of either cable for its specific application.)
Opt. 03 – Deletes GPIB I/F Board, and adds RS-232C I/F Board; includes DB-9 to DB-25 RS-232 Cable (012-1298-00) **NC**
For a 220V/240V, 50 Hz version order one of following options:

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.
[1] Contact your local sales representative.

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1-A5 – Available, see page 488 for description **NC**
Extra Pen Cartridge – Order 016-0876-00 ☎ *[1]
Pens – Four colors (black, red, green, blue) in each package:
(Fiber tip, aqueous ink), Order 016-0879-00 ☎ **$9.00**
(Fiber tip/oil-based ink), Order 016-0878-00 ☎ **$9.00**
(Ball point/aqueous ink), Order 016-0877-00 ☎ **$9.00**
Pens–black, with four pens
(Fiber tip, aqueous ink) Order 016-0939-00 ☎ **$9.00**
(Fiber tip, oil-based ink) Order 016-0940-00 ☎ **$9.00**
(Ball-point, aqueous ink) Order 016-0941-00 ☎ **$9.00**
Interface Board Kits – Has all the parts necessary to install the board in the HC100. It includes the interface board, mounting hardware, and installation instructions.
(GPIB Interface Board Kit), Order 021-0457-00 **$315**
(RS-232C Interface Board Kit), Order 021-0458-00 **$345**
Cables: see accessories section on page 385
HC100 Technical Manual, Order 118-6688-00 **$70**
See next page for additional cables.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

The HC200 TEKPRINTER is an ideal low-cost 9-pin dot matrix printer for the lab as well as the office. It handles virtually any print stock whether continuous form paper, or single sheets of letterhead. It will give years of reliable service with only a minimum of maintenance.

VERSATILE AND AFFORDABLE

The HC200 is a high quality 9-pin printer that has a lot of features not usually found in comparably priced competitive printers:

- 232 cps in draft mode
- 40 cps in near letter quality mode
- Compact size
- Rear or bottom paper feed
- Pin-feed platen for reliable paper handling
- Front panel controls with LED indicators
- Centronics or optional (Opt. 03) RS-232C interfaces
- Printer/scope setup instructions in manual

INSTRUMENT COMPATIBILITY

Using the Epson FX emulation the HC200 TEKPRINTER will work with TEK products that support that standard. Here is a partial listing (check your instrument's manual for Epson FX compatibility as well as which interface to use.): 2201/2211, 2200 Series DSO's with RS-232C Opt. 12, 2710 Opt. 09, 571, 1230 Opt. 02, 11200, 11400, PEP 301, DSA 600, and 11800 Series, 2630, 2510, and PTS 101.

The operator's manual has complete setup instructions for the most common TEK instruments. This will save time getting the printer on line.

The TEKPRINTER will work with any computer, controller, or instrument that has Epson FX compatible software or firmware. It is suggested that the printer be tested with the instrument to assure proper operation.

INTERFACES

The HC200 comes standard with a Centronics interface. Opt. 03 will add an RS-232C interface board to the printer. The Centronics port is disabled when the RS-232C interface board is installed.

Tek has a complete selection of interface cables that will allow the printer to be used with most instruments and PCs. They are listed in the HC100/HC200 Accessory Section on this page.

READY TO USE WITH THE "STARTER PACKAGE"

In order to start using the HC200 immediately an exclusive "ACCESSORY STARTER PACKAGE" is included. It contains a package of form paper, a ribbon cartridge, a universal printer stand, and a operator's manual that includes setup information.

The printer stand adjusts to three different angles for ease of viewing and printer use. It allows the paper to be stored under the printer and fed through the printer's bottom paper path. The stand's skid resistant feet reduces printer noise and prevents marring the work surface.

PRINT CHARACTERISTICS

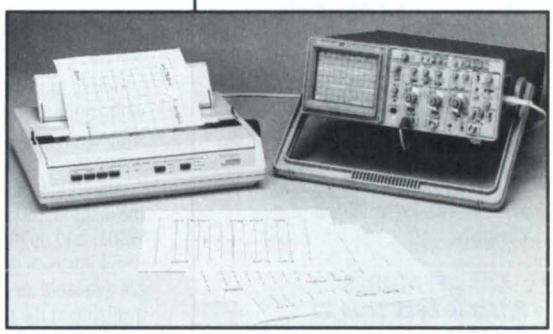
Print Method – Impact, Dot Matrix.
Printhead – 9-pin (.34 mm diameter).
Print Direction – Bidirectional, short line seeking. Unidirectional printing selectable.
Graphics Resolution – 60 x 72 dpi minimum 240 x 72 dpi maximum.

Print Speed and Character Matrix –
High Speed Draft: 232 CPS @ 12 CPI,186CPS @ 10/17 CPI.
Utility: 155 CPS @ 10/12/17.1 CPI
Near Letter Quality: 40 CPS @ 10/12/17.1 CPI.

Characters Per Line –

CPI	Max. characters/line
10	80
12	96
17.1	137

Character Sets – U.S., International STD character set, and Block Graphics character set.



HC200 9-Pin Dot Matrix Printer with 2211 Scope.

PAPER HANDLING

Paper Input – Cut Sheet: 7.2" to 8.5" (18.3 cm to 21.6 cm). Pin Feed: Continuous 9.5" to 10.5" (24.1 cm to 26.7 cm).
Number of Copies – Original plus 3. Original plus 1.
Thickness – 0.014" (0.35 mm) maximum.
Paper Path – Rear or bottom.
Paper Weight – 16 lb. to 20 lb.
Interfaces – Parallel (STD): Centronics standard. Serial interface: RS-232C (19,200 BPS max w/ DB-25 (Opt. 03) female connector.
Reliability – MTBF: 4,000 hours. MTTR: 15 minutes.
Printhead Life – 200 Million characters.
Noise – 57 dBa.

POWER REQUIREMENTS –
Input Power – Voltage: 120 V ac ±10% (US Model). 220 240 V ac ±10% (A1-A5). Frequency: 50/60 Hz ±2%
Power Consumption – Operating: 40 VA, Idling: 15 VA.

PHYSICAL SPECIFICATIONS –
Outside dimensions – 13.2" wide, 10.8" deep, 3.2" high.
Weight – 9.9 lb. (4.5 kg).

TYPICAL APPLICATIONS

- *Instrumentation Documentation*
- *General Purpose Printer for the Lab, Office, or Home*

BENEFITS

- *Ready to Use*
- *Works with Epson FX Compatible Instruments*
- *Setup Documentation on Tek Instruments*
- *Has Accessory "Starter Package"*
- *Quality Copies*
- *Fast Output*
- *Compact Size*

FEATURES

- *Epson FX Emulation*
- *232cps @ 12cpi in High Speed Draft*
- *40cps in Near Letter Quality Mode*
- *Dual Paper Paths*
- *Centronics or Optional RS-232C Interface*
- *Adjustable Stand*

ORDERING INFORMATION

HC200 Printer ☎ *1
Includes: 1 ribbon cartridge; starter pack of paper, Operator's manual (070-7686-00): printer stand (118-8504-00).

OPTIONS

Opt. 02 – Centronics Cable 36-pin male to DB-25 male, 9 foot (012-1250-00). *1
Opt. 03 – Adds RS-232C interface board. *1
Opt. 04 – Centronics cable 36-pin male to male (012-1284-00) 9 foot. *1
Note: Both Options 02 and 04 can be ordered together.

INTERNATIONAL POWER PLUGS

Opt. A1-A5 – See page 488 for descriptions. NC

HC200 ACCESSORIES

Self-inking black ribbon cartridges (3 million characters nominal life), six cartridges per box. Order (118-8502-00). ☎ $60
Universal printer stand, Order (118-8504-00). $15
RS232C Interface Board Kit, includes the RS-232C interface board, mounting hardware, and instruction sheet. Order (119-3806-00). *1

HC100/HC200 ACCESSORIES

CENTRONICS CABLES –
36-Pin male to male centronics, 9 foot, Order 012-1284-00. $75
DB-25 male to 36-pin male centronics, 9 foot, Order 012-1250-00. $45
RS-232C Cables –
DB-25 female to DB-25 male RS-232C, 9 foot, Order (012-1285-00). $40
DB-9 female to DB-25 male RS232C, 9 foot. Order (012-1298-00). $35
GPIB Cables – 1 meter, double shield, low EMI, Order 012-0991-01. $140
2 meter, double shield, low EMI, Order 012-0991-00. $160
Carrying Case – Soft sided carrying case (not for shipping), Order 016-0707-00. *1

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.
*1 *Contact your local sales representative.*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

HC01/HC02 BLACK AND WHITE THERMAL PRINTER/ VIDEO COPIERS

TYPICAL APPLICATIONS

- *With Digitizing Camera Systems. Logic Analyzers (except 1240 Series).*
- *Personal Computers (CGA Mode Only). TV Cameras. Medical Imaging Systems.*
- *Ultra-sound Systems*
- *Manual Production*
- *7250 Digitizer or Products with Composite Video Outputs.*

FEATURES

- *Prints in Less Than 21 Seconds*
- *NTSC Resolution 640 x 476 Dots*
- *64 Levels of Gray*
- *Supports PAL, SECAM, or NTSC*
- *Centronics (Text Only) or RGB-TTL*

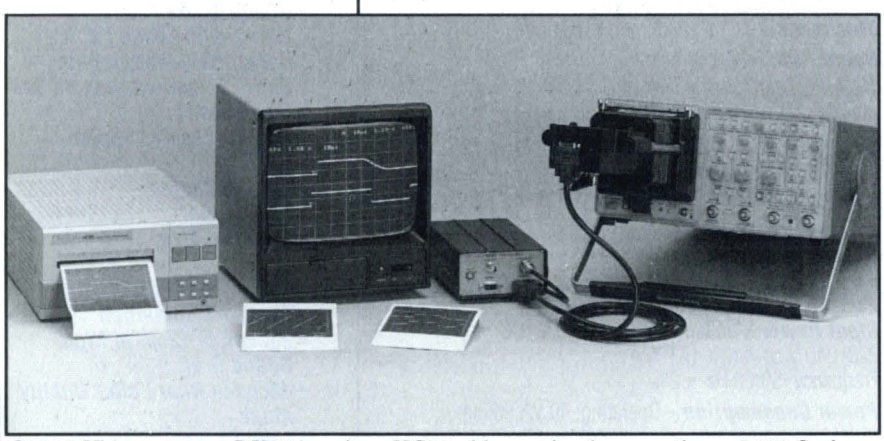
HC01/HC02 BLACK AND WHITE THERMAL PRINTER AND VIDEO COPIERS

These high resolution hardcopiers provide black and white outputs in just 21 seconds or less. You have a wide choice of inputs which make these hardcopiers extremely versatile.

Using inexpensive thermal printing paper one can make up to 180 (4.3 x 4.1 in.) prints per roll with the HC01, and up to 75 (8.5 x 11 in.) prints with the HC02.

64 levels of gray, 4 bits digital and 2 bits dithering, are available for composite video. 16 or 2 gray levels are available in the DOT GRAPHIC MODE. The 16 level DOT GRAPHIC MODE provides gray-scale variation of every dot. This makes for higher-density computer graphic prints that are not possible with conventional printers.

Once an image has been captured by the on-board frame memory, one can make as many copies of that stored image as one likes. Other features include a remote control, images can be printed reversed for negative prints, selectable contrast levels, the print direction can be changed, plus many more useful features.



C1002 Video camera, DX05 monitor, HC01 video copier documenting a 2400 Series DSO's display.

RESOLUTION (DOTS X LINES)
Composite Video Signal

	Frame Mode	Field Mode
NTSC	640 x 476	640 x 238
PAL/SECAM	640 x 512	640 x 289

RGB TTL Signal –
Field Mode: 640 x 200 (Noninterlaced).
Frame Mode: 640 x 400 (Interlaced).

Parallel Data – 640 Dot 80 Column; ASCII 96 Character Built-in; Graphic Mode Application; Printing Speed 160 CH/s

Gray Scale – 64 levels of gray (4 bits digital or 2 bits dithering).

HC01/HC02 Video Copiers/Printers

POWER REQUIREMENTS

Line Voltage – 120 V ac ±10%.
Line Frequency – 50/60 Hz.
Power Consumption – HC01: 60 W. HC02: 110 W.

For A1-A5 Versions
Line Voltage – 220/240 V ac ±10%.
Line Frequency – 50 Hz.
Power Consumption – HC01: 60 W. HC02: 120 W.

PHYSICAL CHARACTERISTICS

	HC01		HC02	
Dimensions	**mm**	**in.**	**mm**	**in.**
Width	210	8.3	368	14.5
Height	112	4.4	119	4.7
Depth	358	14.1	337	13.3
Weight ≈	**kg**	**lb**	**kg**	**lb**
Net	5.5	12.1	7.7	17.0

CHARACTERISTICS

INPUT SIGNALS

NTSC/PAL/SECAM Composite Video – 1 V p-p, 75 Ω terminated, negative sync.

RGB TTL From PC – TTL Level, F (H) = 15.75 kHz.

Parallel Data Interface/Teletext/Videotex – TTL Level.

PRINT SPECIFICATIONS

Paper – Super grade thermal type (black and white).

	HC01	HC02	
		Side Mode	Norm. Mode
≈ Prints/roll	180	75	94
Width	110 mm (4.3 in.)	216 mm (8.5 in.)	
Length	21 m (85 ft.)	21 m (85 ft.)	
Print Size	110 x 115 mm (4.3 x 4.1 in.)	216 x 279 mm (8.5 x 11 in.)	216 x 220 mm (8.5 x 8.6 in.)
Image Size	100 x 74 mm (3.9 x 2.9 in.)	200 x 148 mm (7.8 x 5.8 in.)	
Print Speed	≈ 17 s	≈ 21 s	

ORDERING INFORMATION

Each copier includes a roll of thermal paper, 75 Ω cable, BNC to RCA cable, and a manual.

HC01 4 x 5 in. Video Copier (110 V ac). **$1,300**

HC02 8x10 in. Video Copier (110 V ac.) **$1,710**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1– A5 – (220/240 V ac) are available. **NC**

See page 488 for descriptions.

OPTIONAL ACCESSORIES

Super Grade Thermal Paper – Four rolls per box.
(HC01) Order 016-0867-01 **$49**
(HC02) Order 016-0868-01 **$90**

Data Cable – 10 foot, male-to-male with 9-PIN DB connectors. Order 174-0537-01 **$20**

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

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Camera Accessories 397

FILM-BASED CAMERAS

A camera can be a key part of your measurement system. It allows you to capture single events and to document and communicate your results with clarity and credibility.

MOUNTING ADAPTERS

The camera and adapter selection guide indicates the recommended camera and appropriate adapters required for most Tektronix instruments. For non-Tek instruments contact your Tek sales representative.

GRATICULE LIGHTING

Most scopes have graticule illumination. For those that do not, an image of the graticule may be obtained by using the flash in the C-5C or C-7 Cameras, or by using the storage scope's background illumination (flood guns).

LENSES

Tektronix camera lenses differ mainly in speed (light-gathering ability), field of view, and magnification.

Speed

The f-number of a lens inversely signifies its aperture area and light-gathering ability. For example: the aperture area of an f/1.4 lens is four times that of an f/2.8 lens of the same magnification and gathers four times the light. The relative light-gathering ability of all lenses used in Tektronix cameras is referenced to the f/1.9, 0.85-magnification lens which is arbitrarily rated at 1.0. For recording a stored or stable recurrent CRT display, a lense as slow as the f/16 type used in C-5C and the C-7 Cameras is adequate.

However, to record a fast, dim, single-sweep trace, one may need a lens as fast as the f/1.2 types used in the C-31B and C-51 Cameras.

Field of View

The field of view signifies how large a CRT display the camera can fully record. It is determined by the combined effects of the magnification and angular field of view of the lens, any field-limiting apertures in the camera adapter, camera body, film holder, and the image area of the film.

Magnification

The rated magnification of a lens signifies its image-to-object ratio. For example, if a lens has a magnification of 0.85, then for every square centimeter on the CRT face the camera would record 0.85 square centimeters of image on the film.

For maximum resolution, the lens should produce the largest complete image possible within the image area of the film.

SHUTTERS

Mechanical shutters are simple to operate and are economical. They are actuated by pressure on a release mechanism. Electrically activated shutters permit remote, automatic, or manual release and offer higher reliability. They may be actuated by an insulated switch closure.

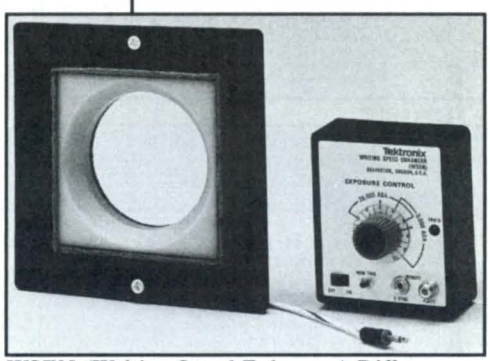
FILMS

Polaroid films are the most convenient to use. They offer the advantages of development in seconds to a finished dry print with wide spectral response, good resolution, and high sensitivity. ASA ratings do not necessarily give a true indication of how a film will respond in CRT recording due to the narrow spectral output range of most phosphors and different spectral sensitivities of various film types. Wet process, roll, or cut films can be used if the proper back is selected. (See the respective camera for optional backs.)

Selected Polaroid films are available through Tek. Technical assistance with Polaroid film and back questions or problems is available directly from the Polaroid Corporation. Call 1-800-343-5000 toll free within the U.S.

FILM BACKS

There is a wide variety of cameras and backs. Backs within a series are interchangeable. See the specific camera for information on a particular back.



WSEN (Writing Speed Enhancer) Diffuser with Control Box

PHOTOGRAPHIC WRITING SPEED

Photographic writing speed signifies the ability of a particular oscilloscope/camera system to provide a useful photographic record of a fast single-sweep trace. It is stated as an oscilloscope performance characteristic and is expressed in cm/µs or cm/ns. It is designed to answer the question, "What is the speed of the fastest single-sweep trace the system can record?" All statements of writing speed must specify the measurement conditions, including the CRT phosphor and film used, and the definition of a readable trace image.

For information on photographing high speed waveforms, request application note 42-W-5335-1.

Increasing Writing Speed

Film fogging is a technique for increasing the maximum sensitivity of photographic film by giving it a short exposure of dim, diffused light. The optional Tektronix Writing Speed Enhancer (WSEN) is designed to fill this need.

The WSEN is powered by two 9-V batteries (not included), which are inside the control box.

Automatic, simultaneous fogging is easily achieved by triggering the enhancer with the oscilloscope-sweep + gate.

Polaroid Film		Relative Film Writing Speed	
ASA Equivalent Speed	Type	Unfogged	Fogged
3,000	667, 107, 084	1*[1]	3*[1]
20,000	612	>2	>3.5

*[1] *Value depends on film, scope, CRT, camera, and the operator.*

RECOMMENDED CAMERAS AND ADAPTERS

CAMERA AND MOUNTING-ADAPTER SELECTION GUIDE

Where two or more cameras are recommended, compare features and specifications to optimize for your application. Tek cameras fit many non-Tek CRT-based products. Contact your Tek Sales Representative for more information.

	Recommended Cameras			Mounting Adapter Part Numbers			
Oscilloscope or Display Device	**High Writing Rate**	**General Purpose**	**Low Cost**	**C-4*11**	**C-5C C-7**	**C-51, C-53, C-59A, C-27, C-28**	**C-30BP*13 C-31BP*13**
11000 Series							
11301(A)	C-51 Opt. 11	C-59A Opt. 11	C-5C; C-7	NR	016-0357-01	016-0249-06	NR
11302(A)	C-51 Opt. 12	C-53 Opt. 11		NR	NR	016-0249-06	NR
11401 11402(A)			C-4*16 Opt. 10	122-0897-01	NR	NR	NR
7000 Series							
8x10 cm Display, i.e., 7104, 7503, R7103, 7504, 7514, 7613N, 7623, 7633, 7704(A), 7834, 7844, 7854, 7934, R7903, 7904, 7094(A), T922R*2	C-51 C-31BP Opt. 01*10*13	C-53 C-30BP Opt. 01*10*13	C-4 Opt. 02 C-5C C-5C Opt. 01 C-7 C-7 Opt. 01	122-0895-01	016-0357-01	016-0249-06	016-0248-01
Large Screen Display,*1 i.e., 7403, 7603, 7603N		C59A	C-4 Opt. 02 C-5C C-5C Opt. 01 C-7 C-7 Opt. 01	122-0895-01	016-0357-01	016-0249-06	NR
5000 Series							
5100 Series Nonstorage,*1*3 i.e., 5110, 5112, D10, D12, 577/D1, 5116*6		C59A	C-4 Opt. 02 C-5C C-7 C-7 Opt. 01	122-0895-01	016-0357-01	016-0249-06	NR
5100 Series Storage,*1*2 i.e., 5111, 5111A, 5113, 5115, D11, D13, D15, 577/D2		C59A	C-4 Opt. 02 C-5C C-7 C-7 Opt. 01	122-0895-01	016-0357-01	016-0249-06	NR
5400 Series Nonstorage,*1*2 i.e., 5403/D40, 5440, 5444, D40		C-59A	C-4 Opt. 02 C-5C C-7 C-7 Opt. 01	122-0895-01	016-0357-01	016-0249-06	NR
5400 Series Storage,*2*4 i.e., 5403/D41, 5441, D41		C-53 C-30 BP Opt. 01*10	C-4 Opt. 02 C-5C C-7	122-0895-01	016-0357-01	016-0249-06	016-0248-01
5223*1		C-59A	C-4 Opt. 02 C-5C C-7 C-7 Opt. 01	122-0895-01	016-0357-01	016-0249-06	NR
Portables							
Older with 0.8-cm. Graticule,*5 i.e., 422, 453, 454, 485, 491	C-31BP	C-30BP	C-4*4	122-0894-01	No adapter	No adapter*5	016-0306-01
Newer with 1cm Graticule,*5 i.e., 2235/A, 2245/A, 2246/A Opt. 01, 2400 Series, 455, 464, 465, 465B, 465M, 466, 468, R468, 475, 475A, 432, 434, 442	C-31BP *7 Opt. 01	C-30BP *7 Opt. 01	C-4 C-5C Opt. 02 C5-C Opt. 04 C-7 Opt. 02 C-7 Opt. 03	122-0894-01	016-0359-01	No adapter*5	016-0269-03
1-cm Nonilluminated Graticule*5 2200 Series			C-7 Opt. 02 C-5C Opt. 04	NR	016-0359-01	No adapter*5	NR
1/4-inch Graticule,*4*5*12 i.e., 305, 314, 326, 355 336A, 1501 1502.		C-30BP Opt. 01*10	C-4 Opt. 03*4	122-0896-01	No Adapter	No adapter*5	016-0327-01
TM 500,*5 i.e., SC 502, SC 503, SC 504*4		C-30BP Opt. 01*10		NR	No Adapter	No adapter*5	016-0327-01
Nonilluminated Graticule*5*8 2335, 2336, 2336YA, 2337			C-5C Opt. 04*8 C-7 Opt. 02*8	NR	016-0359-01	No adapter*5	No adapter
Display Monitors							
8 x 10 cm,*3 i.e., 601, 602, 605, 606, 606B, 607		C-30BP Opt. 01*10 C-59A	C-4 Opt. 02 C-5C C-7 C-7 Opt 01	122-0895-01	016-0357-01	016-0249-06	016-0248--01
Large screen 10 x 12 cm,*1 i.e., 603, 694, 608, 620, 624, 634		C-59A	C-4 Opt. 02 C-5C C-7 C-7 Opt. 01	122-0895-01	016-0357-01	016-0249-06	NR

(continued page 389)

CAMERA AND MOUNTING-ADAPTER SELECTION GUIDE

	Recommended Cameras			Mounting Adapter Part Numbers			
Oscilloscope or Display Device	**High Writing Rate**	**General Purpose**	**Low Cost**	**C-4*11**	**C-5C C-7**	**C-51, C-53, C-59A, C-27, C-28**	**C-30BP*13 C-31BP*13**
Older 5 inch Round*2							
502, 503, 504, 515, 516, 519 530/540/550/580 Series, 575	C-51*2*10	C-53*2*10	C-59A*10	NR	No adapter	016-0225-04	No adapter
Older 5 inch rectangular							
560 Series,*2 i.e. 561, 564, 567, 568		C-53*2*10	C-59A*10	NR	No adapter	016-0224-01	No adapter
Television Products							
380, 381		C-30BP Opt. 01*10	C-4 Opt. 03	122-0896-01	No adapter	No adapter	016-0327-01
520, 520A, 521, 521A, 522 A*1*2		C-59A*10		NR	No adapter	016-0295-01	No adapter
1480C*2		C-53*2*10	C-59A*10	NR	No adapter	016-0342-00	No adapter
528A*2, 1420, 1421, 1422, 1424*1*2		C-59A	C-4 Opt. 02 C-5C C-7 C-7 Opt. 01	122-0895-01	016-0357-01	016-0249-06	016-0248-01
1705, 1701B, 1711B, 1720/21, 1730/31, 1740, 1741, 1742, 1750, WFM300		C-30BP Opt. 01	C-4 C-5C Opt. 02 C-5C Opt. 04 C-7 Opt. 02 C-7 Opt. 03	122-0894-01	016-0359-01	No adapter*5	016-0269-03*15
Spectrum Analyzers							
2710		C-30BP Opt. 01	C-5C Opt. 02 C-7 Opt. 03	122-0894-01	016-0359-01	No adapter	016-0269-03
491		C-30BP		NR	No adapter	No adapter	016-0306-01
490 and 2750 Series		C-59A C-30BP Opt. 01	C-5C C-7 C-7 Opt. 01				
Other Products							
370/A, 371		C-59A	C-4 Opt. 02 C-5C C-7	122-0895-01	016-0357-01	016-0249-06	NR
576, 5030, 5031*9		Only C-59/A*10	C-7*9	NR	016-0357-01 (see note *9)	016-0288-01 (C-59(A) only)	No adapter
OF150, OF151, OF152, OF235 TDR, OF192			C-4 Opt. 02 C-5C C-7 C-7 Opt. 01	122-0895-01	016-0357-01	NR	NR
1240*8*14			C-4 Opt. 11	122-0898-01	NR	NR	NR
T900 Series excluding T922R (see 7000 Series)			C-5C Opt. 03 C-7 Opt. 04	NR	016-0358-01	No adapter	No adapter
571			C-4 Opt. 11	122-0898-01	NR	NR	NR

*1 *Only cameras with < 0.7 magnification can record the entire screen area of a 10 x 12 cm display.*

*2 *The scopes do not have camera power. If the C-51 and C-53 are used only if powered with 016-0270-02 battery pack.*

*3 *The scopes require modification for graticule illumination.*

*4 *Though these scopes do not have illuminated graticules, the graticule may be photographed using storage flood guns on storage models.*

*5 *Due to physical configuration, the C-50 Family cannot be mounted.*

*6 *The C-7 can only be used for color if the image is electronically reversed.*

*7 *A corrector lens is required to increase cameras field of view so that the full 8 x 10 cm CRT display area can be recorded. The camera should be changed from standard to Opt. 01. To do this, order 016-0301-01 for the standard C-30B or 16-0269-04 for the standard C-31B. These kits include the mounting adapter and corrector lens.*

*8 *These scopes have no CRT bezel; therefore, a camera cannot be mounted. A hand held C-5C, C-7, or C-4 can obtain a record.*

*9 *Use with 016-0288-01 adapter. Must remove C-7's spacer (361-0771-02) to correct for the adapter's thickness.*

*10 *Adapter not included with camera. Order adapter separately.*

*11 *Use on scopes with graticule illumination or bistable storage.*

*12 *Scopes do not have graticule illumination.*

*13 *C-30 Series may cut off the first and last small graticule "tick" marks on some scopes.*

*14 *Must use f/22 or f/32 to get enough depth of field for good focus.*

*15 *C-30 Series will not fit models 1740, 1741, 1742, 1750, and WFM300.*

*16 *Cuts off some of the CRT's edges.*

NR Not recommended.

ORDERING INFORMATION

Camera Mounting Adapter and Hood

016-0224-01	$149
016-0225-04	$90
016-0226-01	$85
016-0248-01	$100
016-0249-06**1	$110
016-0269-03	$115
016-0269-04**2	$110
016-0295-01	$90
016-0299-00	$100
016-0301-01**3	$130
016-0306-01**4	$100
016-0327-01	$190
016-0342-00	$235
016-0357-01**5	$22
016-0358-01**6	$20
016-0359-01**7	$22
122-0894-01**8	$60
122-0896-01**9	$60

** 1 *Included with C-50 Series Cameras.*

** 2 *Adapter and lens included with C-31B Opt. 01 Cameras.*

** 3 *Adapter and lens kit included with C-30B Opt. 01 Cameras.*

** 4 *Included with Standard C-30B, C-31B Cameras.*

** 5 *Included with C-5C and C-5C Opt. 01 Cameras.*

** 6 *Included with C5C Opt. 03 Cameras.*

** 7 *Included with C-5C Opt.. 02 and Opt. 04 Cameras.*

** 8 *Included with C-4 (Standard).*

** 9 *Included with C-4 Opt. 02 and Opt. 03.*

RECOMMENDED CAMERAS AND FILMS

CAMERA SELECTION GUIDE

Camera	C-51	C-53	C-59A	C-30B	C-31B	C-5C	C-4	C-7
Features	Fastest writing speed; Adjustable film and shutter speed; Built-in view port ; Remote shutter actuation; Interchangeable film backs; Single-sweep mode.	General purpose for CRT's up to 8 x 10 cm; Adjustable film and shutter speed; Built-in view port ; Remote shutter actuation; Interchangeable film backs; Single-sweep mode.	General purpose for CRTs up to 6 1/2 inches; low cost ; Adjustable film and shutter speed Built-in view port ; Internal batteries; Interchangeable film backs; OEM pricing available.	Continuously variable magnification; Dual swing-away hinge for viewing the CRT; Easy operation; Interchangeable film backs; Compact size; OEM pricing available.	Max writing speed for portable scopes; Dual swing-away hinge for viewing the CRT; Easy operation; Interchangeable film backs; Compact size.	Low cost, mounts most scopes; Graticule illuminator; Viewing door; Easy to use; Fixed Focus; OEM pricing available.	Lowest price Tek camera, hand held; Easily interchangeable hoods; Scope and video hoods; Easy to use; Fixed focus; OEM pricing available.	Motorized film back; Auto developing prints; uses Polaroid Auto Films; Audible indicators; Remote shutter activation; Fixed focus; OEM pricing available.
Lens Aperture	f/1.2 to f/11	f/1.9 to f/16	f/2.8 to f/16	f/1.9 to f/16	f/1.3 to f/16	f/16 fixed	f/4.5 to f/32	f/16 fixed
Magnification	0.5	0.85	0.67	Variable: 0.7 to 1.5 (0.8 with Opt. 01)	0.5 (0.43 with Opt. 01)	0.67 or 0.85	0.80, 0.70, 0.85 depending on hood	0.67 or 0.85
Relative light gathering	3.0	1.0	0.65	1.0 (0.9 with Opt. 01)	2.7 (2.9 with Opt. 01)	0.02	0.14 (0.85 mag) 0.18 (0.70 mag)	0.02
Field of view with Polaroid pack (cm)	8 x 10		10.2 x 12.7	8 x 10 (Opt. 01); 7 x 9 (std)		9.8 x 12.2 or 8 x 10	9.1 x 11.87 (std) 10.4 x 13.5 (Opt. 02) 8 x 10 (Opt. 03)	8.1 x 10.7 (0.85 mag) 10.3 x 13.8 (0.67 mag)
Resolving Power: at center: (lines/mm)	30 or better		10 or better	at 1:1 25 or better	30 or better	6 or better		
at corners: (lines/mm)	15 or better		4 or better	10 or better	15 or better	3 or better		
Shutter Type	Electrical, 1/60 to 4 s (bulb, time, single sweep), remote shutter actuation, x-sync, scope, "+ gate" input		Mechanical, 1/125 to 1 s (bulb and time) x-sync			Electrical 1/10 to 5 s (Time Mode)	Mechanical 1/125 to 1 s (bulb), x-sync	Electronic actuated 1/10 to 5 s (Time Mode)
Film backs	Polaroid pack standard with "P" models Graflok back standard with "G" models			Polaroid pack standard with "P" models Graflok back available (016-0487-00)		Polaroid pack noninterchangeable		Polaroid AutoFilm noninterchangeable
Page	394	394	394	396	396	392	391	393
Price begins	$2,680	$2,200	$1,560	$1,690	$1,990	$530	$430	$630

COMMONLY USED POLAROID FILMS

Film Type	ASA Equivalent Speed	Development Time (seconds at 75° F)	Format	Resolution	Characteristics	CRT Recording Uses: Repetitive	Stored	Single Sweep	Video Display	Scintillation Type Display	Color Displays	Scanning Electron Microscope
3 1/4 x 4 1/4-in. Pack Films – Actual image area 7.3 x 9.5 cm (2 7/8 x 3 3/4-in.), 8 prints per pack												
611[*1]	200	45	PP	20	Low Contrast, Wide Gray Scale				✓	✓		•
612[*5]	20,000	30	PP	20 to 25	High Contrast			✓				
665[*4]	75	30	N PP	160 to 180 14 to 20	Medium Contrast, Wide Gray Scale	•[*4]	•[*4]		•[*4]			✓
667[*1*5]	3000	30	PP	11 to 14	Medium Contrast, Coaterless	✓	✓	•	•	✓		✓
669[*5]	80	60	CP	11 to 14	Balanced for Color–Electronic Flash	•			•		✓	
691[*5]	80	4 min	CT		Includes Mounts	•			•	•	✓	
AutoFilm (For C-7 only) – Actual image area 10 x 7.5 cm (4 x 3 in.), 10 prints per pack												
331[*1*3*5]	400	60	PP	20	Med. Contrast, Extended Gray Scale	•	•		✓	✓		✓
337[*1*5*6]	3200	60	PP	20 to 25	Medium Contrast	✓	✓					
339[*1*2]	640	> 60	CP[*2]	7 to 9	Medium Contrast, High Speed Color				•[*2]		✓[*2]	

✓ *Preferred film for application*
• *Acceptable performance*
*1 *No coating required*
*2 *Requires electronic scan reversal to yield a correct reading image.*
*3 *Similar to Type 611*
*4 *Allows prints to be made from negative; good for documentation or publications.*
*5 *Available from Tektronix. See right.*
*6 *Available 1st quarter 1990*

PP = Positive Print
N = Negative
CP = Color Positive Print
CT = Color Transparency
NT = Negative Transparency

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

C-4 HAND HELD CAMERA

The C-4 is a versatile high-quality CRT camera at a budget price. It produces sharp photos using Polaroid Pack Films that develop in seconds to clear prints or transparencies. From oscilloscopes to video displays... the C-4 is an ideal CRT camera for the lab, classroom, medical facility, TV studio, and design bench.

A SNAP TO USE

Simply hold the C-4 up to the CRT and pull the shutter trigger. You can easily make quality pictures after just a few minutes of self study with the camera and manual. No special photographic skill or training is required.

THE ADAPTER HOODS

The adapter hoods are a key part of the C-4 system: they block out ambient light and place the camera at the correct object distance from the CRT screen. A corrector lens in each hood provides a focused film image and proper magnification for the hood's field of view. The hoods are secured to the camera body by two snap locks for quick changing.

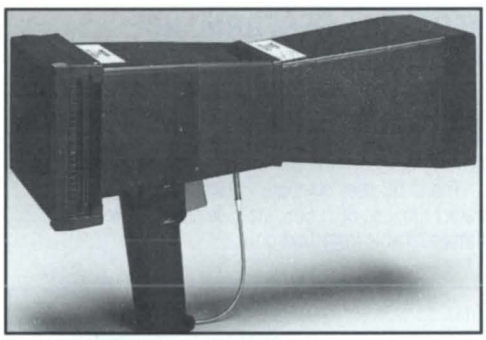
RECOMMENDED USE

We recommend the C-4 for scopes with an illuminated graticule, or with a storage display that can backlight the graticule with floodguns. On scopes with a nonilluminated graticule, the C-4 will record only the waveform. (The Tektronix C-5C or C-7 Cameras with flash is recommended for scopes with an unilluminated graticule.)

USEFUL WITH OTHER PRODUCTS, TOO

With its many various-size adapter hoods, the C-4 can also be used with a variety of CRT-based instruments. To help determine if there's an adapter hood to fit such products, check the hood front-lip dimensions in the "Adapter Hood Selection Guide." (The hoods can fit around the CRT bezel or the can fit inside the bezel against the CRT face itself.)

Also use the same "Selection Guide" to determine if the "Scope Hood" has enough "Field of View" to fully record the CRT display.



Standard C-4 Hand-Held Camera

CHARACTERISTICS

Aperture – f/32 to f/4.5 (continuously variable).

Lens – Four glass elements.

Focal Length – 105 mm nominal (without hood).

Magnification – Dependent on hood. See Adapter Hood Selection Guide below.

Resolving Power – At Center: At least 6 lines/mm. At Camera: At least 3 lines/mm.

Relative Light Gathering Ability – See Adapter Hood Selection Guide below.

Field of View – Dependent on hood. See Adapter Hood Selection Guide below.

Shutter – Mechanical; 1/125 s to 1 s, and bulb.

Synchronization – X-sync switch closure occurs when the shutter reaches its fully open position.

ADAPTER SELECTION GUIDE

Extend the C-4's flexibility with additional snap-on hoods

SCOPE HOODS

Scope Hood Part Number	Dimensions*1 Nominal Front Lip Height*3 mm	in.	Width*3 mm	in.	Hood Length*2*3 mm	in.	Relative Light Gathering	Field of View*1 (cm)	Magnification	Net Weight kg	lb
122-0894-01 with Std C-4	108	4.2	122	4.8	178	7.2	0.15	9.1 x 11.87	0.8	0.1	0.3
122-0895-01 with Opt. 02	132	5.2	143	5.6	206	8.1	0.18	10.4 x 13.5	0.7	0.2	0.4
122-0896-03 with Opt. 3	80	3.2	100	3.9	171	6.8	0.14	8.0 x 10.0*2	0.85	0.1	0.3

VIDEO HOODS

Video Hood Part Number	Dimensions*1 Nominal Front Lip Height mm	in.	Width mm	in.	Diagonal Inside mm	in.	Outside mm	in.	Hood Length*2*3 mm	in.	Magnification	Hood Net Weight kg	lb
122-0897-01 with Opt. 10	114*3	4.5*3	159*3	6.3*3	183	7.2	188	7.4	244	9.6	0.55	0.3	0.7
122-0898-01 with Opt. 11	127*3	5.0*3	168*3	6.6*3	211	8.3	213	8.4	257	10.1	0.55	0.3	0.7
122-0899-01 with Opt. 12	186*4	7.3*4	262*4	10.3*4	318	12.5	323	12.7	404	15.9	0.35	0.6	1.4

**1 Nominal dimensions.*

**2 Image size is limited by front opening of the hood.*

**3 For outside dimensions add 0.30 cm (0.12 in.) to each value. Each wall thickness nominally is 0.15 cm (0.06 in.).*

**4 For outside dimensions add 0.14 in. to each value. Each wall thickness nominally is 0.07 in.*

**5 From mounting surface to front lip.*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.

TYPICAL APPLICATIONS

- *Oscilloscopes*
- *Instrument CRT Displays*
- *PC Terminals*
- *Video Displays*
- *Medical Imaging/Ultrasound*
- *CAD/CAM Displays*

BENEFITS

- *Hand Held – Easy to Use*
- *Adapts to Most Tek and Non-Tek Scopes and CRT displays*
- *No Focusing Required*

FEATURES

- *Uses Polaroid 3 1/4 x 4 1/4 in. Pack Films*
- *Rugged Mechanical Shutter*
- *Adjustable Lens Aperture*
- *Six Snap-on Adapter Hoods*
- *OEM Pricing Available*

ORDERING INFORMATION

Additional hoods can be purchased separately. See Adapter Hood Selection Guide.

C-4 Camera ☎ **$430**
Includes: Body; Pistol Grip (122-0901-00); hood (122-0894-01); operator manual (070-5000-00).

OPTIONS

Opt. 01 – Delete Hood (Body only). **–$45**
Opt. 02 – Substitute 122-0895-01 Hood. **NC**
Opt. 03 – Substitute 122-0896-01 Hood. **NC**
Opt. 10 – Substitute 122-0897-01 Hood. **+$45**
Opt. 11 – Substitute 122-0898-01 Hood. **+$45**
Opt. 12 – Substitute 122-0899-01 Hood. **+$75**

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	180	7.4
Height		
With pistol grip	236	9.3
Without pistol grip	119	4.7
Depth		
With standard hood	363	14.3
Without standard hood	185	7.3
Weight ≈	**kg**	**lb**
Net		
With standard hood	1.0	2.1
Without standard hood	0.8	1.8

See Page 397 for C-4 accessories as well as fresh Polaroid film available from Tek.

TYPICAL APPLICATIONS
- *Oscilloscopes*
- *Small Video Displays*
- *Nuclear Medicine*
- *CAD/CAM Displays*

BENEFITS
- *Lightweight–Easy to Use*
- *No Focusing Required*
- *Fits Most Tek and non-Tek Scopes*
- *With 8 x 10 cm and 9.8 x 12.2 cm CRTs*

FEATURES
- *Uses Polaroid 3 1/4 x 4 1/4 in. Pack Films*
- *Graticule Flash*
- *Hood Mounts to CRT Bezel*
- *Electronically-Controlled Shutter*
- *Interchangeable Adapters*
- *OEM Pricing Available*

ORDERING INFORMATION

Camera includes one hood. Additional hoods can be purchased separately, see page 397.

C-5C Camera ☎ **$530**
Includes: Adapter hood (016-0357-01); Flash unit (016-0642-02); Battery holder; Instruction manual (070-2824-00).

OPTIONS

Opt. 01 – 016-0357-01 adapter hood, no flash. **–$30**
Opt. 02 – 016-0359-01 adapter hood, no flash. **–$30**
Opt. 03 – 016-0358-01 adapter hood, with flash. **NC**
Opt. 04 – 016-0359-01 adapter hood, with flash. **NC**

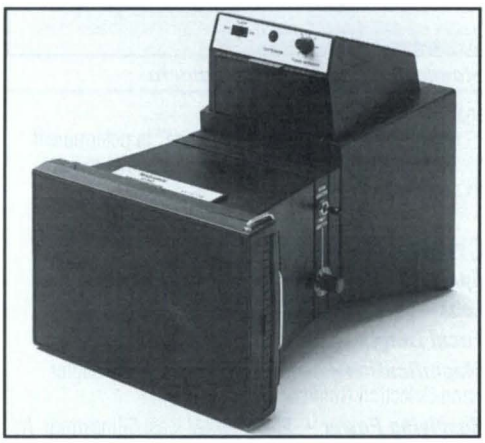
☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

For C-5C Accessories and for fresh Polaroid film see page 397.

VERSATILE PERFORMANCE AT LOW COST

If your application doesn't require special photo techniques, such as recording fast single sweeps, the C-5C will satisfy your documentation needs for a versatile general-purpose CRT camera, at a friendly price.

The C-5C uses standard Polaroid 3 1/4 x 4 1/4 in. Pack Film; i.e., 667, 665, etc. See page 397 for Polaroid films available from Tektronix.



Standard C-5C (with flash).

CHARACTERISTICS

Aperture – Fixed at f/16.

Lens – Three glass elements.

Magnification – 0.67 or 0.85.

Relative Light – Gathering Ability – 0.02.

Shutter – Electronic; 1/10 to 5 s; time.

Field of View – 9.8 cm x 12.2 cm (0.67 magnification) or 8.0 cm x 10.0 cm (0.85 magnification).

Power – The C-5C requires (4) AA alkaline batteries (not included). Battery holder inside camera.

PHYSICAL CHARACTERISTICS*[1]

Dimensions	mm	in.
Width	168	6.6
Height	140	5.5
Depth	257	10.1
Weights ≈	**kg**	**lb**
Net	1.4	3.0
Shipping	1.9	4.1

[1] Standard C-5C

FEATURES COMMON TO C-5C AND C-7

ELECTRONICALLY-CONTROLLED SHUTTER

Both the C-5C and C-7 use a highly reliable and accurate shutter. The shutter can also be triggered remotely by an optional foot switch via the Shutter/Remote Trigger jack.

GRATICULE FLASH

For scopes with a non-illuminated graticule. A variable-intensity xenon flash makes the CRT phosphor glow which evenly backlights the graticule. The flash unit comes on the C-5C, and options 03 and 04, or the C-7, and options 02 and 04, it can easily be retrofitted on C-5Cs or C-7s that don't have it.

ADJUSTABLE MAGNIFICATION

To accommodate different-size CRT displays one can easily configure the cameras to 0.67 or 0.85 magnification, by exchanging the positions of the lens and spacer modules. No focus adjustment required.

CAMERA-TO-PRODUCT COMPATIBILITY

The C-5C and C-7 cover the most widely-used CRT displays: 8x10 cm and 9.8x12.2 cm. They can be used with most Tek and non-Tek scopes. Please see the "Camera Guide" on pages 388 and 389.

ADAPTER HOODS

One of three interchangeable adapter hoods come with each model of the C-5C or C-7. The hoods are changed by removing four screws inside the hood. Additional hoods can be ordered separately.

CRT VIEWING DOORS

A door on the flash unit provides direct viewing of the CRT. Non-flash models replace the flash unit with a large lift-up viewing door (016-0630-00).

EASY CAMERA-TO-INSTRUMENT MOUNTING

For convenient mounting and removal, the adapter hood mounts into a groove atop the CRT bezel and swings down snugly around its perimeter.

The C-5C and the C-7 are separate camera systems; therefore, a C-5C cannot be converted into a C-7 and vice versa. However, they do use the same hoods and flash assemblies.

C-5C and C-7 Adapter Hoods

	016-0357-01		016-0359-01		016-0358-01	
Hood Dimensions*[1]	**cm**	**in**	**cm**	**in**	**cm**	**in**
Height: Inside	13.0	5.13	10.5	4.13	9.5	3.74
Outside	13.7	5.38	11.2	4.40	11.2	4.41
Width: Inside	14.2	5.60	2.0	4.70	11.8	4.65
Outside	14.9	5.85	12.7	4.99	13.1	5.14

[1] All dimensions are approximate since each hood has additional plastic notches and grooves for mounting onto the CRT bezel.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.

C-7 GENERAL PURPOSE AUTO EJECT CAMERA

FEATURING NEW POLAROID 3200 ASA AUTOFILM™

This general-purpose CRT camera incorporates Polaroid's AutoFilm™ system which includes a motorized film back, three integral films, and a snap-on print holding chamber.

After each exposure, the film automatically ejects and self-develops to a clean dry print with no peeling, development timing, or coating necessary.

In less than four seconds after an exposure, the camera is ready to take another picture while the exposed film is developing.

There is no need to touch the exposed prints while they're developing. This is especially important in medical and clean-room applications where the handling of film might cause chemical contamination. Prints are collected in a light-tight, snap-on holder.

In addition, the film-back's rollers require infrequent cleaning since the processing chemicals are sealed within the print and do not contact the rollers.

The C-7/AutoFilm™ system is certified for use in Class 100 cleanrooms.

Polaroid AutoFilm™

The C-7 Camera uses Polaroid's AutoFilm™ exclusively in its motorized film back. AutoFilm™ comes in convenient 10-exposure packs.

The C-7 can be used with Polaroid's new 3,200 ASA type 337 AutoFilm™, which is scheduled for release in the first quarter of 1990. This film will give the C-7 the same performance as a C-5C that is using type 667, 3,000 ASA pack film. Now the C-7 can be used with scopes and other CRT based products that require a faster film to fully capture the image.

The AutoFilm's™ usable image area is 4 x 3 inches; the actual image size on the film depends, of course, on the lens magnficiation setting, and the size of the image on CRT.

Type 337 and 331 are available from Tek, see page 397 for ordering information.

Wide Product Compatibility

The C-7 uses the same adapter hoods as the C-5C and can be used with most Tektronix oscilloscopes and small monitors. Non-Tek displays can also be photographed if the instrument has a Tek-style CRT bezel, or if the camera can be held up to the CRT.

Audible Alarms

An exposure counter in the filmback monitors the film supply. An alarm sounds when the last print is ejected. A buzzer also sounds to indicate low voltage input.

CHARACTERISTICS

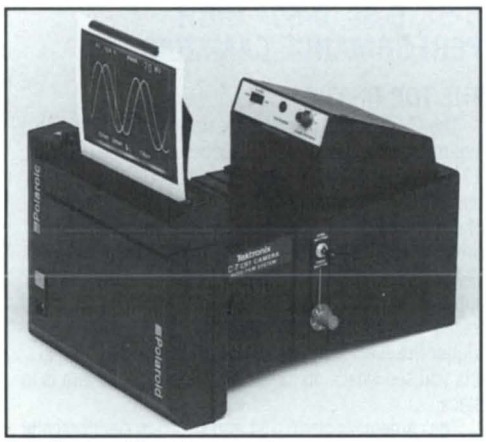
OPTIONAL/MECHANICAL

Relative Aperture – Fixed at f/16.

Magnification – 0.67 or 0.85.

Lens – Three glass elements.

Relative Light-Gathering Ability – 0.02.



C-7 Option 02 with ejected print.

Field of View (Nominal) – 8.1 cm x 10.7 cm (13.4 cm diagonal) at 0.85 mag; or 10.3 cm x 13.8 cm (17.3 cm diagonal) at 0.67 mag.

Shutter – Electronically Actuated: 1/10 s to 5 s; open-shutter mode.

Remote Shutter Jack – Open collector TTL compatible (for use with foot switch).

Time Between Shots – ≈ 4 s (plus shutter time).

Audible Indicators (Buzzer) – Out-of-Film Warning: After tenth print is ejected, buzzer will sound for approximately one second. Low- or High-Voltage Warning: Buzzer will sound during the film-eject cycle when the batteries start to get weak.

POWER REQUIREMENTS

The C-7 requires external power from an ac power supply, battery pack, or a customer supplied source via a Lemo connector.

Voltage – 8 V to 12 V (can be configured for 5 V to 12 V, see service manual).

Current – Idle: ≈1 mA. Maximum: 3 A for 10 s. Mechanical Interface – Lemo type connector (cable and connector, Tektronix part number 131-0778-00).

POWER SUPPLIES (OPTIONAL)

110 V (119-1847-02) – Output Voltage: 9.5 V nominal. Output Current: 1.5 A nominal, 3 A peak. Line Voltage: 90 to 132 V ac, 50 to 60 Hz nominal.

Battery Pack (016-0799-01) – Number of Cells: Eight. Type of Cells: alkaline or NiCad AA. (Batteries not incuded, velcro strips included.)

PHYSICAL CHARACTERISTICS (Std C-7 w/Flash)

Dimensions	mm	in.
Width	180	7.1
Height to top of flash	196	7.7
Height with chamber	264	10.4
Depth	251	9.9
Weight≈	**kg**	**lb**
Net	1.3	3.7
Shipping	2.6	5.8

TYPICAL APPLICATIONS

- *Oscilloscopes*
- *Clean Rooms*
- *Medical Imaging/Ultrasound*
- *Nuclear Medicine*
- *Oscilloscopes*
- *Instrument CRT Displays*
- *Small Video Displays*

BENEFITS

- *No Focusing Required*
- *Film Auto Ejects and Self Develops*

FEATURES

- *New 3,200 ASA AutoFilm™ (Similar to 667)*
- *Graticule Flash*
- *Motorized Film Back*
- *Electronically-Controlled Shutter*
- *Snap-on Print-Hold Chamber*
- *Buzzer Alarm for Low Batteries and Last Print*
- *OEM Pricing Available*

ORDERING INFORMATION

C-7 Requires a power source (does not come as a standard accessory). Order Opt. 30*1, or Opt 31*1, or use your own power via Lemo connector.

C-7 Camera with Flash ☎ **$630**
Includes: Adapter hood (016-0357-01); Print holding chamber (122-1039-00); Circuit board covers for 0.67 mag (200-3074-00), for 0.85 mag (200-3031-00); Operator manual (070-5127-00).

OPTIONS

Opt. 01 – 016-0357-01 Hood and no flash. **–$30**
Opt. 02 – 016-0359-01 Hood and flash. **NC**
Opt. 03 – 016-0359-01 Hood and no flash. **–$30**
Opt. 04 – 016-0358-01 Hood and flash. **NC**
Opt. 05 – 016-0358-01 Hood and no flash. **–$30**
Opt. 20 – Camera Body Only, no Flash or Hood. **–$40**
Opt. 30*1 – With 016-0799-01 (batteries not included). **+$38**
Opt. 31*1 – With ac Power Supply (110 V). **+$67**

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

*1 One of each power source can be ordered.

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

See page 397 for ordering information for C–7 accessories and for fresh Polaroid Autofilm™.

C-51/C-53/C-59A

TYPICAL APPLICATIONS

- *For High Resolution Lab Work*
- *High Speed Transient Capture*
- *Imaging*
- *Medical and SEM*
- *General Documentation*

FEATURES

- *Three Cameras to Select From:*
  C-51 for High Speed Work
  C-53 for General Purpose
  C-59 for For 6 1/2 in. CRTs
- *Highest Resolution Lenses*
- *Electronically-Actuated Shutter for Remote Applications (C-51, C-53)*
- *Interchangeable Film Backs*
- *Adapts to Many Lab Instruments*
- *Photometer Exposure Aid*
- *Swings Away from CRT*

C-51

- *Fastest Writing Speed*
- *Reduced Image Size (0.5 Mag) on Print*
- *Remotely Controllable Shutter*
- *Foot Switch Available*
- *Writing Speed Enhancer Available*

ORDERING INFORMATION

"P" Models accept only Polaroid pack film. "G" Models have a Graflok-type back that requires a film holder.
Note: Optional battery pack (016-0270-02) is required when C-51 or C-53 are used on other than 7000 Series or 11300 Series scopes. Battery holder (352-0355-00) is supplied standard on C-59A. The C-59A battery pack requires eight AA size alkaline batteries (not included).

C-51G Camera **$2,800**
Includes: Mounting adapter for all 7000, 5000, 11301(A) /11302(A) and small 600 Series (016-0249-06); camera visor (337-0411-02); Graflok film back (122-0931-01) with integral focusing screen; Instruction manual (070-1011-03).

C-51P Camera **$2,680**
Includes: Same as C-51G except it has a Polaroid pack film back (122-0926-02) instead of a Graflok film back, and a focus plate (387-08930-02).

Opt. 11*1 Corrector lens for 11301(A) **+$95**

Opt. 12*1 Corrector lens for 11302(A) **+$95**

*1 *One or both options can be ordered.*

C-51, C-53, C-59A HIGH PERFORMANCE CAMERAS

THE TOP OF THE LINE

The C-50 Series cameras are designed for use with all Tektronix 7000 Series oscilloscopes, the 11301(A) and 11302(A), can be adapted to fit most 500 Series oscilloscopes and other Tek instruments. Full selection of film backs, and adjustable film and shutter speeds provide the flexibility to best record your measurements. The photometer exposure aid provides an easy way to approximate the correct exposure for repetitive or stored traces. X-sync connectors allow the camera shutter to trigger the event. The camera's built-in viewing tunnel lets you see what's on the display when the camera is in place.

The camera shutter (C-51 and C-53) is electronically actuated, open and close, by the shutter button or remotely through a remote-input connector located on the side of the camera.

When a C-50 Series camera is used with Tektronix 7000 Series, 11301(A), or 11302(A) oscilloscopes, a three-pin connector in the scope bezel applies power to the camera, and receives from the camera a pulse for resetting the scope sweep when the scope and camera are both in single-sweep mode. When the scope and camera (C-51 and C-53 only) are in the single-sweep mode, the "+gate" output from the scope can be applied to the "+gate" input connector on the camera to close the shutter five seconds after the end of the scope's sweep.

The C-51 and the C-53 are available in ruggedized versions. Contact your Tektronix Sales Office for further details.

C-51

The C-51 offers the fastest writing speed of any Tek camera. The f/1.2 lens shoots images at 0.5 magnification, clearly capturing fast transients or single sweeps, although at some expense to the image size on the film. The electric shutter can operate at speeds ranging from 1/60 to 4 seconds and offers bulb, time, and single-sweep modes by manual or remote control. Two screw-on corrector lenses for 11301(A)/11302(A) compatibility are available.

C-51G (Shown with Option 11 and 12 corrector lens off.)

CHARACTERISTICS

Aperture – Variable from f/1.2 to f/16.

Magnification – 0.5.

Resolving Power – Center: At least 30 lines/mm. Corners: At least 15 lines/mm.

Field of View – 8 cm x 10 cm (with pack film).

Relative Light-Gathering Ability – 3.0.

Shutter – Electric; 1/60 to 4 s, bulb, time, and single sweep modes, manual or remote control. Scope's "+gate" is used for shutter actuation.

Power requirement – +15 V from 7000 or 11300 Series oscilloscopes, or an optional battery pack for non-7000 Series instruments (see page 397).

Synchonrization – X-sync switch closure.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width	248	9.8
Height	292	11.5
Depth	273	10.8
Weights≈	**kg**	**lb**
Net	4.3	9.5
Shipping	6.8	15.0

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

C-53P (Shown with Option 11 corrector lens off.)

C-53 HIGH PERFORMANCE CAMERAS

The C-53, with 0.85 mag lens, provides the largest practical image of an 8x10 cm CRT display on Polaroid 3 1/4 x 4 1/4 inch pack films. It's f/1.9 lens and 0.87 magnification offer somewhat slower writing speed. The electric shutter offers speeds ranging from 1/60 to 4 seconds and can be operated manually or remotely in bulb time, or single-sweep modes. A screw-on corrector lens is available for 11302(A) compatibility.

CHARACTERISTICS

Aperture – Variable from f/1.9 to f/16.

Magnification – 0.85.

Resolving Power – Center: At least 30 lines/mm. Corners: At least 15 lines/mm.

Field of View – 8 cm x 10 cm (with pack film).

Relative Light-Gathering Ability – 1.0.

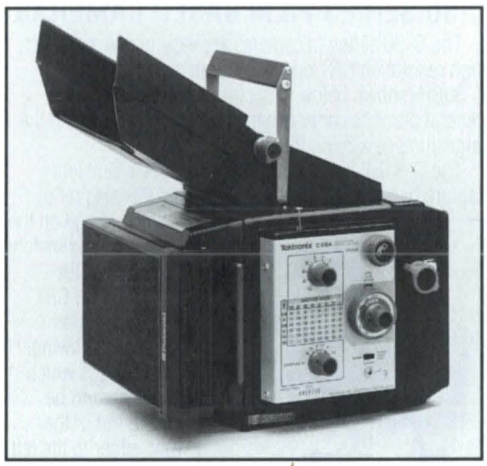
Shutter – Electric; 1/60 to 4 s, bulb, time, and single sweep modes, manual or remote control. Scope's "+gate" is used for shutter actuation.

Power Requirement – +15 V from 7000 or 11300 Series oscilloscopes, or an optional battery pack for non-7000 or 11300 Series instruments (see page 397).

Synchronization Output Jack – X-sync switch closure output.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width	191	7.5
Height	292	11.5
Depth	273	10.8
Weights≈	**kg**	**lb**
Net	2.4	7.5
Shipping	5.4	12.0



C-59AP

C-59A HIGH PERFORMANCE CAMERAS

The C-59A is designed for CRTs up to 6 1/2 inches (10.2 x 12.7 cm field of view with Polaroid pack film). With the 016-0288-01 kit, the field of view is expanded to fully cover the display and adjacent scale readout characters of the Tek 576 Curve Tracer. Many of the features of the higher priced C-50 Series are standard on the C-59A: photometer exposure aid, range-finder focusing, bulb/time operating modes, x-sync contacts, and film-back interchangeability.

CHARACTERISTICS

Aperture – Variable from f/2.8 to f/16.

Magnification – 0.67.

Field of View – 10.2 cm x 12.7 cm (wider with optional 016-0288-01 adapter frame/corrector lens).

Relative Light-Gathering Ability – 0.65.

Resolving Power – Center: At least 10 lines/mm. Corners: At least 3 lines/mm.

Shutter – Mechanical; 1/125 s to 1 s, bulb and time.

Synchronization – X-sync switch closure.

Power requirement – Receives power (+15 V) from a 7000 or 11300 Series oscilloscope, or from an internal battery pack 8 AA size alkalines (not included) (12 V) if used on a non-7000 or 11300 Series oscilloscope.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width	193	7.7
Height	292	11.5
Depth	273	10.8
Weights ≈	**kg**	**lb**
Net	3.2	7.0
Shipping	5.0	11.0

C-53

- *Medium Speed*
- *General–Purpose Camera With 0.85 Mag*
- *Remotely Controllable Shutter*
- *Foot Switch Available*
- *Writing Speed Enhancer Available*

C-59A

- *For Larger CRTs (0.67 mag)*
- *Mechanical Shutter*
- *Lowest Priced C-50 Series*
- *Photometer Exposure Aid*
- *Range–Finder Focusing*
- *Internal Battery or External Power*
- *OEM Pricing Available*

ORDERING INFORMATION

CONTINUED

C-53P Camera **$2,200**
Includes: Same as C-51P.
Opt. 11– Corrector lens for 11302(A). **+$95**
C-59AG Camera **$1,610**
Includes: Same as C-51G except instruction manual (070-3632-00).
Opt. 11– Corrector lens for 11301(A). **+$95**
C-59AP Camera **$1,560**
Includes: Same as C-51P, except instruction manual (070-3632-00).
Opt. 11– Corrector lens for 11301(A). **+$95**
C-59A Kit for 576 and 5030 Series – Expands the field of view to fully cover the 6 1/2 in. CRT and adjacent scale readout characters of the 576 Curve Tracer and 5030-Series oscilloscopes. The slip-on corrector lens (352-0293-00) reduces the effective magnification of the C-59 from 0.67 to 0.5 so it can record the entire display on Polaroid 3 1/2 x 4 1/2 in. film (for the C-59A camera only). Adapts camera to 576, 5030, and 5031. Order 016-0288-01. **$220**

**1 One or both options can be ordered.*

See page 397 for a complete listing of C-50 Series accessories as well as Polaroid films.

C-30BP/C-31BP

TYPICAL APPLICATIONS

- *Portable and Lab Scopes with 8x10 cm CRTs*
- *Imaging – Medical, SEM, Ultrasound*
- *High Speed Transient Work (C-31BP)*
- *General CRT Documentation*

FEATURES

- *High Resolution Lenses*
- *Mechanical Shutters*
- *Cover 0.8 cm/div CRTs (Standard C-30)*
- *Optimized for 8 x 10 cm CRTs (C-30 Option 01)*
- *Continuously Variable Magnification (C-30B)*
- *Writing Speed Enhancer Available*
- *Interchangeable Backs*
- *Swings Away for CRT Viewing*

BENEFITS

- *Adaptable to Many Instruments*
- *Fast Light-Gathering Ability, with C-31B (0.5 Mag)*
- *OEM Pricing on C-30BP*

ORDERING INFORMATION

("P" denotes that the camera has a 3x4 in. pack film back. All models include Polaroid pack film back.)

C-30BP Camera **$1,690**
Includes: Polaroid pack film back with split image focus plate (122-0752-02); Mounting adapter (016-0306-01); Instruction manual (070-2825-00).

Opt. 01 – Expanded Field of View
Includes: same as C-30BP except with 016-0269-03 mounting adapter and corrector lens (352-0341-01). **+$70**

C-31BP Camera **$1,990**
Includes: same as C-30BP, except instruction manual 070-2869-00 is included.

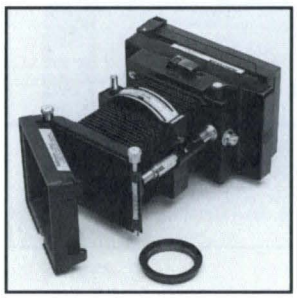
Opt. 01 – Expanded Field of View
Includes: same as C-31BP except with 016-0269-03 mounting adapter and corrector lens (122-0980-00). **+$70**

See page 397 for C30B/31B accessories and for Polaroid films.

C-30 SERIES FILM BASED CAMERAS

The C-30 series of cameras are easy to use, compact, high resolution CRT documentation products. The C-30BP (shown below with corrector lens off) is the general purpose camera that provides versatility with the largest image size on the film.

The C-31BP is optimized for high speed transient capture by using a fast lens, and a fixed 0.5 mag ratio, i.e., the image on the film is approximately 50% that of the image on the CRT.



C-30 Opt. 01 with corrector lens off.

The cameras feature dual swing-away hinges which allow them to be swung out of the way, either to the left or right, for direct viewing of the CRT. By using supplied, or optional adapters, the cameras will mount on a variety of scopes, spectrum analyzers, display monitors and other CRT-based products. See pages 388 and 389.

C-30B

The cameras come standard with 3 1/4 x 4 1/4 in. pack film backs. An optional Graflok back can be purchased which will allow the use of various film holders such as 4x5, and wet developed roll films.

The standard versions of the C-30B and C-31B are primarily for use on the older 400 Series portables that have 0.8 cm/div CRTs.

The C-30B is a versatile, general purpose camera for scopes that have 0.8 cm/div CRTs. It is the only Tektronix oscilloscope camera that features continuously variable magnification (from 0.7 to 1.5) giving you greater photographic flexibility. The standard C-30B is recommended for the 453, 454, 485, and 491.

The C-30B Option 01 provides an expanded field of view by adding a corrector lens and different mounting adapter. This allows photographic coverage of an 8x10 cm CRT screen without vignetting. Option 01 is recommended for the 2400 Series, 455, 464, 465, 465B, 466, 468, 475, and 475A oscilloscopes.

Option 01 is optimized for use at 0.8 mag only.

CHARACTERISTICS (C-30B)

Aperture – Variable from f/1.9 to f/16.

Lens Speed – f/1.9.

Magnification – Variable from 0.7 to 1.5 (0.8 magnification on Option 01 with C-30B set to 1.0 magnification).

Resolving Power – (At 1:1 magnification) At Center: At least 25 lines/mm. At Corners: At least 10 lines/mm.

Relative Light-Gathering Ability – 1.0 (0.9 on 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 9.0 cm. Option 01: 8.0 cm x 10.0 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-31B

Option 01 adds a slip-on corrector lens and a different mounting adapter (016-0269-03) for coverage of 8x10 cm displays, such as for the 2400 Series, 465, etc. Option 01 can also be used on some 7000 and 5000 Series Lab scopes.

The C-31B's f/1.3, 0.5 magnification lens offers the fastest writing speed for 2400 and 400 Series oscilloscopes. The image size on the print will be approximately one-half the size of the C-30B's. The standard C-31B is recommended for the 453, 485, and 454 if you need fast writing speed capture of single-sweep traces.

The C-31B Option 01 provides an expanded field of view. This allows photographic coverage of CRT screens up to 8 cm x 10 cm. Option 01 is recommended for the 2400 Series, 455, 464, 465, 465B, 466, 475, and 475A oscilloscopes.

CHARACTERISTICS (C-31B)

Aperture – Variable from f/1.3 to f/16.

Lens Speed – f/1.3.

Magnification – Fixed at 0.5 (0.43 on Option 01).

Resolving Power – At Center: At least 30 lines/mm. At Corners: At least 15 lines/mm.

Relative Light-Gathering Ability – 2.7 (2.9 on Option 01).

Shutter – Mechanical; 1/125 to 1 s, bulb and time.

Synchronization Output – X-sync contact closure.

Field of View – Standard: 7 cm x 9 cm. Option 01: 8 cm x 10 cm.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width	231	9.2
Height	140	5.5
Depth	269	10.6
Weights ≈	**kg**	**lb**
Net	3.1	6.8
Shipping	5.4	11.0

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.

FILM BASED CAMERA ACCESSORIES

Product	Application	Order No.	Price
Replacement Film Backs			
Polaroid 3 1/4" x 4 1/4 " Pack Film Backs	C-12, C-19, C-13, C-27	122-0671-01	$360
	C-30, C-30 A/B Series	122-0752-02	$220
	C-50 Series	122-0926-02	$210
Slit-Image Focus Plate	Fits inside pack back	387-0893-02	$6.75
Polaroid Replacement Roller Assemblies for Pack Film Backs	If your roller assembly is solid gray or two-tone gray	401-0304-00	$40
Graflok Type Film Backs	C-12, C-27	122-0604-01	*1
	C-30 Series	016-0487-00	$275
	C-50 Series	122-0931-01	$265
Polaroid #545 Film Holder	Polaroid 4 x 5" Single Exposure Film Packets	016-0201-01	$285
RH/50 70 mm Film Holder	50 exposure 2 1/4 x 2 1/4 inch image	Through local camera shop	
Polaroid #550 Pack Film Holder	For Polaroid 4 x 5" pack films	Available only through Polaroid 1-800-343-5000 In United States	
Polaroid #405 Pack Film Holder	For Polaroid 3 1/4 x 4 1/4 inch pack films		
Writing Speed Enhancers			
Increases film's effective writing speed about three times for ASA 3000 film	C-30A/B, C-31A/B	016-0284-02	$290
	C-51	016-0279-02	$270
	C-53	016-0300-02	$325
	C-59A	016-0290-02	$300
Polaroid Pack Films Available From Tek			
Polaroid 3 1/4" x 4 1/4" Pack Films (Recommended for all cameras with a Polaroid 3 1/4" x 4 1/4 " Pack Back)			
Type 667 – B&W print, no coating required (3000 ASA)	3 twin packs (48 prints)	006-6824-00	$49
	25 twin packs (400 prints)	006-6825-00	$390
Type 612 – B&W print, high contrast (20,000 ASA)	3 single packs (24 prints)	006-6822-00	$40
Type 669 – Color print (80 ASA)	3 twin packs (48 prints)	006-6826-00	$73
	25 twin packs (400 prints)	006-6827-00	$540
Type 691 – Color Transparancy with mounts (80 ASA)	50 single packs (400 trans)	006-6845-02	*1
Polaroid AutoFilm™ (for C-7 only)			
Type 331 – B&W print, with extended gray scale (400 ASA)	3 twin packs (60 prints)	006-6815-00	$67
	10 twin packs (200 prints)	006-6816-00	$205
Type 337 – B&W print, similar to 667 pack film (3200 ASA)	Will be available in the first quarter of 1990		
C-4 Optional Accessories			
For Color CRTs	Color Filter Kit	122-0909-00	$16
Scope Hoods	9.1 cm x 11.87 cm field of view	122-0894-01	$60
	10.4 cm x 13.5 cm field of view	122-0895-01	$60
	8.0 cm x 10.0 cm field of view	122-0896-01	$60
Video Hoods	7.2 in diagonal	122-0897-01	$105
	8.3 in diagonal	122-0898-01	$105
	12.5 in diagonal	122-0899-01	$125
C-5C Optional Accessories			
	Large viewing door for hoods	016-0630-00	$9.00
	Graticule Flash Unit	016-0642-02	$180
Hoods (Requires either a viewing door or flash, see above)	5K, 7K, 11K and T-922R	016-0357-01	$22
	T900 Series except T-922R	016-0358-01	$20
	2400, 2200, 46X and 475 Series	016-0359-01	$22

*1 *Contact your local sales representative.*

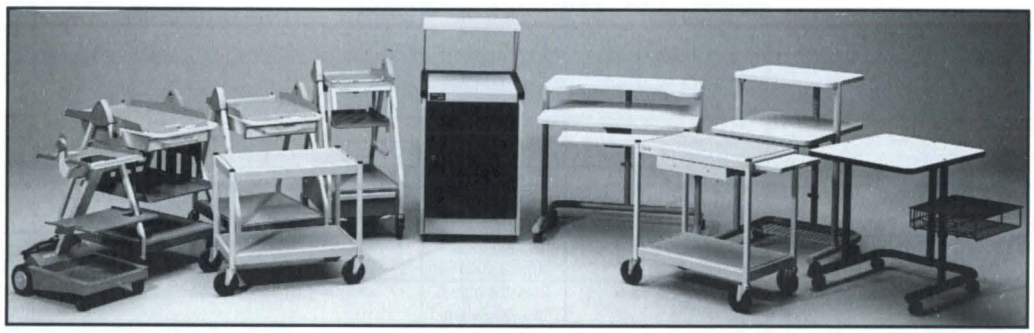
Product	Application	Order No.	Price
C-7 Optional Accessories			
	Extra Print Holding Chamber	122-1039-00	$22
	Foot Switch with 8 ft. Cable	260-1189-02	$22.50
	Extra Battery Pack (8 AA alkaline batteries not included)	016-0799-01	$40
	Lemo connector for Power-in	131-0778-00	$18.75
	Service (only) manual	070-5051-00	$10
Extra AC Power Supply with Lemo Connector and a 8 ft cable	STD 110 V ac 50 Hz to 60 Hz (w/Opt. 31)	119-1847-02	$90
Hoods/Flash/Viewing door	See C-5C section		
Polaroid AutoFilm™ (For C-7 only)	Type 331 – B&W print with extended grey scale (Like Type 611) (400 ASA)		*1
	Type 337 – B&W print (3,200 ASA)		*1
C-12 & C-27 Optional Accessories			
Mounting Adapters	C-12 to 7000 Series and 5000 Series	016-0299-00	$100
	C-12 to 530, 540, 550 Series	016-0226-01	$85
	Carrying Case	016-0208-01	*1
	Film Backs	See "Backs" sect.	
C-30 Series Optional Accessories			
	Carrying Case	016-0587-00	$160
	Portra Lens (C-30A/B only)	016-0246-02	$38
	X-sync Cable	012-0364-01	$30
Converting Option 01 Model to Standard Model	The Opt. 01 versions of the C-30B and C-31B Cameras can be converted to standard models by simply slipping off the corrector lens, removing the mounting adapter, and adding an 016-0306-01 mounting adapter.		$100
Converting Standard Model to Option 01 Model	Std C-30B to Opt. 01 Includes 016-0269-03 adapter and C-30B corrector lens (352-0341-01)	016-0301-01	$130
	Std C-31B to Opt. 01 Includes 016-0269-03 adapter and C-31B corrector lens (122-0980-00)	016-0269-04	$110
	Film Backs	See "Backs" sect.	
C-50 Series Optional Accessories			
	Carrying Case	016-0177-00	$345
	X-sync Connector Plug	134-0079-00	$1.50
	Battery pack for C-51 and C-53 cameras (12 AA Alkaline batteries not included)	016-0270-02	$380
	C-59A Adapter Frame/ Connector lens kit for the 576 Curve Tracer and the 5030 Series scopes (includes connector lens 352-0293-00)	016-0288-01	$220
	Film Backs	See "Backs" sect.	
	Foot switch with 8 ft. Cable (C-51, C-53 only)	260-1189-02	$22.50
11301(A)/11302(A) Corrector Lenses These lenses easily screw in or snap on the camera lens.	C-51/11301(A)	122-1043-00	$95
	C-51/11302(A)	122-1044-00	$95
	C-53/11302(A)	122-1045-00	$95
	C-59A/11301(A)	122-1046-00	$95

INSTRUMENT CARTS/WORKSTATIONS

Contents

K212 Portable Instrument Cart 399
K501 Tek-Tilt ™ Pedestal 399
K217 Rack Instrument Cart 400
K217S Rack Instrument Cart 400
K636 Mobile Workstation 400
K213 Lab Instrument Cart 401
K318 PC Cart 401
206 Utility Cart 401
K332WH PC/Instrument Cart 402
K335BN PC/Instrument Cart 402
K336BN Midsize Instrument Cart 402

We can free up your valuable work space and make sharing and moving equipment easy while getting you closer to the device under test. Our Scopemobiles® and workstations are designed with instrument integration in mind and are built with the highest standards in materials and pride of ownership in the industry today. From the K212 which is the standard by which other portable carts are measured against, to the new K636 rackmount mobile workstation, Tektronix has a mobile platform solution for all your application needs. Call us, we are here to help.



Instrument/Workstation Compatability

	206/K318	K212	K213	K213 Shelf	K217	K217S	K217S Shelf	K332WH	K335BN	K336BN	K501	K636
Terminals/Copiers/Monitors/Plotters												
4000 Series	•							•	✔	✔		
4600 Series	•							•	✔	•		
4900 Series	✔							✔	•	•		
60X/62X Series	✔	•		•			•	✔	✔	•		
65X/67X Series	•				✔	•		✔	✔	•		
Television/Spectrum Analyzers/Cable Testers												
1410R Series	•				✔	•		•	•	•		
1420 Series		✔		•			•	•				
1430/1440/1450/1470	•				✔	•		•	•	•		
1480 Series Cabinet		✔		•			•	•				
1480 Rackmount	•				✔	•		•	•	•		✔
1500 Series		✔					•	•			•	
17XX Series		✔		•			•	•				R
1910 (Cabinet)	•				✔	•		•	•	•		
2710					✔	•					✔	R
275X Series	•				✔	•		•	•	•		R
49X Series		✔						•			✔	R
Analyzer Systems										✔		•
OF 150/235		✔						•			•	
Logic Analyzers												
1230/1240/1241	•	✔		•			•	•			✔	R
DAS 9100	•					✔		•	•	•		
DAS 9200									✔	•		
LV500										✔		
Prism 3000	•							•	✔			

✔ – Recommended • – Compatible

	206/K318	K212	K213	K213 Shelf	K217	K217S	K217S Shelf	K332WH	K335BN	K336BN	K501	K636
Curve Tracers												
370A/371	•				✔	•		•	•	•		
576/577	•		•		✔	•		•	•	•		R
5370 FA	•							•	✔			
Oscilloscopes/Digitizers/Controllers												
11000 Series	•					✔		•	•	•		R
DSA 601/602	•					✔		•	•	•		R
2200/2300	•	✔	•	•	•		•	•	•	•	✔	R
2400	•	✔	•	•	•		•	•	•	✔	✔	R
2600									•	✔		
305/314/336	•	✔		•			•	•	•	•		
390AD	•				✔	•		•	•	•		
400 Series		✔	✔		•			•	•	•		R
5XX Series (Cabinet)	•		✔					•	•			
5XX Series (Rackmount)	•				✔	•		•	•			R
5000/7000 Series (Cabinet)	•		✔					•	•			
5000/7000 Series (Rackmount)	•				✔	•		•	•			R
7612/7912	•				✔	•		•	•			R
7020T		✔		✔			✔					R
T900 Series		✔	•									
TM500/TM5000 Series												
TM503/TM504/ TM5003	•	•	•	✔			✔	•	•			R
TM506/TM515/ TM 5006	•					✔	✔	•	•			R

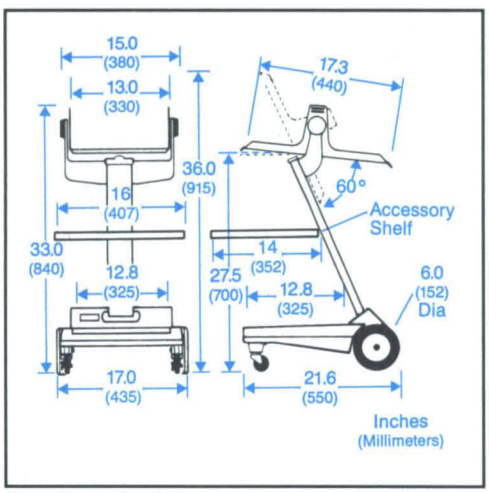
R – Suitable for rackmounting applications

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

Cart Selection Guide

Features	K212		K213		K217		K217S		K318/206		K332WH		K335BN		K336BN		K501		K636	
Load Capacity	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb
Top Tray	36	80	34	75	45	100	45	100	45	100	68	150					23	50	104	230
Base	45	100	11	25	45	100	45	100	45	100					9	20	—	—		
Middle Tray	18	40	18	40	—	—	18	40	—	—							—	—		
Top Shelf													32	70	32	70			18	40
Middle Shelf													36	80	36	80			18	40
Total	99	220	77	170	95	200	90	200	90	200	68	150	68	150	68	150	23	50	180	400
Weights≈																				
Net	9	20	26	57	20	43	21	45	14	30		37		55		77	.8	1.8	65	145
Shipping	13	28	34	75	26	57	27	60	17	38		40	26	58		55/25	1.0	2.2	72	160
Page	399		401		400		400		401		402		402		402		399		400	
Prices	$375		$655		$565		$655		$385/$265		$160		$299		$349		$49		$975	

NOTE: *For dimensions, see dimensional drawings*

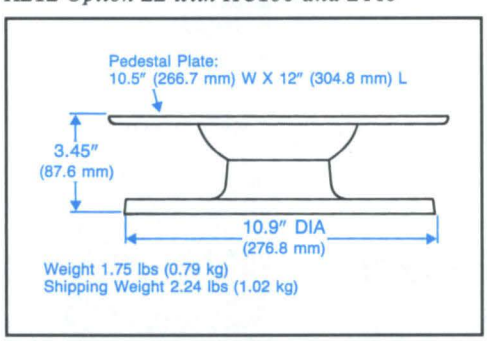


Base is made of thermoset polyester, column and trays made of high-strength aluminum. Base and trays are Tek Blue. Column and yoke are silver grey.

K501 Tek-Tilt™ Pedestal

This compact platform will enhance any bench top application. The K501 allows repositioning of screen height, angle, and eye-to-screen distance. Rubber feet on the base stabilizes this attractive platform. K501 data sheet 56-W-5077 is available.

K212 Option 22 with HC100 and 2440



K501

K212

- *Designed for All Portable Instruments*
- *Sturdy and Mobile Platform*
- *Enhances Sharing and Work Space*
- *Tiltable Top Tray*
- *Locking Front Casters*
- *Wide Track Base*
- *Four Outlet Power Strip with Circuit Breaker (Option 10)*
- *Second Tray with a Paper Slot for Peripherals (Option 12)*

K501

- *Provides the Ability to Move, Adjust, Tilt, Swivel Portable Instruments*
- *Rotates 360° and Tilts up to 30°*
- *Tension Adjustment Located on Base*
- *Enhances Visual and Postural Viewing Angles and Reduces Glare*

ORDERING INFORMATION

K212 Portable Instrument Cart ☎$380
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 +$75
Opt. 22 – Combines Opt. 10/12 +$140
Power Strip Retrofit Kit.*1
Order 016-1025-00 $85
Middle Tray Retrofit Kit.*1
Order 016-1026-00 $95
K501-Tek-Tilt ™ Pedestal. ☎$49

*1 *Everything you need to retrofit these options is included: instructions, hardware and templates.*

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.

K217/K217S

- *Designed for Rack-width Instruments*
- *Stable/Mobile Platform*
- *Locking Wheels*
- *Four Outlet Power Strip*
- *Accessories Drawer*
- *100 Lbs. Top and Bottom Tray Capacity*
- *Middle Tiltable Tray, 40 Lb. Capacity (K217S Only)*
- *Securing Strap Standard*

NEW K636

- *Stable, Rugged Mobile Workstation for Rackmounting Applications*
- *Extremely Soft Ride with Balloon Cushion 5 Inch Back Wheels and 3 1/2 Inch Front Casters*
- *Standard Top Shelf Rides in Extrusion Track*
- *Pop-out Size and Back Panels*
- *Surge Protector*
- *3 1/2 Inch Recessed Front Vertical Supports*
- *Optional Side Shelf Pops On and Off and is Interchangeable from Side to Side*

ORDERING INFORMATION

K217 Rack Instrument Cart Probe holders, securing strap included.	**$570**
Opt. 01– Brown finish To order additional 1 1/2" x 53" Securing Strap for top tray,	**NC**
(Blue) Order 346-0070-01	**$40**
(Brown) Order 346-0070-03.	**$40**
K217S Rack Instrument Cart Probe Holders, securing strap included	☎ **$660**
K636 Mobile Work Station Probe holder and securing strap included.	**$975**
Opt. 05 – Flush-Mount Adaptor Kit	**+$65**
Opt. 6 – Delete Power Strip	**NC**
Opt. 10 – Side Shelf	**+$120**
Opt. 11 – 23 1/2" high smoked plastic door*2	**+$165**
Opt. 12 – 26" high smoked plastic door*2	**+$175**
Opt. 13 – 3 1/2" deep drawer*1	**+$75**
Opt. 14 – 7 inch Deep Drawer*1	**+$85**
Opt. 15 – Keyboard Platform*1	**+$125**
Opt. 19 – Blower Cut-Out	**+$80**
Back Panel – 1 3/4 high cover plate, Order 333-1351-07	**$20**
3 1/2" high cover plate, Order 333-0997-06	**$30**
5 1/4" high cover plate, Order 333-0999-06	**$35**

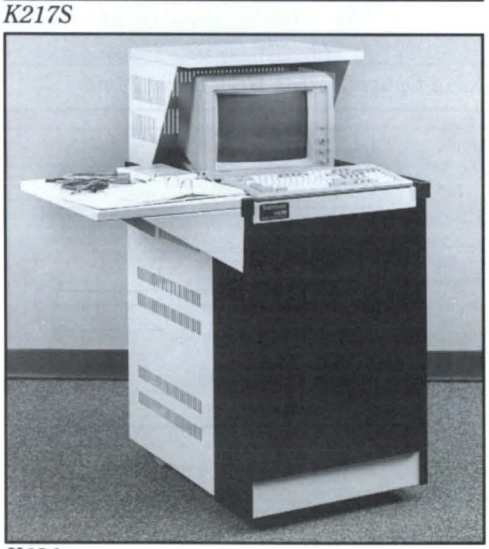
*1 *Includes drawer slides and hardware.*

*2 *Door includes popout hinges, attractive handle, and lock.*

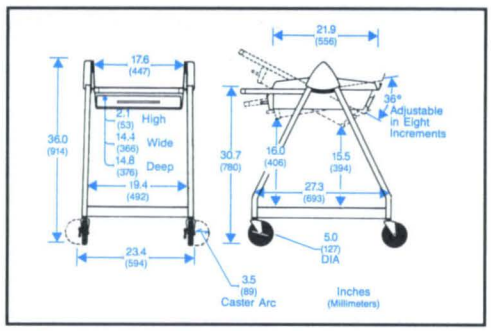
☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

K217

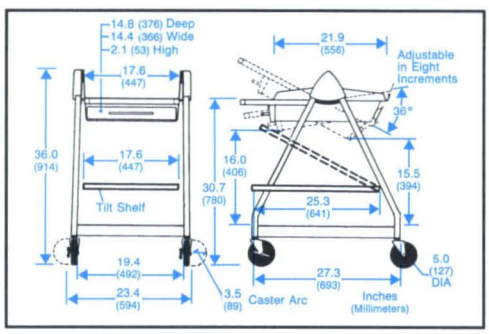
K217S



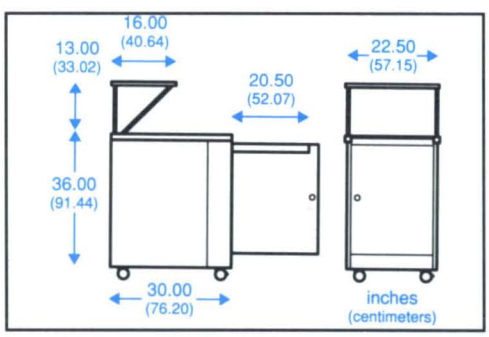
K636



This sturdy, portable cart is ideal for manufacturing, research and design environments. For a quality, sturdy, mobile instrument cart, the K217 is the answer. K217/K217S Data Sheet 56W-7132 is available.



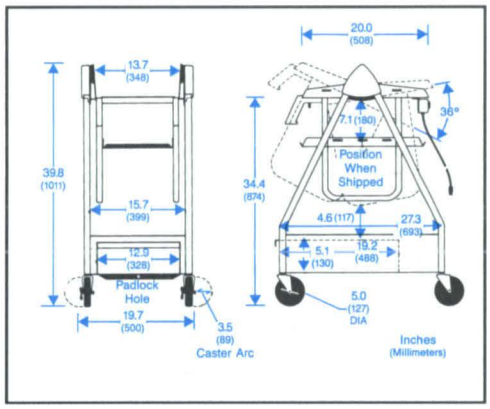
This ruggedized version of the K217 is designed with the Tek 11000 series in mind. The tiltable middle tray is also rack width to accommodate additional instruments. This cart easily is the industry standard for quality, workmanship and versatility.



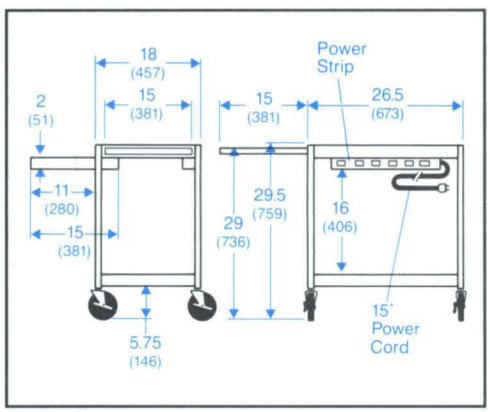
This handsome rackmount workstation provides up to 26" of rack space, 24 1/2" with keyboard platform.*1 The optional side shelf attaches to the extrusion, is easily removable, and can be mounted on either side (side shelf rated at 40 lbs. and measures 16" x 22 1/2"). This cart "breathes" from the sides and back eliminating any "vacuum-cleaner-effect."

*1 *Includes drawer slides and hardware.*

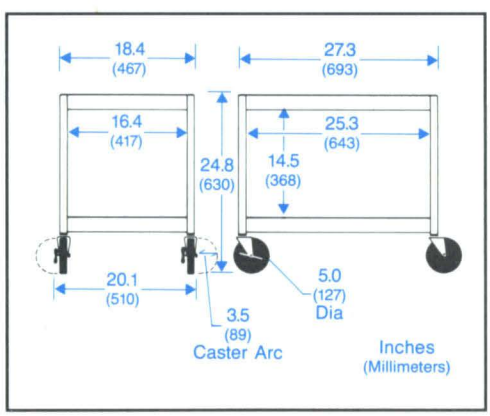
To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.



Standard features also include four-outlet power strip, lock-down bar, middle shelf, securing strap, and accessories drawer, and probe holders. K213 data sheet 56W-7131-1 is available.



This table height platform includes keyboard drawer and pull-out shelf. The K318 is a handsome, sturdy addition to your work environment.



The quality and workmanship is evident in this general purpose utility cart. If you need a cart that lasts, this is the one for you.

K213

K318

Model 206

K213

- *Designed for Laboratory Instruments*
- *Tiltable Top and Middle Trays*
- *Locking Wheels*
- *Lockable Drawer in Base*

K318

- *Ergonomically Sound for Industrial-use, Computers, Peripherals, and Test and Measurement Equipment*
- *Plastic Laminate on Both Surfaces*
- *Four-outlet Power Strip*
- *Locking Wheels*
- *200 lb. Load Capacity*
- *Keyboard/Accessories Drawer*
- *Strong/Stable Slide-out Shelf*
- *K318 Data Sheet 56W-7338 is Available*

206

- *Low Profile Cart (25" Height)*
- *Plastic Laminate on Both Surfaces*
- *Locking Wheels*
- *Stable/Sturdy Platform*
- *Optional Table Height Available (30" Height)*

ORDERING INFORMATION

K213 Lab Instrument Cart Securing strap included	☎ **$660**
Opt. 05 – Delete powerstrip	
Opt. 10 – 7854 Keyboard Drawer	**+$195**
Opt. 12 – 5000/7000 Series Plug-in Storage Cabinet	**+$140**
Opt. 22 – Combines options 10/12	**+$295**
11/2 inch x 42 inch Strap. Order 346-0136-01	**$39**
11/2 inch x 57 inch Strap. Order 346-0156-01	**$32**
Extra Shelf.*1 Order 436-0132-01	**$70**
Keyboard Drawer.*1 Order 436-0197-00	**$225**
Plug-in Storage.*2 Order 436-0196-00	**$165**
Retaining Bar. Order 650-1881-00	**$12**
K318 P.C. Cart	☎ **$380**
Opt. 05 – Delete power cord	**–$25**
206 Utility Cart	**$270**
Opt. 05 – 30" height	

Probe holders included in the K213, K318, and 206.

*1 *Mounts below top tray.*
*2 *Mounts on or under hanging shelves.*

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.

INSTRUMENT CARTS/WORKSTATIONS

K332WH

- *A Low Cost, No frills Workstation*
- *Mobile/Compact Platform*
- *Large/Sturdy Work Shelf*
- *29 Inch High with Three Black Steel Legs*
- *Attractive Vinyl T-Molding Edges*
- *Optional Swing-out Shelf (18 Inch x 14 Inch) with 4 Inch Deep Paper Holder Able to Attach at Any Height*
- *Black, Hard Plastic Castors*
- *5-Year Warranty*

K335BN/K336BN

- *A 35 Inch High, 25 Inch Wide Workstation*
- *The K336BN is 11 Inches Wider than the K335BN (at 35 Inches High by 36 Inches Wide)*
- *Incredibly Strong and Attractive*
- *Adjustable Height and Configuration*
- *Four 2-3/8 Inch Castors (2 Locking)*
- *Cable Management Clips; Tools for Assembly Are Included*
- *Optional Slide-out Shelf, Wire Base, and 5 Inch Extension Tubes, Add Versatility and Functionality.*
- *5-Year Warranty*

ORDERING INFORMATION

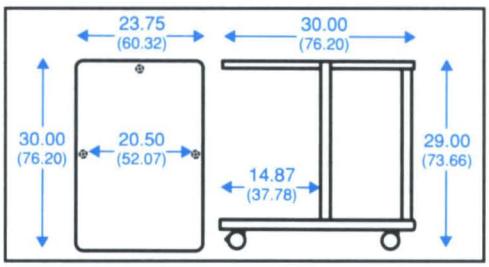
K332WH P.C./Instrument Cart	**$160**
Opt. 10 – Swing Out Shelf	**+$70**
K335BN Compact P.C./ Instrument Cart	**$299**
Opt. 10 – Slide Out Shelf	**+$90**
Opt. 11 – Wire Base	**+$45**
Opt. 14 – (3) 5" Extension Tubes	**+$40**
K336BN Midsize P.C./ Instrument Cart	**$349**
Opt. 12 – Keyboard Holder	**+$130**
Opt. 14 – (3) 5" Extension Tubes	**+$40**
To order these options separately order:	
Swing out shelf*1 118-8494-00	**$90**
Wire base*2 118-8493-00	**$60**
5" Extention tubes*3 118-8492-00	**$50**
Keyboard holder*3 118-8496-00	**$130**
Slide out shelf*4 118-8495-00	**$115**

*1 *K332WH only*
*2 *K335BN only*
*3 *K335BN or K336BN only*
*4 *K335BN and K336BN only (Do not use with keyboard holder.)*

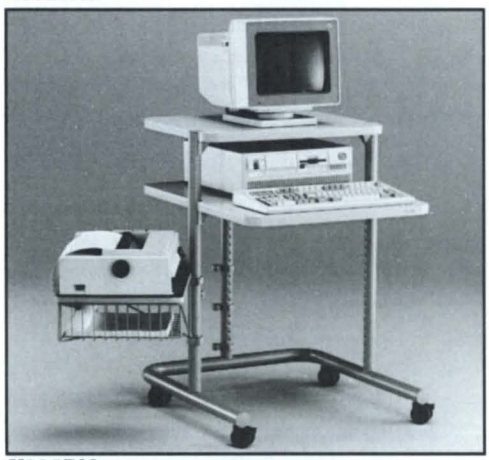
Tools included for assembly.

If your workstation needs go beyond Scopemobiles® Tektronix now offers a line of Anthro® Technology Furniture® to help solve all your application needs. You can now call on Tektronix for not only your instrumentation solutions, but your work platform solutions as well. Anthro® originated as part of Tektronix, and we're proud to offer a limited line of these products.

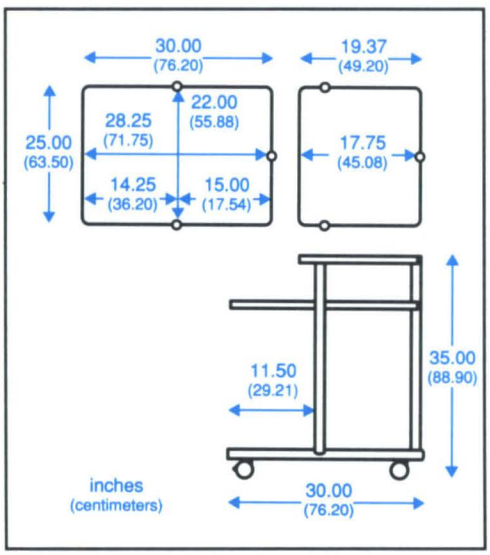
K332WH



Legs and base are 16 gauge, seam-welded, cold rolled steel with baked on powder coated black finish. The sturdy white shelf is made of 1" laminated with an attractive molding edge.

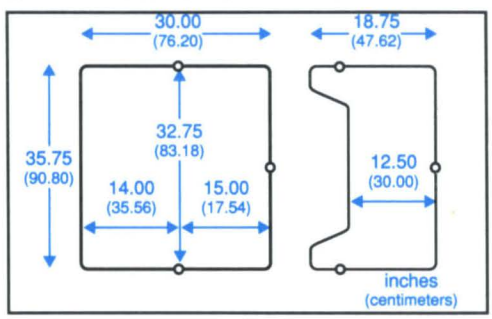


K335BN



K335BN is bone in color with putty grey legs and base. A 1" laminated top and molding edge make the K332BN an attractive addition to any work area. Add options to best solve your platform needs.

K336BN

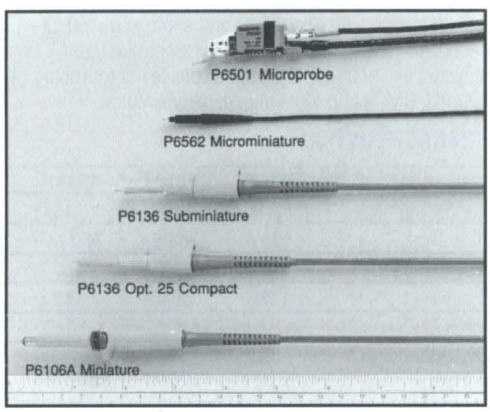


The K336BN is bone in color with putty grey legs and base. A 1" laminated top and molding edge compliment the high level of quality and value.

THE VITAL LINK TO YOUR SCOPE

No factor is more critical to optimized test and measurement results than the use of the proper probe for your scope. Using an off-the-shelf, general purpose commodity probe that is not designed specifically for your scope can result in significant loss in measurement integrity, and cause costly delays and errors. Tektronix probes, on the other hand, are designed, assembled and tested to provide the best high-performance link possible between your instruments and the device under test.

For over 40 years Tektronix has designed probes that are matched not only to our scopes, but to your instrument's requirements and your applications. Tektronix is continually expanding its line of signal acquisition probes for higher bandwidth, lower circuit loading, reduced aberrations, increased ruggedness and the ability to fit smaller geometries.



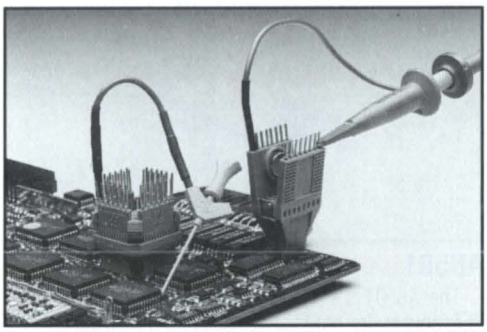
Sizes Ranging from Miniature to Microprobe

Manufactured under the most stringent contamination controls, Tek probes are constructed of materials that resist degradation from moisture and other environmental conditions. Plus, they incorporate features such as resistive center conductor cables which reduce aberrations, increase bandwidth and minimize circuit loading.

Tek offers you the world's largest and most respected line of signal acquisition probes. Our line includes passive and active voltage probes, current probes, high voltage probes, low impedance/high frequency probes, differential probes, logic trigger probes, opto-electrical converters, specialty probes and fixtured probes.

As your circuits continue to decrease in size, you can make solid mechanical connections using fixed probes or SMT Device interconnects. Tek fixtured probes are designed specifically for ATE, manufacturing or other repetitive testing of circuit boards, hybrids, SMDs or other dense circuitry.

Miniature, compact, subminiature and microminiature sizes feature low-mass tips and extremely flexible cable for easy access to dense circuitry. The handy SMD interconnects permit easy, hands-free probing.



SMD Interconnects (SMG50, PLCC and SOIC)

Tek modular probes save you time and money in repair and maintenance. The modules (probe head, cable and connector/compensation box) are easily replaced. You can stock spare modules to avoid sending your probes out for repair, thus minimizing downtime. Modularity, rugged construction and highly reliable hybrid circuitry make Tektronix probes, such as the NEW P6119 1X/10X probe, the best value on the market.

You can depend on Tek for designed-in equipment compatibility and consistently high quality. Any item you order, from our top-of-the-line active (FET) probe to the simplest connector, is backed by an unparalleled warranty and worldwide service network. We have an uncompromising insistence on customer satisfaction.

THE ABC'S OF PROBES (PRIMER)

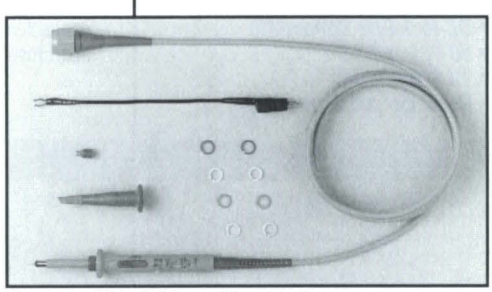
You can learn about signal acquisition in our comprehensive primer on signal acquisition probes with sections on understanding probe specifications and applications, selecting probes, and advanced probing techniques. Easy to use charts and tables speed the probe selection process for your specific application.

For your free copy, ask your Tektronix sales engineer for Literature 60W-6053 or call toll-free in the U.S.A. 1-800-426-2200.

PROBE AND SIGNAL CONCEPTS (VIDEO TAPE)

A 53 minute video tape and 40-page booklet describe practical uses of passive, active and current probes. Emphasis is on selecting the correct probe for your application.

To order, ask your Tektronix sales engineer for part number 068-0229-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). Additional booklets are available by ordering Literature number 60W-6770.



P6119 1X/10X Low Cost Probe

Tek Probes Provide the Most Cost Effective, Reliable, and Accurate Solution to Your Acquisition Needs.

Contents

Fixtured Probes 404
Spring Contact Probes 405
Probe Selection Chart 406
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SMT Device Interconnects 429
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NEW

BUFFER AMPLIFIER AND MICROPROBES FIXTURED PROBES

NEW A6501

1 GHz, 1 MΩ, 10X Buffer Amplifier

TYPICAL APPLICATIONS

- *Use in Test Fixtures*
- *Mount on Probe Cards*
- *Place onto Circuit Boards*

FEATURES

- *DC to 1 GHz Bandwidth*
- *High Impedance (1 MΩ, < 2.5 pF)*
- *Drives 50 Ω Coaxial Cable*
- *10X Attenuation*

P6501

750 MHz, 1 MΩ, 10X Microprobe

TYPICAL APPLICATIONS

- *For Hybrid and SMD Probing*
- *Mount on Probe Cards*
- *Use in Probing Stations*

FEATURES

- *DC to 750 MHz Bandwidth*
- *High Impedance (1 MΩ, < 1.8 pF)*
- *Drives 50 Ω Coaxial Cable*
- *10X Attenuation*
- *Replaceable Probe Tips*

P6507

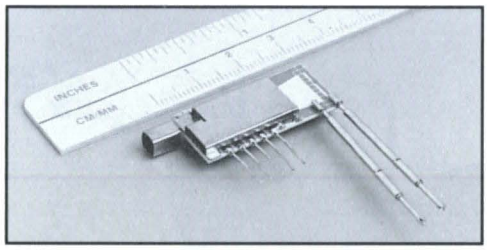
1 GHz, 50Ω, 1X Microprobe

TYPICAL APPLICATIONS

- *For Hybrid and SMD Probing*
- *Mount on Probe Cards*
- *Use in Probing Stations*

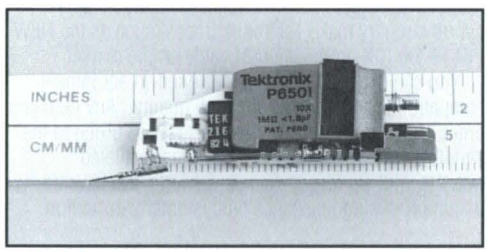
FEATURES

- *DC to 1 GHz Bandwidth*
- *50 Ω Input*
- *1X Attenuation*
- *Replaceable Probe Tips*



A6501

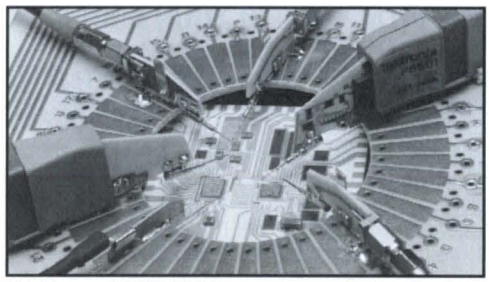
The A6501 is a high performance 10X, dc-to-1.0 GHz FET input buffer amplifier designed for placement onto a circuit board, probe card or bed-of-nails test fixture. The A6501's versatile connection design provides connection to the circuit board or fixture by either twisted wires, spring loaded contacts, or 0.100" (2.54 mm) pitch leads. The A6501 features low input capacitance, high input impedance, and drives a 50 Ω load.



P6501

The P6501 Microprobe is a 1M Ω input active probe optimized for probe card mounting and probing stations. Its very low profile about (0.5 in. high) avoids interference with the objective lens of microscopes and lasers. The narrow body (about 0.100 in. wide) makes it well suited for high-density probing applications.

The power and signal cables can be conveniently removed for set up and storage of probe cards between uses. The 50 Ω coaxial signal uses a miniature 50 Ω connecter at the probe end and a BNC connecter on the instrument end. Note the probe's power requirements.



P6501 and P6507 Mounted on a Probe Card.

P6507

The P6507 Microprobe is a 50 Ω input probe and companion to the P6501. The probe can be used as either a 50 Ω input or output probe in card-mounted applications. It consists of a 30 mil thick Alumina hybrid substrate with a 50 Ω stripline and a miniature 50 Ω connector. The P6507 maintains a low profile thus allowing use of multiple probes in dense microprobing of hybrids, SMDs and other high density circuits.

CHARACTERISTICS

	P6501	P6507	A6501
Bandwidth	750 MHz	1 GHz	1 GHz
Rise Time	450 ps	350 ps	350 ps
Attenuation	10X	1X	10X
Input R	1 MΩ	50 Ω	1 MΩ
Input C	≤ 1.8 pF	N/A	≤ 2.5 pF
Dynamic Range	± 10 V	N/A	± 10 V
Maximum Nondestructive Input Voltage	± 26.5 V	± 42.5 V	± 26.5 V
Power Supply Requirements	± 15 V at 20 mA, ± 5 V at 17 mA	N/A	± 15 V at 20 mA ± 5 V at 17 mA

ORDERING INFORMATION

A6501 1GHz, 1M Ω, 10X Buffer Amplifier — **$399**
Includes: 3-3/4" and 10-1/4" Peltola (50 Ω) signal cables, Peltola-cable-to-circuit-board adapter, three 0.1" spring contacts, 0.1" pitch lead frame; Instruction sheet/Application notes (070-7308-00).

P6501 750 MHz, 1M Ω, 10X Microprobe — **$499**
Includes: Two tungsten probe tips (206-0371-01); Ground lead (196-3141-00); Instruction sheet (070-6300-00).
Opt. 01– Add 115 V ac, 60Hz power supply and 1.5 m 50 Ω cable. **+$159**
Opt. 02 – Add Tekprobe™ cable Order 015-0540-00 **+$159**

P6507 1GHz, 50 Ω, 1X Microprobe — **$59**
Includes: One tungsten probe tip (206-0371-01); instruction sheet (070-6301-00).
Opt. 01 – Add 0.5 m 50 Ω cable. **+$39**

OPTIONAL ACCESSORIES

A6501

2x3 Power Connector – For Male, Order 131-3941-00 For Female order 131-3821-01 — *1
Peltola-to-BNC adapter – Order 131-1315-01 — **$5**
100 MIL Centers Spring Contacts – Pkg of 10. Order 016-0946-00 — **$50**
Power Supply – Order 119-2461-00 — **$135**
Power Cable – To connect probe to 1102 power supply (see page 428). Order 174-0943-00 — **$100**

P6501

Manual – Order 070-6188-00 — **$10**
Power Supply – Order 119-2461-00 — **$135**
50 Ω Cable – Miniature to BNC, 1.5 m. Order 174-0538-00 — **$33**
Power Cable – To connect probe to 1102 power supply (See Page 428). Order 174-0943-00 — **$100**
Ground Lead Assembly – Order 196-3141-00 — **$7**

P6507

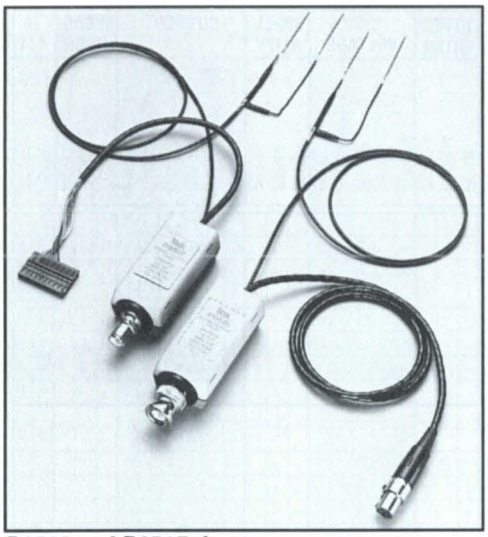
50 Ω Cable – Miniature to BNC 0.5 m. Order 174-0668-00 — **$33**
Ground Lead Assembly – Order 196-3141-00 — **$7**

REPLACEABLE TIPS

The P6501/6507 tips can be easily replaced as they wear or for different applications.
Standard Length – 0.20" (5.08 mm)
Tungsten Probe Tip – Pkg of 5. Order 206-0371-02 — **$28**
Palladium Probe Tip – Pkg of 5. Order 206-0370-02 — **$28**
Long Length – 0.46" (11.6 mm)
Tungsten Probe Tip – Pkg of 5. Order 206-0371-03 — **$28**
Palladium Probe Tip – Pkg of 5. Order 206-0370-03 — **$28**

*1 *Contact your local sales representative.*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.

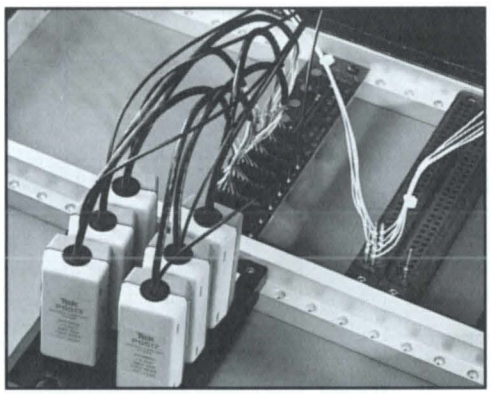


P6515 and P6517 shown.

P6511/P6513/P6515/P6517

The P6511, P6513 are 10X, DC-to-300 MHz (DC-to-250 MHz for P6515, P6517) probes designed for placement into a bed-of-nails fixture or other fixtured applications. The probe is designed for low circuit loading and high-bandwidth signal acquisition. This enables acquisition of ac parametric waveform information from high-impedance test points.

Electrically, the probe consists of a high impedance spring-loaded contact and active circuitry to drive a 50 Ω transmission line. The probe's spring contact receptacle



P6513 and P6517 in test fixture.

allows the user to interchange spring contacts to accommodate a variety of different tip configurations.

P6511/P6515 has a standard twist-on BNC; the P6513/P6517 has a push-on BNC for ease of connection when used with the Tektronix TSI (Test System Interface), (see pages 309–318). Power connection is made with a Berg connector for the P6513/P6517. The P6511/P6515 uses a DIN connector for power. The 1102 power supply powers up to four P6511s or P6515s.

Programmable P6513/P6517 scanning is provided by the TSI family of products (see pages 309-318). Complete support packages including probe power, are available for 12 probes. These packages facilitate use of the probes in automated testing applications such as functional board test. The probe receptacle's diameter permits mounting on 100 MIL (50 MIL for P6515/P6517) centers, used in most circuit board testing.

CHARACTERISTICS

Electrical	P6511/P6513	Common To All	P6515/6517
Bandwidth	300 MHz*3		250 MHz*3
Rise Time	< 1.17 ns		< 1.4 ns
Attenuation		10X	
Input R		1 MΩ	
Input C	≤ 3.8 pF		≤ 4.0 pF
Dynamic Range		±15 V	
Max. Nondestructive Input Voltage		±30 V at dc	
Power Supply Requirements		±15 V at 30 mA/ ±5 V at 45 mA	
Low-Frequency Compensation		Fixed, flat ±3%	
Propagation Delay		3.8 ns ±100 ps	
Probe Aberrations		< ±6%, 8% p-p in the first 4 ns; < ±2%, 3% p-p after 4 ns	
Output Zero		< ±2 mV	
DC Thermal Drift		< 50 µV/°C	
Physical			
Net Weight		2.0 oz (56 g)	
Recommended Minimum Center Spacing	0.100" (2.54 mm)		0.05" (1.27 mm)
Recommended Travel (2/3 Full)	0.167" (4.24 mm)		0.127" (3.23 mm)
Spring Force Pre-loaded 2/3 travel	2.0 oz (57 g) ±20% 5.5 oz (155 g) ±20%		1.26 oz (36 g) ±20% 3.5 oz (99 g) ±20%
Mounting Hole Diameter	.067" to .069" (1.70 to 1.75 mm)		.037 to .038" (.940 to .965 mm)
Recepticle (outside diameter)	.066" (1.68 mm)		.036" (.914 mm)

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.

P6511/P6513/ P6515/P6517

TYPICAL APPLICATIONS

- *In Bed-of-Nails Fixtures*
- *Other Fixtured Applications Which Require High B/W, Low Loading*

FEATURES

- *DC to 300 MHz Bandwidth (250 MHz for P6515/P6517)*
- *High Impedance (1 MΩ, < 3.8 pF for P6511/P6513) (< 4.0 pF for P6515/P6517)*
- *Drives 50 Ω Coax Cable*
- *Standard 100-MIL or 2.54 mm Spacing (P6511/P6513)*
- *Standard 50-MIL or 1.27 mm Spacing (P6515/P6517)*
- *Automated Scanning Available*

ORDERING INFORMATION

P6511, P6513 Spring Contact Probes. **$259**
Each includes: 2 signal receptacles, 4 GND receptacles; 5 100-MIL crown spring contact tips;*1 4 GND leads; instruction sheet.

P6515, P6517 Spring Contact Probes. **$259**
Each includes: 5 receptacles; 5 50-MIL crown spring contact tips;*2 2 sig. leads; 4 GND leads; instruction sheet.

RECOMMENDED ACCESSORIES

Manuals –
(P6511) Order 070-6776-00. **$10**
(P6513) Order 070-6845-00. **$10**
(P6515) Order 070-7263-00. **$10**
(P6517) Order 070-7265-00. **$10**

OPTIONAL ACCESSORIES

Power Connector –To power P6511 or P6515 probes from other supplies. Order 131-4408-00 **$12.75**

System Interface Kits
To interface P6513 or P6517 probes to test systems such as the TSI family (see page 317).

ITA Probe Scanner Kit –
Support for one fixture.
Order 021-0443-00 **$125**

ITA/Rcvr/Power Probe Scanner Kit –
Support for one TSI System.
Order 021-0444-00 **$350**

**1 Available in packages of 10 receptacles and tips or order directly from Q.A. Technology.*

**2 Available in packages of 10 receptacles and tips or order directly from Everett/Charles.*

**3 For 1 GHz bandwidth see the A6501 on the previous page.*

INSTRUMENT/PROBE REFERENCE

	PASSIVE VOLTAGE																											ACTIVE						DIFFERENTIAL			HIGH VOLTAGE				SPECIALITY			CURRENT						MICRO/POGO			Zo *11	
	P6053B	P6062B	P6063B	P6101A	P6102A	P6103	P6105A	P6106A	P6107A	P6108A	P6109	P6119	P6121	P6122	P6127	P6130	P6131	P6133*1	P6134C	P6136*1	P6137	P6149A	P6562	P6201*2	P6202A*2	P6203*3	P6204*3	P6230*2	P6231*3	P6046	P6055A	P6135A	A6902B	P6007	P6009	P6009 OPT. 14	P6015	P6008*4	P6048	P6125	AM503S	AM503S OPT. 03	CT1	CT2	P6021*5	P6022*5	P6501	P6507	P651X*6	P6150*7	P6156*7
11000/DSA600/CSA800 SERIES																																																			
11201/11201A	-		-	R											R	-			S				R			+	R		R	-			-		R			-	-		-	-	+	-	-	-	R	+	-	+	R
11A32	-		-	R											R	-			S				R			+	R		R	-			-		R			-	-		-	-	+	-	-	-	R	+	-	+	R
11A33	+		+	R											+	+			+				R			+	R		R	-		S	-		R			-	+		-	-	+	+	-	+	+	+	+	+	R
11A34	-		-	R											R	-			S				R			+	R		R	-			-		R			-	-		-	-	+	-	-	-	R	+	-	+	R
11A52																										+	R		S	-			-								-	-	+	-	-	-	R	+	-	+	R
11A72/11A71																										S	S		S	-			-								-	-	+	-	-	-	R	+	-	+	R
SD20/22/24/26																								R	-	-	R	-	-													-					-	-	-	R	R
7000 SERIES																																																			
7250																								R	-	-	-	R	-	-			-								-	-	-	-			-	-	-	R	R
7A13	+	-	R	R			R	+	-		+		-			+								+	R			+		-	R		-	-	R		-	-		-	-		+	-	+					
7A15A	+	+	R	R			R	+	+		+		+			+								+	R			+		+			-	-	R		-	+	+	-	-		+	-	+					
7A16A	-	-	-	R			-	R	-		-		-			R								+	R			+		+			-	-	R		-	-	-	-	-		+	-	-					
7A18A	+	+	+	R			+	+	+		+		+			+								+	R			+		+			-	-	R		+	+	+	-	-		+	-	+					
7A19																								R	-		+	R		-			-								-	-	+	-			+	-	-	+	R
7A22		R		R	R				+															+	+			+		+	R		+	+	R		+	+					+	+		+	+	+			
7A24																								R	+		+	R		-			-								-	-	+	-			+	-	-	+	R
7A26	R	-	R	R			-	+	-		-		-			+								+	R			+		-			-	-	R		-	-		-	-		+	-	-					
7A29/7A29P																								R	-		+	R		-			-								-	-	+	-			-	-	-	+	R
7A42	-	-	-	R			-	-	-		-				R	-	R		+				+	+	R		+	R		-			-	-	R		-	-		-	-	+	-	-	-	+	+	-	+	R
7D12				R		R				+		R		+		-			+					+	+			+		+			-	-	-	R	+	+	+				+	+		+	+	+			
7D13A																																																			
7D15			-					+		-		-		-		+																		-	-		R	-													
7D20	R	R	+	R			+	+	+		+		+			+								+	+			+		+			-	-	R		+	+		-	-		+	-	+					
7L5		R		R			R	+	+		+					+								+	R			+															+	+	+	+	R
S1/S2																								R	-			R														R						R	R
S4/S6																								R	-			R														R						R	-
5000 SERIES																																																			
5A13N		R		R	R				+															+	+			+		+	R		+	R	+		+	+					+	+		+	+	+			
5A14N/5A15N/5A18N		R		R	R				+															+	+			+		+			+	R	+		+	+					+	+		+	+	+			
5A21N		R		R	R				+															+	+			+		+	R		+	R	+		+	+					+	+		+	S	+			
5A22N		R		R	R				+															+	+			+		+	R		+	R	+		+	+					+	+		+	+	+			
5A26		R		R	R				+															+	+			+		+	R		+	R	+		+	+					+	+		+	+	+			
5A38	+	R	+	R			R	+	+		+		+			+								+	+			+		+			-	-	R		+	+	+				+	-		+	+	+			
5A45	+	R	+	R			R	+	+		+		+			+								+	+			+		+			-	-	R		+	+	+				+	-		+	+	+			
5A48	+	R	+	R			R	+	+		+		+			+								+	+			+		+			-	-	R		+	+					+	-		+	+	+			
5D10		R		R	R				+															+	+			+		+			+	R	+		+	+					+	+		+	+	+			
2500/2800/MISC SERIES																																																			
25AA1/25AA2		-		R		-				R		R		R		+		+				-		+	+			+		+			-			R	-	+	+		-	-		+	-	+				+	+
2815		-		R		S				+		R		+		+		+				+		+	+			+		+			-			R	+	+			-	-		+	+	+					
RTD710A/720	+	R	+	R			R	+	+		+		R		+	+								+	R			+		+			-	-	R		-	+			-	-		+	-	+					

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	P6053B	P6062B	P6063B	P6101A	P6102A	P6103	P6105A	P6106A	P6107A	P6108A	P6109	P6119	P6121	P6122	P6127	P6130	P6131	P6133*1	P6134C	P6136*1	P6137	P6149A	P6562	P6201*2	P6202A*2	P6203*3	P6204*3	P6230*2	P6231*3	P6046	P6055A	P6135A	A6902B	P6007	P6009	P6009 OPT. 14	P6015	P6008*4	P6048	P6125	AM503S	AM503S OPT. 03	CT1	CT2	P6021*5	P6022*5	P6501	P6507	P651X*6	P6150*7	P6156*7	
2400 SERIES																																															
2430	+	-	+	R			-	+			-				R		S	S		+	+		+	+	R			+	-			-		R			-	-		-	-	+	-	-	+		+	
2430A/2430M	+	-	+	R			-	+			-				R		+	S		+	+		+	+	R			+	-			-		R			-	-		-	-	+	-	-	+		+	
2431L	-	-	-	R			-	-			-				R		+	-		S	R		+	R	+			R	-			-		R			-	-		-	-	+	-	-	R		R	
2432/2432A/2432M	-	-	-	R			-	-			-				R		+	-		R	S		+	R	+			R	-			-		R			-	-		-	-	+	-	-	R		R	
2440/2440M	-	-	-	R			-	-			-				R		+	-		R	S		+	R	+			R	-			-		R			-	-		-	-	+	-	-	R		R	
2445	-	-	+	R			-	+			-				R		S	+		+	+		+	+	R			+	-			-		R			-	-		-	-	+	-	-	+		+	
2445A/2445B	-	-	+	R			-	+			-				R		+	S		+	+		+	+	R			+	-			-		R			-	-		-	-	+	-	-	+		+	
2455A	-	-	-	R			-	-			-				R		+	-		S	+		+	+	R			+	-			-		R			-	-		-	-	+	-	-	R		R	
2455B	-	-	-	R			-	-			-				R		+	-		S	+		+	+	R			+	-			-		R			-	-		-	-	+	-	-	R		R	
2465	-	-	-	R			-	-			-				R		S	-		R	+		+	R	+			R	-			-		R			-	-		-	-	R	+	-	R		R	
2465A	-	-	-	R			-	-			-				R		-	-		S	R		+	R	+			R	-			-		R			-	-		-	-	R	+	-	R		R	
2465B	-	-	-	R			-	-			-				R		-	-		R	S		+	R	+			R	-			-		R			-	-		-	-	R	+	-	R		R	
2467	-	-	-	R			-	-			-				R		-	-		S	R		+	R	+			R	-			-		R			-	-		-	-	R	+	-	R		R	
2467B	-	-	-	R			-	-			-				R		-	-		R	S		+	R	+			R	-			-		R			-	-		-	-	R	+	-	R		R	
2300 SERIES																																															
2335/2336/2337	-	+	-	R			R	+	R	S	+		R	R		R								+	+			+	+				-	-		R		-	-		+	-	R						
2336YA	-	+	-	S			R	+	R	S	+		R	R		R								+	+			+	+				-	-		R		R	R		+	-	R						
2200 SERIES																																															
2201				R		S				+	+	R	+	R		+						+		+	+			+	+				+	R			+	R		+	-	+	+	+					
2205		-		R		S				+	+	S	+	R		+						+		+	+			+	+				+	R			+	R		+	-	+	+	+					
2210		-		-		S				+	+	R	+	S		+						+		+	+			+	+				-	-		R	+	+		+	-	+	+	+					
2211	+	S		-			+	+	+		S		+			+						+		+	+			+	+				-		R		+	+		+	-	+	+	+					
2213/2215				-		R				+	+	R	+	S		+						+		+	+			+	+				-	-		R	+	+	+	+	-	+	+	+					
2213A/2215A				-		-				+	S	R	+	S		+						+		+	+			+	+				-	-		R	+	+	+	-	-	+	+	+					
2220				-		-				+	S	R	+	S		+		S				+		+	+			+	+				-	-		R	+	+	+	-	-	+	+	+					
2221	+	S	+	-		-	R	+	+		S		S			+		S				+		+	R			+	+				-		R		-	+	+	-	-	+	-	+				+	
2224	+	S		-		-	+	+	+		S		+			+						+		+	+			+	+				-		R		+	+		+	-	+	+	+					
2225				-		S				+	+	S	+	S		+						+		+	+			+	+				-	-		R	+	+		+	-	+	+	+					
2230/2232	+	S	+	-			R	+	+		S		R			+		S				+		+	R			+	+				-		R		-	+	+	-	-	+	-	+				+	
2235/2235A				-						R	S	S	+	R		+						-		+	R			+	+				-	-		R	-	+	+	-	-	+	-	+				+	
2235L				S						R	R	R	+	S		+						-		+	R			+	+				-	-		R	-	+	+	-	-	+	-	+				+	
2236/2236A	+	R	+	-			R	+	+		S		S			+								+	R			+	+				-		R		-	+	+	-	-	+	-	+				+	
2245A/2246A/2247A	+	S	+	-			R	+	+		S		R			+		S						+	R			+	+				-		R		-	+	+	-	-	+	-	+				+	

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INSTRUMENT/PROBE REFERENCE

	PASSIVE VOLTAGE																													ACTIVE					DIFFERENTIAL			HIGH VOLTAGE				SPECIALITY				CURRENT						MICRO/POGO			Zo *11	
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400 SERIES																																																				
434	+	R	+	R			S	+	+		+		+			+								+	+			+		+			-	-	R	+	+	+				-		+	+	+			
455	+	R	+	R			S	+	+		+		+			+								+	+			+		+			-	-	R	+	+	+				-	-	+	+	+			
464/DM44	+	S	+	R			R	+	+		+		+			+								+	R			+		+			-	-	R	-	+	+				-	-	+	-	+			
464M*8	+	R	+	R			R	+	+		+		+			+								+	R			+		+			-	-	R	-	+	+				-	-	+	-	+			
465B/DM44	+	R	+	R			S	+	+		+		+			+								+	R			+		+			-	-	R	-	+	+				-	-	+	-	+			
466/DM44	+	S	+	R			R	+	+		+		+			+								+	R			+		+			-	-	R	-	+	+				-	-	+	-	+			
468	+	R	+	R			S	+	+		+		+			+								+	R			+		+			-	-	R	-	+	+				-	-	+	-	+			
475/A/DM44	+	-	-	R			-	S	-		-		-			R								+	R			+		-			-	-	R	-	-	-				-	-	-	-	-			
485	+	-	-	R			-	R	-		-		-			R								+	R			+		-			-	-	R	-	-	-				-	-	+	-	-	+	+	+		R
300 SERIES																																																			
305/314		R		R	+				+													S		+	+			+		+			+	R			+	+				+	+		+	+	+			
335		R		R	+				+													S		+	+			+		+			-	-		R	+	+				+	-		+	+	+			
336/336A *9		R		R			+	+	+		+					+								+	+			+		+			-	-	R		+	+				+	-		+	+	+			
390AD	+	R	+	R			+	+	+		R		+			+								+	+			+		+			+	-	R		+	+				+	-		+	+	+			
T900 SERIES																																																			
T912/T921		+		R		R				+		R		+		+						+		+	+			+		+			+	R			+	+				+	+		+	+	+			
T922/T922R		+		R		R				+		R		+		+						+		+	+			+		+			+	R			+	+				+	+		+	+	+			
T932A/935A		+		R		R				S		R		+		+						+		+	+			+		+			-	-		R	+	+				+	-		+	+	+			
TM5000/TM500 SERIES																																																			
AM502		+		R	R				+															+	+			+		+	R		+	R			+	+				+	+		+	+	+			
DC503A				R				R	-	-				-		+								+	R			+									-		R											R
DC50004/DC504A		+		R				+	-	+				R		+								+	R			+									-		R											R
DC5009/DC509		-		R				R	-	-				-		+								+	R			+									-		R											R
DC5010/DC510		-		R				R	-	-				-		-								+	R			+									-		R											R
SC501		R		R	R				+															+	+			+		+			+	R		+	+	+				+	+		+	+	+			
SC502		R		R	R				+															+	+			+		+			+	R		+	+	+				+	+		+	+	+			
SC503		R		R	R				+															+	+			+		+			+	R	R	+	+	+				+	+		+	+	+			
SC504	+	R	+	R			R	+	+		+		+			+								+	+			+		+			-	+	+	+	-	+				-	-		+	-	+			
SI5010/1360S																								R	R			R		-			-											-	-	+	-	-	-	+	+	-		R
SPECTRUM ANALYZERS																																																			
2710																								R	-		-	-														-	-		-	-	-		R	R
2753P																								R	-		-	-														-	-		-	-	-		R	R
2754/P																								R	-		-	-														-	-		-	-	-		-	-
2755/P/A/AP																								R	-		-	-														-	-		-	-	-		-	-
2756P/2782																								R	-		-	-														-	-		-	-	-		-	-
3052	+																		R		+		+	+	R		+	+														+	+		+	+	+		R	R
492/A/AP/B/BP/PGM																								R	-		-	-														-	-		-	-	-		-	-
494/P/494A/P																								R	-		-	-														-	-		-	-	-		-	-
495/P/496/P/497P																								R	-		-	-														-	-		-	-	-		R	R

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A FEW TIPS FOR SELECTING PROBES

The following chart provides a brief overview of the Passive and Active Voltage probes available form Tektronix. In most cases the chart reflects the standard probe only, but optional lengths are available for most units. For further information on each probe listed see the page indicated in the last column of the chart.

Voltage probes provide a convenient path from the circuit under test to your measurement instrumentation. When you are choosing a voltage probe many items should be considered. You would like the probe to be transparent to the DUT (Device Under Test), so the circuit continues to function as if no external influence had been added. If the probe presents an impedance which is much less than an order of magnitude larger than the circuit impedance, the the probe starts to interact with the circuit and is no longer transparent to the circuit under test. Therefore circuit performance may change and your measurements may no longer reflect actual circuit performance.

Factors which should be considered when choosing a probe include: the instrumentation being used; circuit under test characteristics, such as: testpoint impedance, voltage level and size (geometries, number of connection points and type of connection point); and the type of measurement you wish to make, such as: amplitude, bandwidth, risetime, aberrations (perturbations), propagation delays or timing measurements.

For additional information on choosing a probe (voltage, current, etc.) please request free of charge our "ABC's of Probes" booklet.

Practical uses of passive, active and current probes are described in a 53 minute video tape, Probe and Signal Concepts "The Vital Link". See page 364 for ordering information for "The Vital Link" video tape.

**1 P6131, P6133, P6136, P6137 probes are designed for 2400 series and provide optimum performance to these scopes.*

**2 Bandwidth ratings vary when scope input capacitance moves away from the designed nominal value of the probe's compensation range. In most cases this is ≈20 pF for the P610XA and P612X or ≈15 pF for the P613X and P6562.*

**3 Probe pair, designed for differential inputs (P6135A for the 11A33 only)*

**4 Other probe lengths available for passive probes, see identified page for further information.*

Passive Probe Selection Chart

Type	Atten-uation	Nominal*4 Length	Loading		BW MHz at -3 dB*2	DC + pk AC Maximum	Scope In pF	Readout/ Identify	Page
P6007	100X	6 ft	10MΩ	2.2pF	20	1.5kV	15 to 55	No/No	420
P6008 (Environmentalized)	10X	6 ft	10MΩ	2.5pF	100	600V	12 to 47	No/No	422
P6009	100X	9 ft.	10MΩ	2.5pF	120	1.5kV	12 to 47	Yes/No	420
P6015	1000X	10 ft	100MΩ	3.0pF	75	20 kV	12 to 47	No/No	420
P6048	10X	6 ft	1kΩ	1.0pF	100	20 V	15 to 20	No/No	422
P6053B	10X	6 ft	10MΩ	12.5pF	200	500 V	15 to 24	Yes/Yes	422
P6055A*3	10X	1.5 m	1MΩ	9.9pF	150	500 V	17 to 23	Yes/Yes	418
Opt 33*3	10X	1.5 m	1MΩ	10.5pF	150	500 V	13 to 17	Yes/Yes	418
P6062B	10X	6 ft	10MΩ	14.0pF	100	500 V	15 to 47	Yes/No	411
	1X		1MΩ	105.0pF	6				
P6063B	10X	6 ft	10MΩ	14.0pF	200	500 V	15 to 24	Yes/No	411
	1X		1MΩ	105.0pF	6				
P6101A	1X	2 m	1MΩ	54.0pF	15	500 V	Any	N/A (1X)/No	410
P6102A	10X	2 m	10MΩ	13.2pF	60	500 V	36 to 55	Yes/No	410
P6103	10X	2 m	10MΩ	13.2pF	50	500 V	15 to 35	No/No	412
P6105A	10X	2 m	10MΩ	11.2pF	100	500 V	15 to 35	Yes/No	410
P6106A	10X	2 m	10MΩ	11.2pF	250	500 V	15 to 35	Yes/No	410
P6107A	10X	2 m	10MΩ	13.0pF	100	500 V	20 to 51	Yes/No	410
P6108A	10X	2 m	10MΩ	11.2pF	100	500 V	15 to 35	No/No	410
P6109	10X	2 m	10MΩ	13.2pF	150	500 V	15 to 35	Yes/No	412
P6115	1X	1.5 m	1MΩ	64pF	>5	42 V	Any	No/No	410
P6119	10X	2m	10MΩ	15.3pF	100	500 V	15 to 35	No/No	411
	1X		1MΩ	120pF	8	350 V			
P6121	10X	1.5 m	10MΩ	11.0pF	100	500 V	20 to 26	Yes/No	412
P6122	10X	1.5 m	10MΩ	11.0pF	100	500 V	15 to 35	No/No	412
P6125	5X	1.5 m	5MΩ	20.0pF	200	250 V	15 to 33	No/No	422
P6127	10X	1.5m	10MΩ	12.7pF	300	500 V	12 to 18	Yes/No	411
	1X		1MΩ	100pF	8	350 V			
P6130	10X	2 m	10MΩ	13.2pF	250	500 V	15 to 35	Yes/No	410
P6131*1	10X	1.3 m	10MΩ	10.8pF	300	500 V	15 to 35	Yes/No	413
P6133*1	10X	2 m	10MΩ	12.7pF	150	500 V	15 to 30	Yes/No	413
P6134C	10X	1.5 m	10MΩ	10.8pF	400	500 V	12 to 18	Yes/Yes	414
P6135A*3	10X	1.5 m	1MΩ	10.5pF	150	500 V	13 to 17	Yes/Yes	418
P6136*1	10X	1.3 m	10MΩ	10.8pF	350	500 V	12 to 18	Yes/No	413
P6137*1	10X	1.5 m	10MΩ	10.8pF	400	500 V	12 to 18	Yes/Yes	413
P6149A	10X	2 m	10MΩ	13.0pF	50	500 V	20 to 51	No/No	410
P6156	10X	1.5 m	500Ω	1pF	3500	15 V	N/A (50Ω)	Yes/Yes	419
Opt 25	100X	1.5 m	5kΩ	1.1pF	3000	55 V	N/A (50Ω)	Yes/Yes	419
Opt 26	20X	1.5 m	1kΩ	1pF	3500	22 V	N/A (50Ω)	Yes/Yes	419
Opt 27	1X	1.5 m	50Ω	N/A (50Ω)	1500	Scope input	N/A (50Ω)	Yes/Yes	419
P6562	10X	1.5m	10MΩ	10.3pF	350	42 V	15 to 30	Yes/No	413

Active Probe Selection Chart

Type	Atten-uation	Nominal Length	Loading		BW MHz*2 at -3 dB	DC+pk AC Maximum	Offset	Linear Range	Page
P6201	1X	6 ft	100kΩ	3.0pF	>900	±100V	±5.6V	±0.6	416
	10X	6 ft	1MΩ	1.5pF	>900	±200V	±56V	±6.0	
	100X	6 ft	1MΩ	1.5pF	>900	±200V	±200V	±60	
P6202A	10X	2 m	10MΩ	2.0pF	>500	±200V	±55V	±6.0	416
	100X	2 m	10MΩ	2.0pF	>500	±200V	±200V	±60	
P6203	10X	1.5 m	>10kΩ	2.0pF	1000	±40V	±10V	±10	414
P6204	10X	1.5 m	10MΩ	1.9pF	1000	±40V	±15V	±10	414
P6230	10X	1.6 m	450Ω	1.3pF	1500	±30V	±5V	±5	417
P6231	10X	1.5 m	450Ω	1.6pF	1500	±30V	±5V	±5	417

PASSIVE VOLTAGE PROBES FOR 1 MΩ INPUTS

P6101A
- *DC to 34 MHz, 1X*

P6115
- *DC to >5 MHz, 1X*

P6102A
- *DC to 60 MHz, 10X*

P6105A
- *DC to 100 MHz, 10X*

P6106A
- *DC to 250 MHz, 10X*

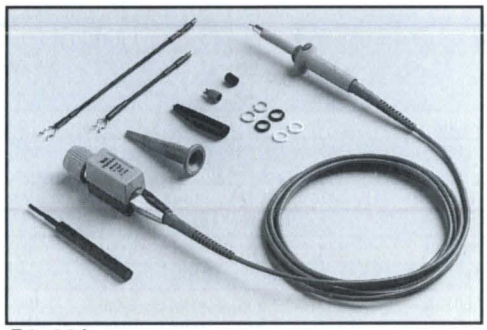
P6107A
- *DC to 100 MHz, 10X*

P6108A
- *DC to 100 MHz, 10X*

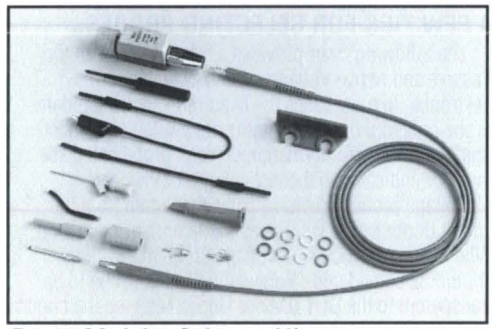
P6149A
- *DC to 50 MHz, 10X*

P6130
- *DC to 250 MHz, 10X Subminiature*

FEATURES/BENEFITS
- *High Fidelity Signal Acquisition at Low Cost*
- *Hybrid Circuitry for Improved Performance*
- *Rugged for Greater Reliability*
- *Miniature Size Tip*
- *Modular Construction*



P6106A



P6130 Modular Subassemblies

MODULAR PROBES

Tektronix modular probes are designed to save you money in repair and maintenance over the life of the probe. The three modules (probe head, cable, and connector/compensation box) quickly snap or screw together eliminating the need for soldering. Spare modules can be ordered and stocked, reducing down-time and eliminating the need to send a probe in for repairs (see page 431). 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. The P6102A, P6105A, P6106A and P6107A will automatically scale the readout on oscilloscopes equipped with this feature. All but the P6101A, P6115, P6108A and P6130 provide a ground reference button on the probe head for quick trace identification. The P6107A and P6149A feature a right angle BNC connector.

P6149A

CHARACTERISTICS

	Nominal Length	Attenuation	Bandwidth	Loading	DC Max	Scope C in pF	Readout
P6101A Opt. 01	1 m	1 X	34 MHz	1 MΩ/32.0 pF	500 V	Any	No
P6101A	2 m	1 X	15 MHz	1 MΩ/54.0 pF	500 V	Any	No
P6101A Opt. 03	3 m	1 X	8 MHz	1 MΩ/78.0 pF	500 V	Any	No
P6115	1.5 m	1 X	> 5 MHz	1 MΩ/64.0 pF	42 V	Any	No
P6102A	2 m	10 X	60 MHz	10 MΩ/13.2 pF	500 V	36-55	Yes
P6105A Opt. 01	1 m	10 X	100 MHz	10 MΩ/8.7 pF	500 V	15-35	Yes
P6105A	2 m	10 X	100 MHz	10 MΩ/11.2 pF	500 V	15-35	Yes
P6105A Opt. 03	3 m	10 X	90 MHz	10 MΩ/13.2 pF	500 V	15-30	Yes
P6106A Opt. 01	1 m	10 X	250 MHz	10 MΩ/8.7 pF	500 V	15-35	Yes
P6106A	2 m	10 X	250 MHz	10 MΩ/11.2 pF	500 V	15-35	Yes
P6106A Opt. 03	3 m	10 X	150 MHz	10 MΩ/13.2 pF	500 V	15-30	Yes
P6107A	2 m	10 X	100 MHz	10 MΩ/13.0 pF	500 V	20-51	Yes
P6108A Opt. 01	1 m	10 X	100 MHz	10 MΩ/8.7 pF	500 V	15-35	No
P6108A	2 m	10 X	100 MHz	10 MΩ/11.2 pF	500 V	15-35	No
P6108A Opt. 03	3 m	10 X	90 MHz	10 MΩ/13.2 pF	500 V	15-30	No
P6149A	2 m	10 X	50 MHz	10 MΩ/13.0 pF	500 V	20-51	No
P6130A Opt. 01	1.5 m	10 X	250 MHz	10 MΩ/12.7 pF	500 V	15-35	Yes
P6130A	2 m	10 X	250 MHz	10 MΩ/13.2 pF	500 V	15-35	Yes
P6130A Opt. 03	3 m	10 X	150 MHz	10 MΩ/14.5 pF	500 V	15-30	Yes

ORDERING INFORMATION

P6101A 1X 34 MHz, 2 m Modular Probe *[1] ☎ $60
Includes: Retractable hook tip(013-0107-06); Probe tip ground cover (166-0404-01); 5-in Ground lead (175-0124-01); 12-in Ground lead (175-0125-01); Alligator clip (344-0046-00); Two each of black, white and silver cable markers; Instruction sheet (070-5299-00).

P6105A 10X, 100 MHz, 2 m Modular Probe ☎ $100
Includes: Same as the P6101A plus adjustment tool (003-1433-00); Instruction sheet (070- 5516-00).

P6106A 10X, 250 MHz, 2 m Modular Probe ☎ $150
Includes: Same as the P6105A except 3-in Ground lead (175-0263-01) instead of 12-in Ground lead; Instruction sheet (070-5517-00).

P6108A 10X, 100 MHz, 2 m Modular Probe ☎ $90
Includes: Same as the P6105A; Instruction sheet (070-5519-00).

P6130 10X, 250 MHz, 2 m Subminiature Probe ☎ $150
Includes: Adjustment tool (003-1433-00); Retractable hook tip (013-0208-02); Circuit board connector (131-2766-03); 8-in. Alligator ground lead (196-3286-00); 6-in. Microhook ground lead (196-3302-00); 2-in. Ground lead (195-4240-00); Probe holder (352-0687-00); Two each of white, gray, red and green cable markers; Instruction sheet (070-5513-00).

OPTIONAL CABLE LENGTHS
(P6101A, P6105A, P6106A, P6108A, P6130)

Opt. 01 – 1-m (P6130 1.5 m) cable +$5.00
Opt. 03 – 3-m cable +$15

OPTIONAL ACCESSORIES

Conversion Kit – Subminiature Tip to Compact Tip P6130 Order (040-1253-02) $60

[1] Only P6101A 1 M cable (Opt. 01) available thru Tek Direct.

P6102A 10X, 60 MHz, 2 m Modular Probe ☎ $70
Same as the P6105A; Instruction sheet (070-5824-00).

P6107A 10X, 100 MHz, 2 m Modular Probe $130
Includes: Same as the P6105A; Instruction sheet (070-5518-00).

P6115 1X, >5 MHz, 1.5 m Modular Probe ☎ $32
Includes: Retractable hook tip (013-0107-06); 12-in Ground lead (175-0124-01); 12-in Ground lead (196-3121-00); Two each red and yellow cable markers; Instruction sheet (070-6429-00).

P6149A 10X, 50 MHz, 2 m Modular Probe $130
Includes: Same as the P6105A; Instruction sheet (070-5510-00).

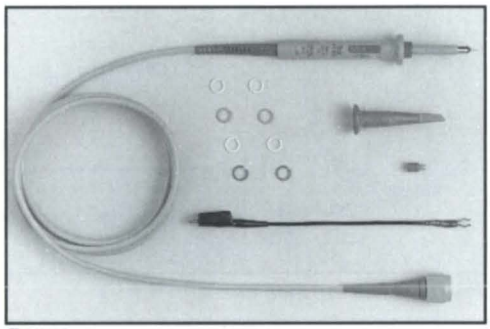
For probe accessories, see pages 432-435.
For replaceable modular subassemblies, see page 431.
Instrument compatibility chart is on pages 406-408.

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

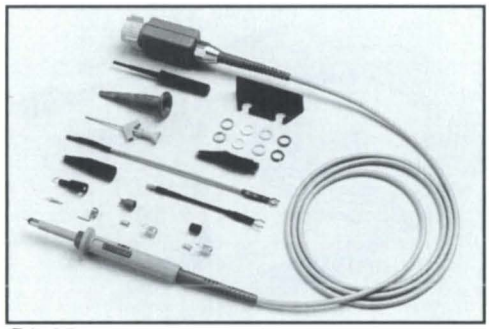
To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

PASSIVE VOLTAGE PROBES FOR 1 MΩ INPUTS 1X/10X/GROUND REFERENCE

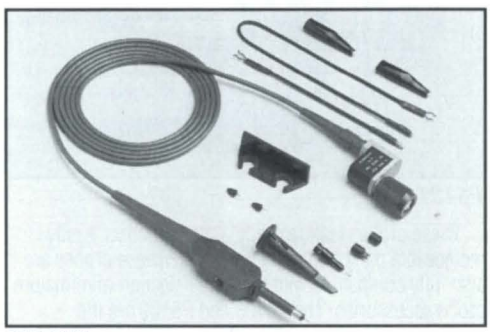
NEW



P6119



P6127



P6063B

1X/10X probes give you two probes in one. One of the four Tektronix 1X/10X probes can satisfy almost any of your passive voltage measurement requirements. Each has ground reference capability which allows you to quickly establish the ground level and to easily identify your probe without having to leave the circuit. All four probes are compatible with the miniature accessories.

NEW P6127
- *300 MHz*

NEW P6119
- *100 MHz*

P6063B
- *200 MHz*

P6062B
- *100 MHz*

TYPICAL APPLICATIONS
- *Power Supply/Amplifier Design and Test*
- *Field Service*
- *Education*

FEATURES/BENEFITS
- *1X/10X/Ground Reference Switchable with Associated Readout Function (P6127, P6062B, P6063B)*
- *Rugged/Modular Design for Low Cost of Ownership (P6119, P6127)*
- *Miniature Probe Tip Compatible with Wide Range of Miniature Accessories*

CHARACTERISTICS

	Nominal Length	Attenuation	Bandwidth	Loading	DC Max	Scope C in pF	Readout
P6119	2 m	10 X	100 MHz	10 MΩ/15.3 pF	500 V	15-35	No
		1 X	8 MHz	1 MΩ/120 pF	350 V		No
P6119 Opt. 03	3 m	10 X	100 MHz	10 MΩ/17.5 pF	500 V	15-35	No
		1 X	6.7 MHz	1 MΩ/14.5 pF	350 V		No
P6127	1.5 m	10 X	300 MHz	10 MΩ/12.7 pF	500 V	12-18	Yes
		1 X	8.5 MHz	1 MΩ/100 pF	350 V		Yes
P6127	2 m	10 X	250 MHz	10 MΩ/14.4 pF	500 V	12-18	Yes
		1 X	6.5 MHz	1 MΩ/110 pF	350 V		Yes
P6062B Opt. 01	3.5 ft	10 X	100 MHz	10 MΩ/13.5 pF	500 V	15-47	Yes
		1 X	8 MHz	1 MΩ/100 pF	500 V		Yes
P6062B	6 ft	10 X	100 MHz	10 MΩ/14 pF	500 V	15-47	Yes
		1 X	6.7 MHz	1 MΩ/105 pF	500 V		Yes
P6062B Opt. 03	9 ft	10 X	95 MHz	10 MΩ/17 pF	500 V	15-47	Yes
		1 X	4.5 MHz	1 MΩ/135 pF	500 V		Yes
P6063B Opt. 01	3.5 ft	10 X	200 MHz	10 MΩ/11 pF	500 V	15-24	Yes
		1 X	12 MHz	1 MΩ/80 pF	500 V		Yes
P6063B	6 ft	10 X	200 MHz	10 MΩ/14 pF	500 V	15-24	Yes
		1 X	6 MHz	1 MΩ/105 pF	500 V		Yes

ORDERING INFORMATION

P6119 100 MHz, 2 m Switchable 1X/10X probe **$60**
Includes: Screwdriver adjustment tool (003-1433-00); Retractable hook tip (013-0107-06); 5" Ground lead (196-3120-00); 1 IC test probe tip; Two each of white, yellow, red, and green markers; Instruction sheet (070-7432-00).
Opt. 03 – 3.0 m cable **+$15**

P6127 300 MHz, 1.5 m Switchable 1X/10X Probe *1
Includes: Adjustment tool (003-1433-00); Retractable hook tip (013-0107-06); Hook Tip (206-0114-00); Spring Ground Contact (214-4125-00); Probe Tip Ground Cover (166-0404-01);6-in. Ground Lead 0.025 connector(196-3198-00); 3-in. Ground lead #6-32 thread (175-0263-01); Alligator Clip for #6-32 thread (344-0046-00); Alligator Clip for 0.025 connector (344-0398-00); SMT Grabber Clip (206-0364-00);Probe holder (352-0351-00); Two each of white, yellow, red and green cable markers; Replaceable probe tip (131-3723-00); two ECB-to-Probe-Tip Adapters, IC probe Tip, Instruction sheet (070-7433-00);
Opt. 02 – 2m Cable *1

P6062B 100 MHz, 6 ft Switchable 1X/10X Probe ☎ **$190**
Includes: Retractable hook tip (013-0107-06); Probe tip ground cover (166-0404-01); 5 in. ground lead (175-0124-01); 12" ground lead (175-0125-01); Hook tip (206-0114-00); Two replaceable tips (206-0191-00); Probe holder (352-0351-00); Two alligator clips (344-0046-00); Instruction sheet (062-2927-00).
Opt. 01 – 3.5 ft cable. **+$5.00**
Opt. 03 – 9 ft cable **+$15**

P6063B 200 MHz, 6 ft Switchable 1X/10X probe **$240**
Includes: Same as P6062B except 3-in. Ground lead (175-0263-01) instead of the 12-in. Ground lead; Instruction sheet (062-2928-01);
Opt. 01 – 3.5 ft cable **+$5.00**

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.
*1 *Contact your local sales representative.*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.

PASSIVE PROBES FOR 1 MΩ INPUT

Ruggedized Probes

P6103
- *DC to 50 MHz, 10X*

P6109
- *DC to 150 MHz, 10X, with Readout*

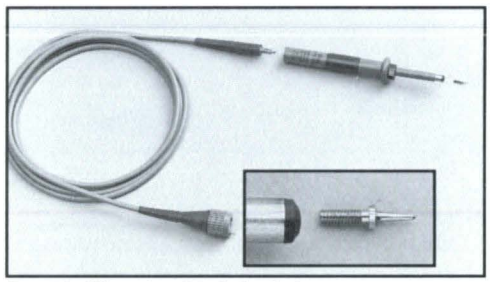
FEATURES
- *Improved, Rugged, Replaceable Tip*
- *Hybrid Circuitry for Improved Performance*
- *Two-Piece Modularity*
- *UL Listed*

P6121
- *DC to 100 MHz, 10X, with Readout*

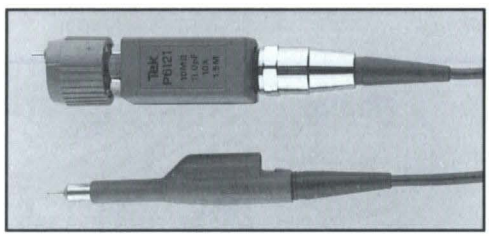
P6122
- *DC to 100 MHz, 10X*

FEATURES
- *Small, Precision Tip*
- *Flexible, Low Mass Cable*
- *Hybrid Circuitry for Improved Performance*
- *UL Listed*

P6103



P6109 (Showing Modularity)



P6121

The P6103/P6109 are ruggedized, modular passive voltage probes. The modular probe head houses all circuitry, including low frequency compensation. The cable assembly comes with an attached BNC connector. Both probes feature easily replaceable screw-in probe tips. These probe tips have been specifically engineered to provide improved long-term performance and reliability. Both are compatible with the miniature size probe accessories (see probe accessories page 433).

Oscilloscopes equipped with readout can be activated by the P6109 or P6121.

The P6122 general purpose probe accommodates oscilloscopes with bandwidths up to 100 MHz.

The P6121 with readout capability is specifically designed for the Tektronix 2236A Oscilloscope to provide close tolerance readings when using the 2236A DMM functions.

These probes feature modular construction, easily replaceable parts and hybrid circuitry. These probes are also fully compatible with the wide selection of miniature probe accessories. The P6103 and P6109 are the standard probes for most 2200 Series Oscilloscopes.*1

*1 *P6103 – 2201 and 2225*
P6109 – 2211, 2221, 2224, 2232, 2235A, 2236A, 2245A, 2246A and 2247A.

CHARACTERISTICS

	Length	Attenuation	Bandwidth	Loading	DC Max	Scope C in pF	Readout
P6103 Opt. 01	1 m	10X	50 MHz	10 MΩ/10.9 pF	500 V	15-35	No
P6103	2 m	10X	50 MHz	10 MΩ/13.2 pF	500 V	15-35	No
P6103 Opt. 03	3 m	10X	50 MHz	10 MΩ/15.5 pF	500 V	15-30	No
P6109 Opt. 01*1	1.5 m	10X	150 MHz	10 MΩ/11.8 pF	500 V	15-35	Yes
P6109	2 m	10X	150 MHz	10 MΩ/13.2 pF	500 V	13-35	Yes
P6109 Opt. 03	3 m	10X	100 MHz	10 MΩ/15.5 pF	500 V	15-30	Yes
P6121*1	1.5 m	10X	100 MHz	10 MΩ/11.0 pF	500 V	20-26	Yes
P6122	1.5 m	10X	100 MHz	10 MΩ/11.0 pF	500 V	15-35	No
P6122 Opt. 02	2 m	10X	100 MHz	10 MΩ/12.0 pF	500 V	15-35	No
P6122 Opt. 03	3 m	10X	90 MHz	10 MΩ/14.0 pF	500 V	15-35	No

*1 *Designed specifically for use with the 2236A to ensure optimum DMM readings.*

ORDERING INFORMATION

P6103 10X, 50 MHz, 2 m Modular Probe ☎ **$40**
Includes: Adjustment tool (003-1433-00); Retractable hook tip (013-0107-06); Replaceable probe tip (131-3723-00); 12-in. Ground lead (196-3120-00); Two each of white, yellow, red and green cable markers; Instruction sheet (070-6156-01).
Opt. 01 – 1 m cable **+$5.00**
Opt. 03 – 3 m cable **+$15**

P6109 10X, 150 MHz, 2 m Modular Probe ☎ **$63**
Includes: Same as the P6103; Instruction sheet (070-6157-02).
Opt. 01 – 1.5 m cable **+$5.00**
Opt. 03 – 3 m cable **+$15**

P6122 10X, 100 MHz, 1.5 m Modular Probe ☎ **$63**
Includes: (020-0717-00) Adjustment tool (003-1433-00); Retractable hook tip (013-0107-06); Probe tip ground cover (166-0404-01); 8. in. Alligator ground lead (195-1870-00); 3.5-in. Ground lead (196-3286-00); Alligator clip (344-0046-00); two silver cable marker bands; Instruction sheet (070-5511-00).
Opt. 02 – 2 m cable **+$10**
Opt. 03 – 3 m cable **+$15**

P6121 10X, 100 MHz, 1.5 m Modular Probe ☎ **$120**
Includes: Same as the P6122; Instruction sheet (070-5512-00).

OPTIONAL ACCESSORIES

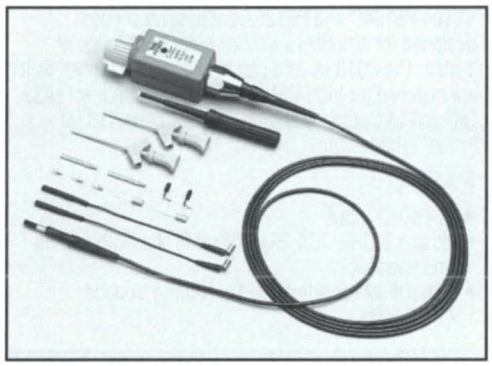
Manuals –
(P6121) Order 070-3739-01 **$1.50**
(P6122) Order 070-4431-01 **$3.00**

For probe accessories, see pages 432-435.
For replaceable modular subassemblies, see page 431.
Instrument compatibility chart is on pages 406 and 408.

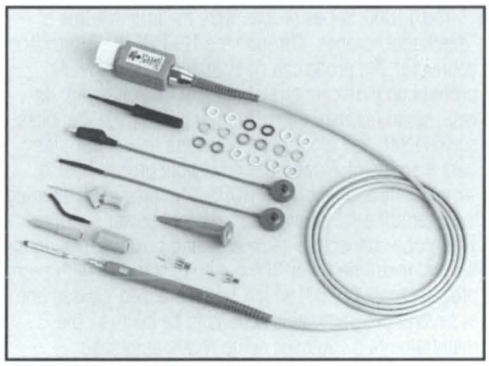
☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

PORTABLE OSCILLOSCOPE PASSIVE VOLTAGE PROBES



P6562 with standard accessories



P6137 shown with typical accessories.

The NEW P6562 is a "micro-miniature" design featuring a low-mass probe head and ultra-lightweight cable for easier, quicker and a more stable circuit attachment. Multiple probes may now be attached to PLCC, SOIC, Tektronix KLIPKIT, and DIP IC Test Clips without the mass and weight of probe disconnecting the probe from the DUT (Device under test). See page 429 for accessories closeup.

The P613X probe family features modular construction, hybrid and SMT circuitry, readout pin which activates the readout encoding circuitry of so equiped oscilloscopes, and small geometry probe tips which easily negotiate dense circuitry and tight spaces.

The P6137 and P6133/P6136 Option 25 probes feature the slightly larger diameter compact probe tip size, which provides additional tip strength, but is still small enough to access today's circuitry. Full compatibility with miniature probe tip accessories is available through use of the "subminiature/compact-to-miniature" probe tip adapter (013-0202-02).

The "Identify" button on the P6137 probe head enables the user to utilize special functions on equiped 2400 Series oscilloscopes, such as Auto Setup, SRQ, Auto Sequencing, and Trace Identification.

CHARACTERISTICS

Type	Nominal Length	Atten-uation	Band-width	Rise time	Loading Input R/C	Max Input V	Scope C in pF	Readout/ Identify	Scopes
P6131	1.3 m	10X	300 MHz	1.17 ns	10 MΩ/10.8 pF	500 V	14-18	Yes/No	2430,2445
P6131 Opt 02	2.0 m	10X	300 MHz	1.4 ns	10 MΩ/13.5 pF	500 V	14-18	Yes/No	2465
P6131 Opt 03	3.0 m	10X	150 MHz	2.23 ns	10 MΩ/14.5 pF	500 V	14-18	Yes/No	7A42
P6133 Opt 01	1.3 m	10X	150 MHz	2.33 ns	10 MΩ/11.4 pF	500 V	15-30	Yes/No	2430A/M
P6133	2.0 m	10X	150 MHz	2.33 ns	10 MΩ/12.7 pF	500 V	15-30	Yes/No	2445A/B
P6133 Opt 03	3.0 m	10X	120 MHz	2.92 ns	10 MΩ/14.5 pF	500 V	15-25	Yes/No	
P6133 Opt 25	1.3 m	10X	150 MHz	2.33 ns	10 MΩ/11.4 pF	500 V	15-30	Yes/No	
P6136	1.3 m	10X	350 MHz	1.0 ns	10 MΩ/10.8 pF	500 V	12-18	Yes/No	2455A/B
P6136 Opt 25	1.3 m	10X	350 MHz	1.0 ns	10 MΩ/10.8 pF	500 V	12-18	Yes/No	2465A,2467
P6137	1.5 m	10X	400 MHz	875 ps	10 MΩ/10.8 pF	500 V	12-18	Yes/Yes	2431L 2432A/M, 2440 2465B, 2467B
P6562	1.5 m	10X	350 MHz	1 ns	10 MΩ/10.3 pF	42 V	15-30	Yes/No	2400/11000/DSA600

NEW P6562

- *350 MHz "Micro-Miniature" Tip*

P6137

- *400 MHz Compact Tip*

P6136

- *350 MHz Subminiature Tip*
- *Opt. 25 350 MHz Compact Tip*

P6133

- *150 MHz Subminiature Tip*
- *Opt. 25 150 MHz Compact Tip*

P6131

- *300 MHz Subminiature Tip*

TYPICAL APPLICATIONS

- *Digital and Analog Design*
- *Telecommunications*
- *Computer Backplane Testing*
- *General Purpose Waveform Characterization*

FEATURES

- *Small Geometry Tips*
- *Identify Button (P6137)*
- *Readout Coding for 10X Attenuation*
- *Flexible Lightweight Cable*
- *Hybrid Circuitry Performance*
- *Modularity for Lower Cost of Ownership*
- *Wide Range of Accessories*
- *UL Listed*

ORDERING INFORMATION

P6131 10X, 300 MHz, 1.3 m Modular Subminiature ☎ **$160**
Includes: Adjustment tool (003-1433-00); Retractable hook tip (013-0208-02); Circuit board connectors (131-2766-03); 8-in Alligator ground lead (196-3286-00); 6-in ground lead (196-3302-00); 2-in Ground lead (195-4240-00); Probe holder (352-0687-00); 2 each of white, gray, red and green cable markers; Instruction sheet (070-5514-00).
Opt. 02 – 2 m cable **+$10**
Opt. 03 – 3 m cable **+$15**

CONVERSION KIT
Subminiature Tip to Compact Tip –
P6131 1.3 m Order (040-1250-02) **$55**
P6133 Opt. 01 – 1.3m Order (040-1251-02) **$55**
P6136 1.3m Order 040-1252-02 **$55**

P6133 10X, 150 MHz, 2 m Modular Subminiature ☎ **$120**
Includes: Same as P6131; except for instruction sheet (070-5795-00).
Opt. 01 – 1.3 m cable **+$5**
Opt. 03 – 3 m cable **+$15**
Opt. 25 – 1.3 m cable compact tip – **NC**
Includes: Same as P6137 except instruction sheet (070-5795-00).

P6136 10X, 350 MHz, 1.3 m Modular Subminiature ☎ **$160**
Includes: Same as P6131; except instruction sheet (070-6025-00).
Opt. 25 – 1.3 m cable compact tip *1
Includes: Same as P6137; except instruction sheet (070-6025-00).

P6137 10X, 400 MHz, 1.5 m Modular Compact ☎ **$170**
Includes: 2-in ground lead (195-4240-00); low inductance lead ground collar (343-1003-01); Retractable hook tip (013-0107-06); IC grabber (206-0364-00); 6-in ground lead (196-3113-02); 6-in ground lead (196-3305-00); Adjustment tool (003-1433-00); 2 circuit board connectors; 2 each of white, gray, red and green cable markers; Instruction sheet (070-6432-00).

P6562 10X, 350 MHz, 1.5 m Micro-Miniature *1
Includes: Adjustment tool (003-1433-00); 2 each IC grabbers (206-0364-00); 2 each 6-in ground leads; 3 each screw in probe tip; 2 each screw-in 0.025-in jack tip assembly; 2 each right angle square pin adapters; 2 each low inductance ground leads; Instruction sheet.

*1 *Contact your local sales representative*

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

LABORATORY OSCILLOSCOPES
VOLTAGE PROBES

NEW P6134C
- 400 MHz Compact Tip
- Passive Voltage Probe

P6135A
- 150 MHz Compact Tip
- Passive Differential Pair

P6150
- 9 GHz
- Low Impedance (Zo) 1X, 10X

P6156
- 3.5 GHz Compact Tip
- Low Impedance (Zo)

P6203
- 1 GHz Miniature Tip
- Bipolar Probe

P6204
- 1 GHz Miniature Tip FET Probe (1.1 GHz, Typical)

P6231
- 1.5 GHz Subminiature Tip
- Bias/Offset Probe

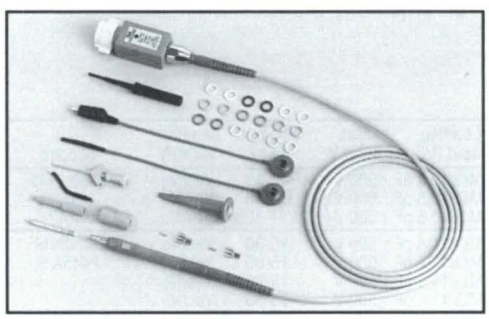
TYPICAL APPLICATIONS
- Analysis of Analog and Digital Circuitry such as ECL, CMOS, TTL, and GaAs
- Amplitude Levels, Aberration, Propagation Delay, Bandwidth and Rise Time Measurements for Research, Design, Manufacturing, and Calibration Labs
- Sampling and Time Domain Reflectometry

FEATURES/BENEFITS
- **Low Input C, High Input R**
  Lower Circuit Loading, Better Measurement Accuracy
- **Wide Range of Accessories**
  Compatibility and Easy Circuit Attachment
- **Identify Button on Each Probe**
  Allows Remote Sequencing of Oscilloscope Programs
- **Probe Power from TEKPROBE™ Interface**
  No additional Cables or Supplies Required
- **Automatic Input Impedance Selection**
- **Readout Coding for Attenuation**
  Reduces Measurement Reading Errors

The 11000-Series probes were the first in a line of "intelligent" probes. Through the TEKPROBE ™interface connector, the probe can (if available on the specific probe) communicate one or more of the following: its type, serial number, attenuation, input impedance, offset scale factor, and other key parameters to and from the host instrument. Power for compatible probes is also supplied through the TEKPROBE ™interface, eliminating the need for extra cabling and external power supplies. The probe connectors allow easy and positive locking to the test instrument. An "ID" button is standard with each probe (except P6150) which, when pressed, causes one of several programmable actions to be taken by the mainframe (e.g., autoset, setup recall, automatic measure, SRQ, etc.).

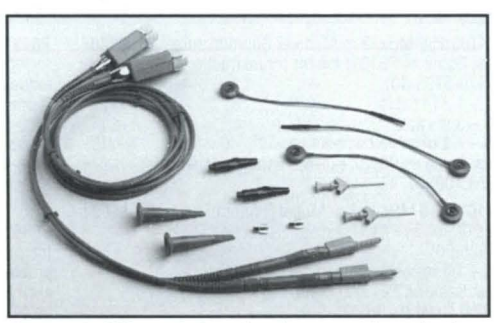
A 50-ohm termination is required by the P6203, P6204 and P6231 and is automatically accommodated by the 11000-Series mainframe. When an 11000-Series active probe is connected to an input connector of an 11A32, 11A33, or 11A34 Amplifier plug-in unit, the plug-in input impedance is automatically switched to 50 ohms.

P6134C
- DC to 400 MHz, 10X, Passive Probe, with Identify and Readout



P6134C shown with standard accessories.

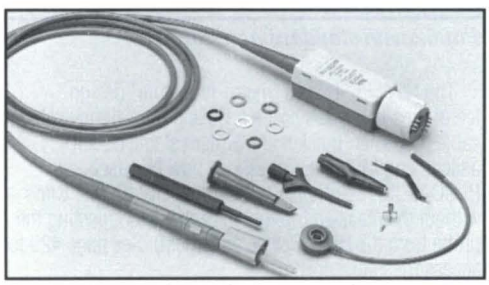
P6135A
- DC to 150 MHz, 10X, Passive Differential Probe Probe, with Identify and Readout



P6135A differential probe shown with typical accessories.

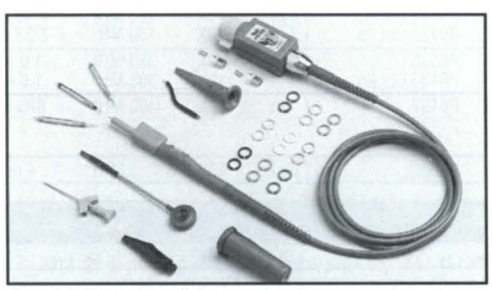
The P6134C and P6135A are passive probes designed for amplifiers with an input impedance of 1 MΩ. The P6135A is a pair of differential probes which are matched for high CMRR when used with the 11A33 Differential Comparator plug-in. (See page 418 for further information.)

P6231
- For 50 Ω Input
- dc to 1.5 GHz, 10X, Bias/Offset Probe, with Identify and Readout
- Bias/Offset for Adjusting Tip Nulling Voltage (±5.0 Vdc)

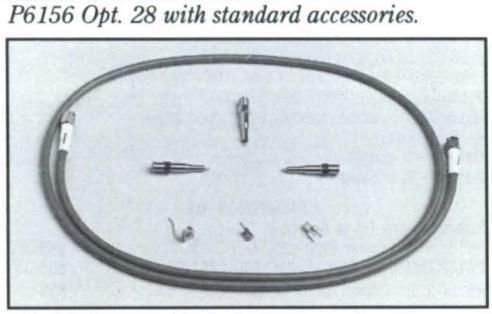


P6231 shown with typical accessories.

The P6231 is an active probe designed for amplifiers with an input impedance of 50 ohms, primarily the 11A52, 11A71 and 11A72 high frequency amplifiers. Connection of the P6231 into any other 11000 Series amplifier or the 1103 TEKPROBE ™ Power Supply automatically causes the input impedance to be set at 50 Ω. Up to five volts of bias may be applied to the tip of the P6231 to reduce the DC loading on the circuit under test. The offset voltage is selectable from the mainframe touch screen.



P6156 Opt. 28 with standard accessories.



P6150 shown with typical accessories.

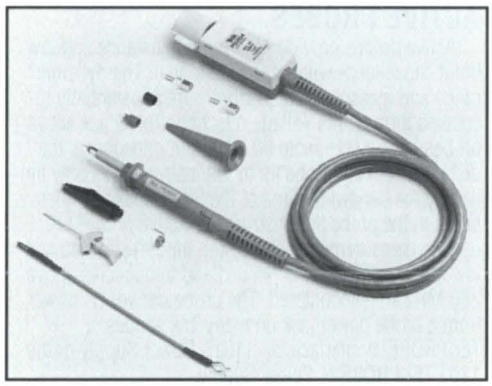
To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

The P6156 and P6150 are Low Impedance, Zo passive voltage probes for use with amplifiers having input impedance of 50 ohms. The P6156 has 1X, 10X, 20X, and 100X attenuation capabilities and has the standard BNC output connector with readout pin for oscilloscope readout encoding activation. The P6150 has 1X and 10X attenuation capabilities and uses an SMA connector system for its output connector. For further information see page 419.

The P6204 and P6203 high-performance Active Probes round out the capabilities of the 11000-Series. The P6204 is a 1-GHz, high impedance (high input R, low input C), miniature size, 10X Active (FET) probe intended for use in high speed digital and analog circuitry. The variable dc offset voltage (±15V) is adjustable via mainframe controls, allowing offset of any dc component within the range of the control. This allows signals with dc components to be brought into the probe's dynamic range.

The P6203 is a 10X, 1-GHz, medium impedance (medium input R, low input C), miniature size, Active (Bipolar) probe intended for use in high speed logic and analog circuitry. The P6203 also provides a variable (±10V) dc offset function which is controlled via the mainframe. Although primarily designed for the 11A52, 11A71 and 11A72 plug-ins the P6204 and P6203 active probes may be used with other 11000 Series plug-ins.

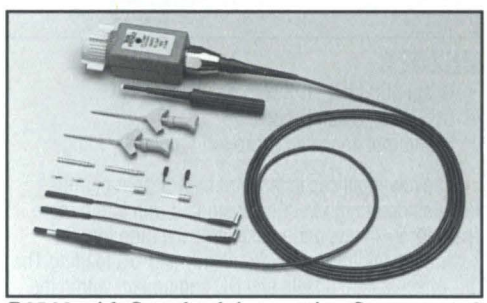
The P6204 and P6203 may also be used with other oscilloscopes via the 1103 TEKPROBE™ power system (see page 428).



P6204/P6203 (P6204 SHOWN)

- DC to 1GHz, (Typically 1.1 GHz*1) 10X, 10-MΩ Active (FET) Probe, with Identify and Readout (P6204)
- DC to 1GHz, 10X, >10 kΩ Active (Bipolar) Probe, with Identify and Readout (P6203)
- Easily Replaceable Probe Tips

*1 *At room temperature*



P6562 with Standard Accessories. See page 413.

ORDERING INFORMATION

P6134C 10X, 400 MHz, 1.5 m Passive Probe, Compact *1
Includes: Adjustment Tool (003-1433-00); Retractable hook tip (013-0208-02); 2 circuit board connectors; 2-in ground lead (195-4240-00); 6-in ground lead (196-3305-00); Miniature alligator clip (344-0398-00); IC grabber (206-0364-00); 2 each of black, white, silver, gray, blue, orange, red, green and yellow cable markers; Instruction manual (070-6029-00).

P6203 1 GHz Bipolar Probe **$860**
Includes: retractable hook tip (013-0107-06); 6-in ground lead (196-3198-00); Alligator clip (344-0398-00); SMT Grabber clip (206-0364-00); Insulating ground cover (166-0404-01); Ground contact, spring (214-4125-00); 2 probe tip to circuit board adapters; Carrying case; Instruction sheet (070-6823-00).

P6204 1 GHz FET probe **$1,425**
Includes: Same as P6203; except Instruction sheet (070-6949-00)

P6231 1.5 GHz Bias/Offset Probe **$475**
Includes: Adjustment tool (003-1433-00); Retractable hook tip (013-0208-02); 2 Circuit board connectors (131-2766-03); 6-in Ground lead (196-3113-02); 2-in Ground lead (195-4240-00); Miniature alligator clip (344-0046-00); IC grabber (206-0364-00); 2 each white, black, silver, gray, blue, orange, red, green and yellow cable markers; manual (070-6027-00).

For probe accessories, see pages 432-435.
For replaceable modular subassemblies, see page 431.
Instrument compatibility chart is on pages 406-408.

*1 *Contact your local sales representative.*

CHARACTERISTICS

Probe Type	Nominal Length	Atten -uation	Bandwidth in MHz	Rise Time	Loading Input R/C	Max Input dc + pk ac	Scope C in pF	Propagation Delay	Linear Dynamic	DC Offset Range	Scope/ Plug-in	Readout/ Identify	Page
P6134C	1.5 m	10X	400	875 ps	10 MΩ/11.3 pF	500 V	12-18	6.93 ns ±100 ps	N/A	N/A	11201 11A32 11A34	Yes/Yes	415
P6135A	1.5 m	10X adj.	150	2.33 ns	1 MΩ/10.5 pF	500 V	13.5-16.5	7.61 ns	N/A	N/A	11A33	Yes/Yes	418
P6150	1.0 m	10X	9000	<38.8 p	500 Ω/<0.15 pF	12.5 V	50 Ω	4.40 ns ±0.1 ns	N/A N/A	N/A N/A	SD20 SD22	No/No	419
		1X	3000	<170 ps	50 Ω/N/A	Scope input	50 Ω	4.40 ns ±0.1 ns	N/A N/A	N/A N/A	SD24 SD26		
P6156	1.5 m	10X 100X 20X 1X	3500 3000 3500 1500	<100 ps <120 ps <100 ps <300 ps	500 Ω/<1 pF 5000 Ω/<1.1 pF 1000 Ω/<1 pF 50 Ω/N/A	15 V 55 V 22 V Scope Max	50 Ω 50 Ω 50 Ω 50 Ω	7.75 ±0.07 ns	N/A	N/A	Any 50 Ω Plug-ins	Yes/Yes	419
P6203	1.5 m	10X	1000	350 ps	10 MΩ/<1.9 pF (1.7pF typical)	±40 V	50 Ω	8.4 ns ±200 ps	±10 V	±10 V	*1	Yes/Yes	415
P6204	1.5 m	10X	1000	350 ps	1 kΩ/<12 pF (1.8 pF typical)	±40 V	50 Ω	8.4 ns ±200 ps	±10 V	±15 V	*1	Yes/Yes	415
P6231	1.5 m	10X	1500	230 ps	500 Ω/1.6 pF	±30 V	50 Ω	8.75 ns	±10 V	±5.0 V	*1	Yes/Yes	415
P6501 Opt 2	1.5 m	10X	750	450 ps	1 MΩ/≤1.8 pF	±26.5 V	50 Ω	7.7 ns*1	±10 V	N/A	*1	Yes/No	404
P6562	1.5 m	10X	350	1 ns	10 MΩ/10.3 pF	42 V	15-30	6.4 ±100 ps	N/A	N/A	DSA/11K/2400	Yes/No	413

*1 *Works with 11000/DS/CSA with 1103 power supply*

ACTIVE VOLTAGE PROBES FOR 50 Ω OR 1 MΩ INPUTS

P6201
- *900 MHz (Typically 1.1 GHz*[1]) FET Probe*

P6202A
- *500 MHz, Miniature Tip FET Probe*

P6230
- *1.5 GHz, Subminiature Tip Bias/Offset Probe*

P6203
- *1 GHz, Miniature Tip Bipolar Probe*

P6204
- *1 GHz (Typically 1.1 GHz*[1]) FET Probe, Miniature Tip*

P6231
- *1.5 GHz, Subminiature Tip Bias/Offset Probe*

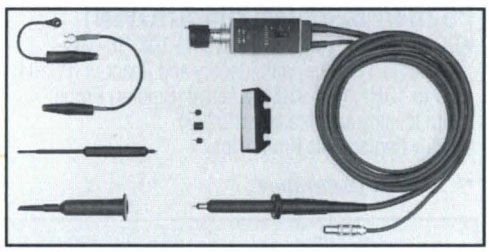
TYPICAL APPLICATIONS
- *Analysis of High-Speed Analog and Digital Circuitry such as ECL, CMOS, TTL, and GaAs*
- *Amplitude Levels, Aberration, Propagation Delay, Bandwidth and Rise Time Measurements for Research, Design, Manufacturing, and Service*

FEATURES/BENEFITS
- ***Low Input C, High Input R*** *Minimizes Circuit Loading (P6201, P6202A, P6204)*
- ***Variable DC Offset*** *Allows Correction for DC Levels to Bring the Signal into the Probe's Dynamic Measurement Range*
- ***Internal/External 50 Ω Terminations*** *Allows Connection to 50 Ω or 1 MΩ Inputs*
- ***Wide Range of Accessories*** *Compatibility and Easy Circuit Attachment*
- ***Easily Replaceable Probe Tips***
- ***Readout Coding for Attenuation*** *Reduces Measurement Reading Errors*

[1] At room temperature.

ACTIVE PROBES

Active probes provide high input resistance and low input capacitance without loss of signal. The dynamic range and measurement capability are substantially increased through the voltage offset control. Since active probes have a selectable 50 Ω output impedance, the distance from the probe tip to the instrument is only limited by the bandwidth limit of the 50 Ω coaxial cables between the probe and instrument. Active probes are used in measurements where high input resistance and low input capacitance is needed and frequencies above 250 MHz are encountered. The probe derives its power from a probe power jack on many Tek scopes, a TEKPROBE™ interface, an 1101A Power Supply or the 1103 TEKPROBE™ Power Supply.



P6202A
- DC to 500 MHz, 10X with Readout
- DC Offset, Small Probe Size
- High Input Impedance through Frequency Range

The low input capacitance of the P6202A permits acquisition of high frequency signals with a minimum loading of circuits under test while the high input resistance minimizes low frequency and DC loading.The DC offset feature offsets any DC component within the range of the control to bring the signal into the dynamic range of the probe.

P6201
- DC to 900 MHz, 1X with Readout (Typically 1.1GHz*[2])
- Unity Gain, Low Input Capacitance
- Two Plug-on Attenuator Heads that Maintain Scope Readout Factor
- DC Offset, AC-DC Coupling Switch

The P6201 is an active (FET) probe providing unity gain and DC to 900 MHz bandwidth. The P6201 is the best general-purpose probe within its voltage range from the standpoint of electrical performance. Very low input capacitance permits acquisition of high frequency signals with minimum loading of circuits under test while high input resistance minimizes low frequency and DC loading. Plug-on attenuator heads provide higher maximum input voltage, DC Offset Range, input resistance and reduced input capacitance.

[2] At room temperature.

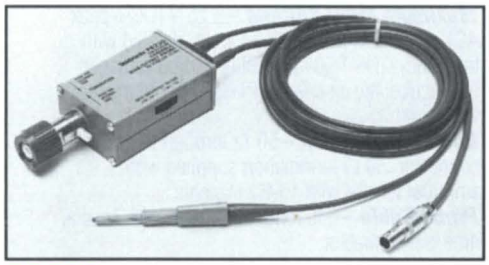
Active Probe Selection Guide

Probe Type	Nominal Length	Attenuation	Bandwidth *[1]	Rise Time	Loading Input R/C	Max V In (DC + Pk AC)	Linear Dynamic Range	DC Offset Range	Interface/ Readout/ Identify
P6201*[6] FET	6 ft	1X	900 MHz*[3]	<0.4 ns	100 kΩ/3 pF	±100 V	±0.6 V	±5.6 V	B/Y/N
		10X	900 MHz*[3]	<0.4 ns	1 MΩ/1.5 pF	±200 V	±6 V	±56 V	B/Y/N
		100X	900 MHz*[3]	<0.4 ns	1 MΩ/1.5 pF	±200 V	±60 V	±200 V	B/Y/N
P6202A*[6] FET	2 m	10X	500 MHz	<0.7 ns	10 MΩ/12 pF	±200 V	±6 V	±55 V	B/Y/N
		100X*[2]	500 MHz	<0.7 ns	10 MΩ/2 pF	±200 V	±60 V	±200 V	B/N/N
P6230*[6] Bias/Offset	1.6 m	10X	1.5 GHz	230 ps	450 Ω/1.3 pF	±30 V	±5 V	±5 V	B/N/N
P6203*[7] Bipolar	1.5 m	10X	1.0 GHz	350 ps	10 kΩ/<2 pF*[4]	±40 V	±10 V	±10 V	T/Y/Y
P6204*[7] FET	1.5 m	10X	1.0 GHz*[3]	50 ps	10 MΩ/<1.9 pF*[5]	±40 V	±10 V	±15 V	T/Y/Y
P6231*[7] Bias/Offset	1.5 m	10X	1.5 GHz	230 ps	450 Ω/1.6 pF	±30 V	±10 V	±5 V	T/Y/Y

[1] Verified by rise time
[2] Optional accessory
[3] Typically 1.1 GHz at room temperature
[4] Typically <1.8 pF
[5] Typically <1.7 pF
[6] 1101A Power Supply or Scope Probe Power required
[7] 1103 TEKPROBE™ Power Supply or TEKPROBE™ Interface required

Interface/Readout/Identify: B=BNC; T=TEKPROBE™

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.



P6230

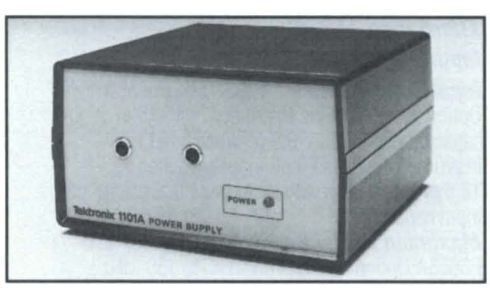
- DC to 1.5 GHz, 10X with Readout
- Bias/Offset, provides adjustable tip "nulling" voltage (±5.0 V dc)
- Internal/External 50 Ω Termination Switch
- Low Impedance
- Fully Compatible with Tek Subminiature Probe Accessories
- UL Listed

The P6230 is a 1.5 GHz, low-impedance, subminiature, 10X active probe for use with broad-band scopes. A switch on the compensation box allows selection of internal or external 50 Ω termination so the probe may be used with instruments having either 50 Ω or 1 MΩ input resistances. A coding pin on the BNC connector activates the readout of instruments with this feature.

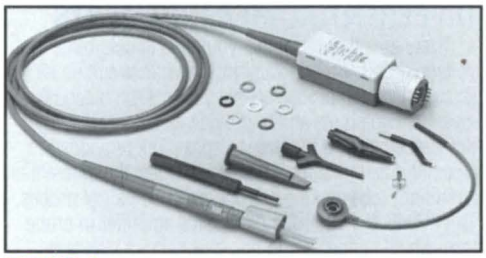
The P6230 acts as a standard 500 Ω passive voltage probe with the additional capability of having an adjustable tip nulling voltage. This feature reduces the DC-loading effects of the probe when it is used to measure signals whose mid-voltage value is not at zero volts, or in circuits where the termination impedance is not returned to ground level. The Input Bias/Offset Voltage may be adjusted so that the voltage at the probe input resistor is equal to the test signal potential; thus, no current flows through the input resistor.

The probe derives its power from the probe power jack on many Tek scopes or the 1101A Power Supply.

The P6230 is compatible with all subminiature probe accessories. With the subminiature-to-miniature probe tip adapter (013-0202-02), all miniature probe accessories on page 416 can be used.

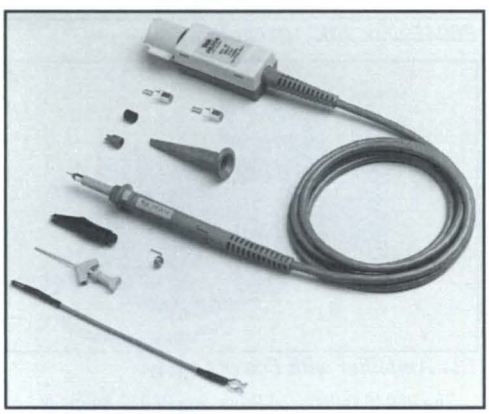


1101A Power Supply – see page 428.



P6231

- DC to 1.5 GHz, 10X, Bias/Offset Probe, with Identify and Readout
- For Use with the Intelligent TEKPROBE™ Interface of the 11000-Series Plug-ins.
- Identify Button on Probe Allows Remote Sequencing of Oscilloscope programs.
- Probe Power Comes through TEKPROBE™ Interface Via 11000-Series or the 1103 TEKPROBE™ Power Supply. See page 414.



P6204/P6203

- DC to 1 GHz, 10X FET Probe with Identify and Readout (P6204)
- DC to 1 GHz, 10X Bipolar Probe with Identify and Readout (P6203)
- Easily Replaceable Probe Tips
  See page 414.

1103 TEKPROBE ™ Power Supply – see page 428.

ORDERING INFORMATION

P6201 900 MHz FET Probe ☎ **$1,350**
Includes: Retractable probe tip (013-0135-00); 10X Attenuator head (010-0376-00); 100X Attenuator head (010-0377-00); 3 Probe tips (206-0200-00); Miniature probe tip adapter (103-0164-00); 12 in. Ground lead (175-0848-02); Ground contact (131-1302-00); Alligator clip (344-0046-00); Electrical insulating sleeve (166-0557-00); Ground contact insulator (342-0180-00); Carrying case; Instruction manual (070-1306-00).

P6202A 500 MHz FET Probe ☎ **$780**
Includes: Retractable probe tip (013-0097-01); 2 alligator clips (344-0046-00); Probe holder (352-0351-00); 3 in. Ground (175-0849-00); Probe adjustment tool (003-0675-01); Carrying case; 6 in. Ground lead (175-1017-00); 2 Replaceable probe tips; Electrical Insulating sleeve (166-0404-01); Instruction manual (070-3642-00).

10X Attenuator – For total 100X attenuation.
Order 010-0384-00 **$85**

AC Coupling Cap – Order 010-0360-00 **$40**

P6230 1.5 GHz Bias/Offset Probe **$475**
Includes: Adjustment tool (003-1433-00); Retractable hook tip (013-0208-02); Circuit board connector (131-2766-03); 8 in. Alligator ground lead (196-3286-00); 6 in. Ground lead (196-3302-00); 2 in. Probe holder (352-0687-00); 2 each of white, gray, red, and green cable markers; Instruction manual (070-4211-00).

APPLICATION NOTE
Active Probes: Their unique characteristics and applications.
Literature Number 60W-6883

Refer to pages 414-415 for additional information on the P6203 Bipolar, P6204 FET, and P6231 Bias/Offset probes, and page 428 for the 1101A and 1103 power supplies.

For probe accessories, see pages 432-435. For replaceable modular subassemblies, see page 431. Instrument compatibility chart is on pages 406-408.

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

NEW

DIFFERENTIAL PROBES FOR 1 MΩ INPUTS (AND 50 Ω INPUTS, P6046)

P6046

- *DC to 100 MHz*
- *1X/10X Differential*
- *1,000:1 CMRR at 50 MHz (DC-Input Coupled)*
- *500:1 CMRR at 50 MHz (AC-Input Coupled)*
- *± 250 V Maximum Voltage with 10X Attenuator*
- *Dual Probe Tips for Greater CMRR at High Frequencies*

NEW P6135A

- *DC to >150 MHz*
- *Attenuation Adjustable to 10X*
- *10,000:1 CMRR on 11A33*
- *± 500 V Maximum Voltage*
- *Matched Pair*

NEW P6055A

- *DC to >150 MHz*
- *Attenuation Adjustable to 10X*
- *20,000:1 CMRR on 5000/7000 Series Differential Amplifiers*
- *± 500 V Maximum Voltage*
- *Matched Pair*

ORDERING INFORMATION

P6046 1X, 6 ft. FET Differential Probe with Amplifier and Power Supply ☎ **$2,000**
Includes: 50 Ω Termination (011-0049-01); Amp and power supply (015-0106-00); 50 Ω Coaxial cable (012-0076-00); Hanger assembly (014- 0029-00); Carrying case (016-0111 01); 10X attenuator (010-0361-00); Dual attenuator head (010-0419-00); Swivel probe tip; Spring ground contact; Connector test point jack; Instruction manual (070-0756-00).
Opt. 11– Probe Without Amplifier and Power Supply **–$800**
Power Supply with Amplifier (015-0106-00)

P6135A Pair of 10X, 150 MHz Differential Probes *1
Includes: Adjustment Tool (003-1433-00); Retractable hook tip (013-107-06); 2 Circuit board connectors; 6 in. Dual-ring ground lead (196-3295-00); 6 in. Ground lead (196-3113-02); Alligator clip (344-0398-00); IC grabber (206-0364-00); 2 each of black, white, silver, gray, blue, orange, red, green and yellow cable markers; Instruction manual (070-7675-00).

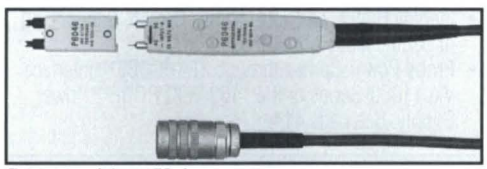
P6055A Pair of 10X, 150 MHz Differential Probes *1
Includes: Same as the P6135A, Attenuator Tip, 47pF; Instruction manual(070-7674-00).
Opt. 33 – Addition of 11A33 Tip Pair *1
Includes: Same as P6055A.

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

*1 *Contact your local sales representative.*

DIFFERENTIAL MEASUREMENTS

There are often times that you need to determine the voltage drop between two points in your circuit under test. Differential probes enable you to simultaneously measure two points and to provide as an output the difference between the two voltages. Tek provides two types of differential measurement probes: the differential amplifier probe and the passive matched pair of probes. The P6046 is a 100 MHz differential amplifier in probe form which connects into one channel of a standard scope amplifier. A matched pair of probes (P6055A or P6135A) can produce CMRR ratios up to 20,000:1 with differential amplifiers. A single 10X probe has accuracy of 1% or less giving a scope-to-probe CMRR of no better than 50:1.



P6046 with 10X Attenuator

134 Amplifier with Power Supply

The P6046 Differential Probe and P6046 Amplifier Unit provide unique measurement capabilities with all Tektronix oscilloscopes. The differential-signal processing takes place in the probe itself, resulting in high common-mode signal rejection at higher frequencies. Differential probe-tip signal processing minimizes the measurement errors caused by differences in probes, cable lengths, and input attenuators.

CHARACTERISTICS

CMRR – With deflection factors of 1 to 20 mV/div: at least 10,000:1 at 50 kHz, 5,000:1 at 1 MHz, and 1,000:1 at 50 MHz (DC coupled).

Common Mode Linear Dynamic Range – ±5 V, ±50 V with 10X attenuator.

Bandwidth – DC to 100 MHz (– 3 dB).

Rise Time – 3.5 ns or less.

Deflection Factor Range – 1 to 200 mV/div in 8 calibrated steps, 1-2-5 sequence, accurate within 3% (with an oscilloscope deflection factor of 10 mV/div). Input RC 1 MΩ paralleled by 10 pF or less.

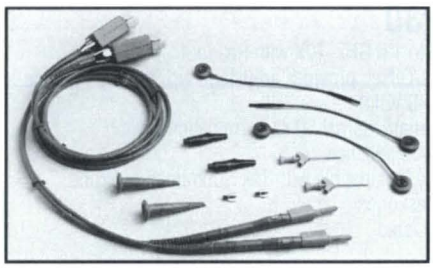
Input Coupling – AC or DC, selected by a switch on the probe. Low frequency response AC-coupled is – 3 dB at 20 Hz, 2 Hz with 10X attenuator.

Displayed Noise – 280 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 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.



P6135A/P6055A

- DC to 150 MHz, 10X, 1.5 m

The P6135A and P6055A are each a pair of compact-sized, high-impedance, 10X probes with identify function designed for use with Tektronix differential amplifiers. The P6135A is designed specifically to be used with the 11A33. The P6055A comes with a set of matched tips which allow it to be used on all 5000 and 7000-Series Differential Amplifiers. P6055A Option 33 allows the P6055A to be used on the 11A33 Differential Amplifier. The attenuation ratio is adjustable to compensate for differences in input resistance of the amplifier which maximizes CMRR.

The P6135A and P6055A are compatible with the 11000-Series TEKPROBE ™ interface and standard BNC interfaces..

CHARACTERISTICS

CMRR – P6135A and P6055A Option 33 on 11A33: 10,000:1 from DC to 1kHz, derating to 100:1 at 20 MHz. P6055A on 7000-Series: 20,000 to 1 from DC to 1kHz derating to 100:1 at 20 MHz.

Attenuation – Adjustable to 10X.

Input Resistance – 1 MΩ ±0.32%

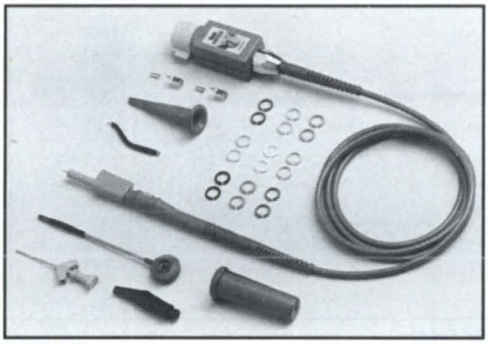
Input Capacitance – P6135A and P6055A Option 33: 10.5 pF on instrument with 15 pF input capacitance; P6055A: 9.9 pF when used with instrument that has 20 pF input capacitance; 12.5 pF when used with instrument that has 47 pF input capacitance.

Maximum Useful Bandwidth – P6135A and P6055A Option 33 on 11A33: DC to 150 MHz ; P6055A on 7A13: DC to > 90 MHz.

Typical Probe Rise Time – P6135A and P6055A Option 33 on 11A33: < 2.33 ns; P6055A on 7A13: < 3.89 ns.

Maximum Voltage – 500 V (DC + pk AC) from DC to 1.3 MHz, derated to 50 V (DC + pk AC) at 100 MHz.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.



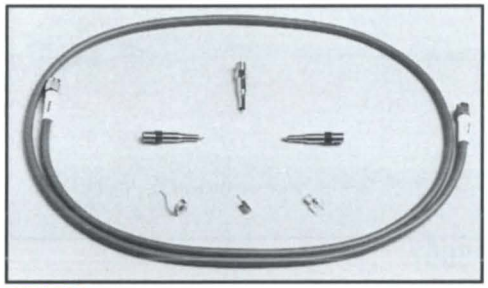
P6156

- DC to 3.5 GHz, 10X, Low Impedance Zo Probe, with Identify and Readout.
- Interchangeable Probe Tips 1X, 10X, 20X, 100X.

The P6156 is a 3.5 GHz, low impedance Zo probe and comes standard with a 10X (500 Ω) attenuator tip. Attenuation values of 1X, 20X, and 100X are available as options to the standard product or as replaceable subassemblies. Although designed around the 11A52 and 11A71/11A72 plug-ins, the P6156 probes may be used with the other 11000-Series plug-ins, the 11800-Series SD2X Sampling/TDR plug-ins, 7000-Series plug-ins and Sampling/TDR units, 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 the 11000–Series mainframe 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 instruction sheet for proper usage. 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.

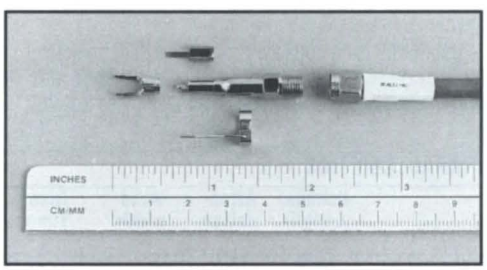
Note: The attenuator tip must be changed and the compensation box readout switch changed to provide the various 1X, 10X, 20X, and 100 attenuation values.



P6150

- DC to 9 GHz, 10X Probe, Low Impedance, Zo with 1X Accessory Tip
- Small Size
- Ideal for 50 Ω Environments
- Interchangeable Probe Tips (1X, 10X)
- Recommended Probe for 11800/SD-2X Family Sampling Plug-Ins
- SMA Cable Connectors for Optimum Signal Integrity
- High Quality, Flexible Probe Cable

The P6150 is a very high bandwidth, 10X attenuation, low impedance probe designed for use with the SD2X family of Sampling/TDR plug-ins. The probe consists of interchangeable, screw-in attenuator tip assemblies (1X and 10X) and an SMA-to-SMA probe cable. An assortment of circuit and grounding attachments are included to optimize attachment to the device under test, while maintaining high signal integrity.



P6150 Typical Accessories

CHARACTERISTICS

Probe Type	Nominal Length	Attenuation	Bandwidth	Rise Time	Loading Input R/C	Max V In (DC + Pk AC)	Instrument Input R/C	Propagation Delay	Interface/ Readout/ Identify
P6150	1 m	10X ± 2%	9 GHz	<38.8 ps	500 Ω/<0.15 pF	12.5 V	50 Ω	4.40 ns ± 0.1 ns	S/N/N
		1X ± 2%	≥3 GHz	≤170 ps	50 Ω/N/A	Scope Max	50 Ω	4.40 ns ± 0.1 ns	S/N/N
P6156	1.5 m	10X ± 3%	≥3.5 GHz	<100 ps	500 Ω/≤1 pF	15 V rms	50 Ω/1 MΩ	7.75 ns ± 0.07 ns	B/Y/Y
		100X ± 3%	≥3.0 GHz	≤120 ps	5000 Ω/≤1.1 pF (Typically 1 pF)	50 V rms	50 Ω/1 MΩ	7.75 ns ± 0.07 ns	B/Y/Y
		20X ± 3%	≥3.5 GHz	<100 ps	1000 Ω/≤1 pF	22 V rms	50 Ω/1 MΩ	7.75 ns ± 0.07 ns	B/Y/Y
		1X ± 5%	≥1.5 GHz	<300 ps	50 Ω/N/A	Scope Max	50 Ω/1 MΩ	7.75 ns ± 0.07 ns	B/Y/Y

Interface/Readout/Identify: Interface: B=BNC; S=SMA
Readout/Identify: Y=Yes; N=No

P6150

- *9 GHZ*

P6156

- *3.5 GHz Compact Tip*

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)*

FEATURES/BENEFITS

- *Low Capacitive Loading to Extremely High Frequencies*
- *Interchangeable Attenuator Tip Assemblies, 1X and 10X (20X and 100X P6156 only)*

ORDERING INFORMATION

P6150 10X, 9 GHz, 1.0 m, Low Impedance Probe **$1,260**
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 electric contact, and 2 each probe to circuit board ground connectors (020-1708-00).

P6156 10X, 3.5 GHz, 1.5 m Low Impedance Probe, Compact ☎ **$240**
Includes: Retractable hook tip (013-0107-06); 2 Circuit board connectors; 2 in. Ground lead (195-4240-00); 6 in. Ground lead (196-3113-02); Ground collar (343-1003-01); Alligator clip (344-0398-00); SMT Grabber (206-0364-00); 2 each cable markers various colors: gray, white, green, red; Probe tip holder (352-0670-00); Instruction sheet (070-6430-00).

Opt. 08 – Accessory Kit **+$355**
Opt. 25 – Adds 100X Attenuator ☎ **+$55**
Opt. 26 – Adds 20X Attenuator ☎ **+$55**
Opt. 27 – Adds 1X Attenuator ☎ **+$55**
Opt. 28 – Attenuator Kit ☎ **+$165**

OPTIONAL ACCESSORIES

SMA Male to BNC Female –
Order 015-0554-00 **$27**
SMA Female to BNC Male –
Order 015-0572-00 **$19.25**

For probe accessories, see pages 432-435. For replaceable modular sub-assemblies, see page 431. Instrument compatibility chart is on pages 406-408.

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

HIGH VOLTAGE PROBES FOR 1 MΩ INPUTS

P6007
- *DC to 25 MHz*
- *1500 V DC*
- *Low Capacitance – 2.0 pF*

P6009
- *DC to 120 MHz*
- *100X with Readout*
- *1500 V DC*
- *Low Capacitance – 2.5 pF*

P6015
- *DC to 75 MHz*
- *1000X*
- *Measure up to 40 kV Peak Pulse (100 ms)*
- *Up to 20 kV DC + Peak AC*
- *Safe Measurement of High Voltage Power Supplies, Industrial Motors, and Power Distribution Systems.*

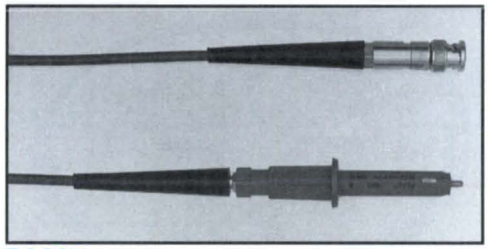
ORDERING INFORMATION

P6007 100X, 6 ft. High Voltage Probe ☎ **$140**
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); 0.055 in. Diameter straight tip (206-0015-00); 0.080 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 **+$5.00**
Opt. 03 – 9 ft.. cable **+$15**
Opt. 04 – 12 ft. cable **+$20**

P6009 100X, 9 ft. High Voltage Probe with Readout ☎ **$230**
Includes: Same as the P6007 plus Bayonet ground assembly (013-0052-00); 3 in. Ground lead (175-0263-01); Instruction manual (070-0401-01).
Opt. 14 – 9 ft. without Readout **NC**

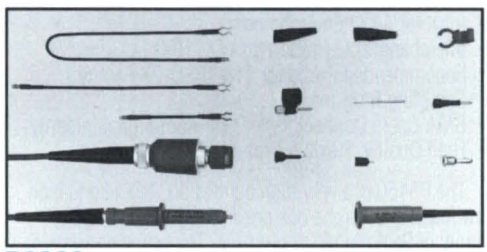
P6015 1000X, 10 ft. High Voltage Probe ☎ **$780**
Includes: Carrying case (016-0128-02); Alligator clip (344-0005-00); Probe holder (352-0056-00); Instruction manual (070-0373-02).
Opt. 10 – without CFC 114 freon charge, Max. 13 kV. **NC**
Opt. 25 – 25 ft. cable (8 MHz B/W) **+$105**
Opt. 26 – without CFC 114 freon charge, Max. 13 kV. **+$105**

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.



P6007

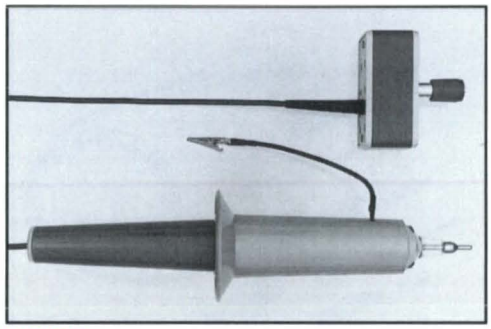
The P6007 is a low input capacitance, high-voltage (1.5 kV) probe. It can be compensated to match all plug-ins and oscilloscopes with nominal input capacitances of 15 to 55 pF and input resistance of 1 MΩ.



P6009

The P6009 is a low input capacitance, high-voltage (1.5 kV) probe designed for use with DC to 150 MHz oscilloscopes. The probe can be compensated to match plug-ins and oscilloscopes with nominal input capacitances of 12 to 47 pF and input resistance of 1 MΩ.

The P6009 is equipped with a special BNC connector that provides CRT Readout information when used with plug-in units and oscilloscopes that have these features.



P6015

The P6015 Provides 1000X attenuation for oscilloscope measurements up to 40 kV peak pulse (100 ms).

Voltage or duty cycle derating is necessary for RF voltages at frequencies over 100 kHz, or at temperatures above 25°C.

The probe can be compensated for instruments with nominal input capacitance of 12 to 47 pF and input resistance of 1 MΩ.

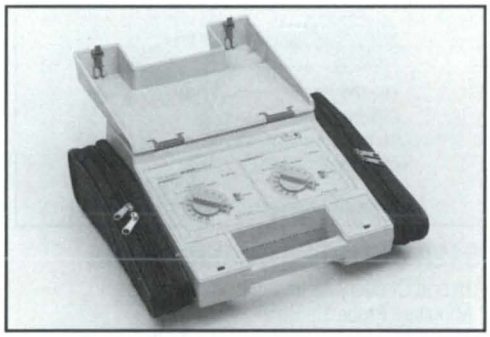
International agreements limit the shipment of the CFC 114 High Voltage Dielectric Fluid refill cans. Without an adequate level of CFC 114, the P6015 is rated at a maximum DC or RMS voltage of 13 kV. If you need to refill your probe, contact your local service center for information.

CHARACTERISTICS

	Nominal Length	Attenuation	Bandwidth	Rise Time	Loading	Max Input V	Scope C in pF DC or RMS	Readout
P6007 Opt. 01	3.5 ft	100X	25 MHz	14 ns	10 MΩ/2 pF	1.5 kV	15-55	NO
P6007	6 ft	100X	25 MHz	14 ns	10 MΩ/2.2 pF	1.5 kV	15-55	NO
P6007 Opt. 03	9 ft	100X	25 MHz	14 ns	10 MΩ/2.4 pF	1.5 kV	15-55	NO
P6007 Opt. 04	12 ft	100X	25 MHz	14 ns	10 MΩ/2.6 pF	1.5 kV	15-55	NO
P6009	9 ft	100X	120 MHz	2.9 ns	10 MΩ/2.5 pF	1.5 kV	15-47	YES
P6009 Opt. 14	12 ft	100X	120 MHz	2.9 ns	10 MΩ/2.5 pF	1.5 kV	15-47	YES
P6015	10 ft	1000X	75 MHz	4.0 ns	100 MΩ/3 pF	20 kV	12-47	YES
P6015 Opt. 10*[1]	10 ft	1000X	75 MHz	4.0 ns	100 MΩ/3 pF	13 kV	12-47	YES
P6015 Opt. 25	25 ft	1000X	8 MHz	43.8 ns	100 MΩ/4 pF	20 kV	12-47	YES
P6015 Opt. 25*[1]	25 ft	1000X	8 MHz	43.8 ns	100 MΩ/4 pF	13 kV	12-47	YES

*[1] *Probe without CFC 114 High Voltage Dielectric Fluid.*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.



A6902B VOLTAGE ISOLATION AMPLIFIER

A dual-channel, optical- and transformer-coupled voltage isolator, the A6902B allows safely grounded test instruments to make floating measurements at high sensitivity levels in the presence of large common mode signals. Placed between your grounded test instrument and the circuit you are testing, it allows you to safely make floating measurements up to to ±500 V (DC plus peak AC) with the small signal probes or ±3000 V (DC + peak AC) with the optional large probes. Both probes are quickly interchangeable at the cable connectors, and can be stored in convenient, removable side pouches.

Designed for use with any dual-channel oscilloscope, the A6902B permits simultaneous observation of two signals at two different points in the same circuit; or signals in two different circuits without respect to common lead voltages. The two channels can be combined to function as an input to a differential amplifier.

Separate, calibrated controls for volts per division on each channel allow precise floating measurements. The plastic case and external controls protect the user during control settings and other operations. Other than probe tip connections, the user is never in close proximity to hazardous voltages.

CHARACTERISTICS

ELECTRICAL

Deflection Factor – Probe Tip Sensitivity: 20 mV/div to 500 V/div in 1-2-5 sequence with oscilloscope set to 10 mV/div. Accuracy: ≤ 5% of indicated V/div switch setting.

Frequency Response Bandwidth – DC coupled (to –3 dB point) is ≥ 20 MHz. AC coupled (to lower – 3 dB point) is ≤ 5 Hz to ≥ 20 MHz. (50 to 500 V/div not specified).

Transient Response – Rise time: 17.5 ns.

Maximum Working Voltage

Small Probe (500 V) – Probe Center Tip to Earth Ground: 500 V (DC + peak AC). Probe Center Tip to Probe Common: 500 V (DC + peak AC) to 3 MHz. 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.

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 900 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 (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 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. When the isolated voltage exceeds 40 V peak (28 V RMS), the A6901 interrupts the power to the instrument, connects it to the power source grounding system and sounds an audible signal. The A6901 also tests for a functional ground between the power source and the instrument before the monitor goes into the isolation mode.

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.

A6901
Ground Isolation Monitor

- *Permits Elevation of Test Instrument Chassis to 40 V Peak (28 V RMS)*
- *Aids in Circuit Analysis or Circumventing Ground Loop Noise Problems*
- *UL and VDE Safety Certification*

A6902B
Voltage Isolation Amplifier

- *For 50 Ω or 1 MΩ Inputs*
- *Two Independently Isolated Channels*
- *High Voltage/High CMRR*
- *UL Certified to 3000 V/ Channel (6000 V Maximum Channel Differential)*[1]
- *DC to 20 MHz Bandwidth*

ORDERING INFORMATION

A6901 Ground Isolation Monitor ☎ **$830**
Includes: Operator manual (070-3618-00).

A6902B Voltage Isolator (500 V Max) ☎ **$2,070**
Includes: Two 500 V isolation probes (010-0411-15); Right angle power cord (161-0117-00); 72 in (183 cm), 50Ω output cables (012-0204-00); Operator manual (070-5614-00).

Opt. 02[*2] – Add two large probes. (010-0409-01) ☎ **+$580**

Opt. 09[*2] – Add two large probes plus two 4 mm banana adapters **+$670**

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**

[*1] *When ordered with Option 02 or 09.*

[*2] *Extends range to 3,000 volts per channel.*

For A6901 (North American 240 V not available. Neutral not grounded in 240 V North American Systems.)

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.

P6008
• 100 MHz, Environmental

P6048
• 100 MHz, Low Capacitance

P6053B
• DC to 200 MHz, 10X with Trace Identify and Readout

P6125
• 250 MHz, Counter/Timer

P6420
• 1 GHz, RF DMM

ORDERING INFORMATION

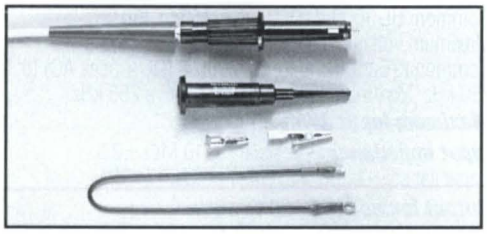
P6008 100 MHz Environmental Probe **$290**
Includes: Retractable hook tip (013-0071-01); Banana tip (134-0013-00); 12 in. Ground lead (175-0125-01); Alligator clip (344-0045-00); Probe holder (352-0090-00); Instruction sheet.

P6048 100 MHz Low Capacitance **$255**
Includes: Retractable hook tip (013-0090-00); 2 Probe tip ground covers (166-0404-01); Insulating sleeves (166-0433-00); 5 in. Ground lead (175-0124-01); 3 in. Ground lead (175-0263-01); Hook tip (206-0114-00); 2 Miniature alligator clips (344-0046-00); Probe holder (352-0090-00); Instruction manual.

P6053B 200 MHz, Trace Identify **$165**
Includes Bayonet tip (013-0085-00); Retractable hook tip (013-0107-06); 2 Probe tip ground covers (0166-0404-01); 5 in. Ground lead (175-0124-01); 3 in. Ground lead (175-0263-01); Hook tip (206-0114-00); 2 Alligator clips (344-0046-00); Probe holder (352-0351-00); 2 each of black, white and silver cable markers; Instruction sheet.
Opt. 01 – 3.5 ft. cable **+$5**
Opt. 03 – 9 ft. cable **+$15**

P6125 250 MHz Counter Probe **$90**
Includes: Adjustment tool (003-1433-00); Retractable hook tip (013-0107-06); Probe tip ground cover (166-0404-01); 8 in. Alligator ground lead (196-3286-00); 3.5 in. Ground lead (195-6176-00); Alligator clip (344-0046-00); 2 Silver cable marker bands; Instruction sheet.

P6420 2 m RF DMM Probe **$175**
Includes: Retractable probe tip (013-0097-01); 2 Alligator clips (344-0046-00); 2 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.



P6008 ENVIRONMENTAL PROBE

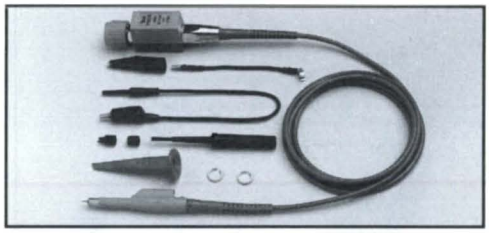
- – 50°C to +150°C Temperature Range

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.

P6048

- Minimum Loading, 1 pF at 1 kΩ
- AC/DC Switch

The P6048 is a miniature low capacitance probe for use with 1 MΩ 20 pF oscilloscopes. The probe input impedance of 1 k Ω paralleled by 1 pF is intended for applications where capacitive loading may distort the circuit waveforms. AC or DC coupling switch is available to extend the measurement range.



P6125 COUNTER/TIMER PROBE

- Hybrid Circuitry for Improved Performance
- Miniature Probe Tip Size

The P6125 is a low capacitance, 5X attenuation passive probe specifically designed for DC to 250 MHz digital counter/timers. Five-times attenuation provides an optimum match between the counter input characteristics and the voltage levels of all common logic families.

P6420

- RF Probe
- 10 kHz to 1GHz Bandwidth
- Voltage Range 0.5 to 25 V rms (70.7 V p-p)

The P6420 RF probe measures high frequency AC voltage from 10 kHz to 1 GHz. It provides a DC output voltage proportional to the RMS value of a sine-wave input.

P6053B (see photo at left)

- Miniature Probe Tip Size
- Trace Identify Button for Remote Selection of 7D20 Menus

The P6053B is a miniature fast-rise 10X passive voltage probe. The probe has a pushbutton for actuating the trace-identify function of the oscilloscope mainframe and readout capability. The P6053B is compatible with all miniature probe accessories.

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
P6048	6 ft	10X	100 MHz	1.95 ns	1 kΩ/≤1 pF	20 V DC/200 V AC	1 MΩ/15-20 pF
P6053B	3.5 ft	10X	200 MHz	1.75 ns	10 MΩ/9.5 pF	500 V	1 MΩ/15-24 pF
P6053B	6 ft	10X	200 MHz	1.75 ns	10 MΩ/12.5 pF	500 V	1 MΩ/15-24 pF
P6503B	9 ft	10X	115 MHz	3.05 ns	10 MΩ/13.5 pF	500 V	1 MΩ/15-24 pF
P6125	1.5 m	5X	250 MHz	N/A	5 MΩ/20 pF	250 V	1 MΩ/15-33 pF
P6420	2 m	N/A	10 kHz to 1 GHz	N/A	10 MΩ/3.7 pF	42.2 V	10 MΩ DMM

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

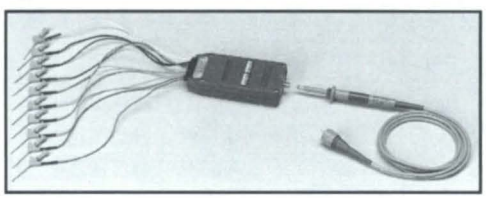
P6407/P6408

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. Probe power is supplied from the host oscilloscope.

The P6408 is available as an option to 2200-Series oscilloscopes and may be field-added at any time. The 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. An optional probe power cable is available that allows the P6408 to be powered from any Tek scope (with a probe power connector), 1101A probe power supply, or from a user-furnished + 5 V supply.

The P6408 includes a P6109, 10X, passive probe which couples the output of the probe pod to a 1 MΩ trigger input of the oscilloscope. This presents a low capacitance load to the probe pod and delivers a fast rise pulse to the scope's trigger input.



P6408

P6408 CHARACTERISTICS

Input Channels – 16 data channels, 1 qualifier channel.

Input Logic Levels – HI/ONE, + 2.0 V or greater; LO/ZERO, + 0.7 V or less.

Maximum Input Voltage Swing – 0 V to V cc.

Maximum Non-destructive Input Voltage – –1 V (LO), +15 V (HI).

Minimum Input Pulse Width – 10 ns for any single channel; 40 ns for any channel combination.

Input to Output Delay – 20 ns max.

Output Pulse Width – 10 ns min. for any single channel; 27 ns max. for any channel combination.

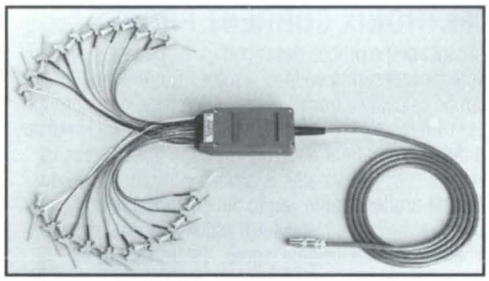
Output Pulse Rise Time – 10 ns max.

Output Pulse Fall Time – 10 ns max.

Output Voltage Level – HI/ONE, + 200 mV or greater; LO/ZERO, + 70 mV or less; (AT output of P6109).

Power Requirements – Volts: + 5 V ±0.25 V

Current: 100 mA max.



P6407

P6407 CHARACTERISTICS

INPUTS AND OUTPUTS

INPUT VOLTAGES

Minimum Input Voltage – – 0.5 V

Maximum Input Voltage – 5.5 V

Maximum Input Low Voltage – 0.6 V

Minimum Input High Voltage – 2.0 V

WORD RECOG OUT

High – > 2.5 V LSTTL output

Low – < 0.5 V LSTTL output

Input High Current – 20 µA

Input Low Current – – 0.6 mA

SYNCHRONOUS MODE

Data Setup Time – 25 ns

Data Hold Time – 0 ns

Minimum Clock Pulse Width – High 20 ns, Low 20 ns

Minimum Clock Period – 50 ns

Delay from Selected Clock Edge to Word Out – < 55 ns

ASYNCHRONOUS MODE

Maximum Trigger Frequency – 10 MHz

Minimum Coincidence Between Data Inputs Resulting in a Trigger – 85 ns

Maximum Coincidence Between Any Two Data Inputs Without Producing a Trigger – 20 ns

Delay from Input Word Coincidence to Word Out – < 140 ns

P6407/P6408

Word Recognizer/Trigger Probes

- *For TTL and TTL-Compatible Logic*
- *Allows Oscilloscope to Trigger on User-Defined Logic States*
- *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*

ORDERING INFORMATION

P6407 Word Recognizer/Trigger Probe **$490**
Includes: 2 (10 wide) Lead headers (012-0747-01); Pkg of 20 SMT Grabber Clips (SMG50); Instruction sheet (070-5582-00).

P6408 Word Recognizer/Trigger Probe ☎ **$350**
Includes: 2 (10 wide) Lead headers (012-0747-01); Pkg. of 20 SMT Grabber Clips (SMG50); P6109 Probe (complete package); Instruction sheet (070-6938-00).

OPTIONAL ACCESSORY

Probe Power Cable – Order 174-1342-00 **$50**

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

TEKTRONIX CURRENT PROBES

Most of the probes described in the previous sections were for measuring voltage signals. Current amplitudes can be calculated from a measured voltage drop through a known resistance value by using Ohm's Law. However, to develop a current waveform through this process is tedious and, realistically, is probably impossible to do. Current probes enable you to directly observe and measure the current waveform which may be very different from the voltage signal. Tektronix current probes are unique in that they can measure and, with an oscilloscope, actually display current waveforms from DC to 1 GHz. Two types of current probes are available: one that measures AC current only and AC/DC probes which utilize the Hall Effect to accurately measure the AC or DC components of a DC or mixed AC/DC signal. AC only current probes use a transformer to convert AC current flux into a voltage signal to the oscilloscope and have a frequency response from a few hundred hertz up to 1 GHz. AC/DC current probes include Hall Effect semiconductor devices and provide frequency response from DC to 50 MHz.

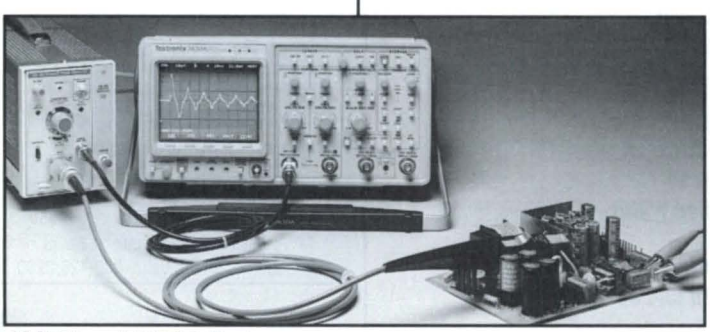
A current probe is used by clipping its jaws around the wire that is carrying the current to be measured, unlike an ammeter which must be connected in series with the circuit. Because current probes are non-invasive, with loading typically in the mΩ to low Ω range, they are especially useful where low loading of the circuit is important. Current probes can also make differential measurements by measuring the results of two opposing currents in two conductors in the jaw of the probe.

The CT-4 increases the high-current measuring capability of most current probes by either 20:1 or 1000:1.

LITERATURE

The following literature on current probes is available from Tektronix:

Title/Description	Literature Number
Data Sheets	
P6021/P6022	60W-6647
A6302/AM503	60W-6649
A6303/AM503	60W-6648
CT-1/CT-2	60W-6645
Application Note	
Switching Power Supply Testing Using the 11000 Series Scopes	47W-6550



AM503 and 2430A Scope

P6021, P6131, and 2430A Scope

CURRENT PROBE SELECTION GUIDE

Type	Bandwidth	Maximum Current					Saturation			
					Derate					
	Hz to MHz (–3 dB)	Pulse Peak	DC + pk AC	AC P-P	Below	Above	DC	Amp-S Product	Display Sensitivity Range in Current/Div.	Prices
A6302/AM 503	DC to 50	50 A	20 A	40 A		20 kHz	20 A	$100x10^{-6}$	1 mA to 5 A*1	$2,000
with CT-4	0.5 to 20	1 kA		1 kA	20 Hz	1.2 kHz		0.1	20 mA to to 5 kA*1	$3,430
A6303/AM 503	DC to 15	500 A	100 A	200 A		20 Hz	100 A	$10,000x10^{-6}$	10 mA to 50 A*1	$2,570
P6021 with Passive Termination	120 to 60	250 A		15 A	300 Hz	5 MHz	0.5 A	$500x10^{-6}$ 100 mA*1	20 mA*1 or 100 mA*1	$480
P6021 with CT-4	120 to 20	1 kA		1 kA	300 Hz	1.2 kHz	20 A	0.5	400 mA*1 or100 A	$1,910
P6021 with 134	12 to 38	250 A		15 A	230 Hz	5 MHz	0.5 A	$500x10^{-6}$	1 mA to 1 A*2	$1,200
P6021 with 134 and CT-4	25 to 20	1 kA		1 kA	230 Hz	1.2 kHz	20 A	0.5	20 mA to 1 kA*2	$2,630
P6022 with Passive Termination	935 to 120	100 A		6 A	3 kHz	10 MHz	0.2 A	$9x10^{-6}$	10 mA or 100 mA*1	$530
P6022 with 134	100 to 65	100 A		6 A	1.3 kHz	10 MHz	0.2A	$9x10^{-6}$	1 mA to 1 A*2	$1,250
CT-1	25 k to 1000	12 A		1.4 A			0.2 A	$1x10^{-6}$	2,0 mA*1 (5 mV/mA)	$260
CT-2	1.2 k to 200	36 A		7 A			0.2A	$50x10^{-6}$	10.00 mA*1 (1 mV/mA)	$230

*1 *Scope set at 10 mV/div.*

*2 *Scope set at 50 mV/div.*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

AM 503S CURRENT PROBE SYSTEM

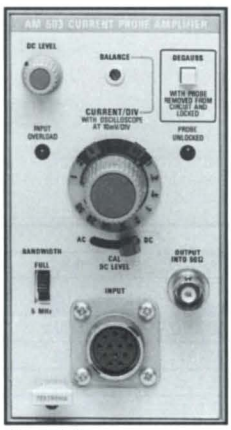
The AM 503S Current Probe System provides you the capability to measure both AC and DC current with one probe. The AM503S consists of an A6302 or A6303 Current Probe, an AM 503 Current Probe Amplifier and a TM 502A Power Module. The DC current flux field is sensed by the Hall Effect semiconductor device in the A6302/3, converted to a voltage and transmitted to the oscilloscope by the AM503. Simultaneously, the AM503 passes an opposing DC current of equal magnitude through the jaw of the probe. This "bucking" current cancels out the saturation effect of the DC current on the probe core and allows accurate measurement of the AC current in the device under test. You attach the probe by sliding back the top jaw, placing the conductor inside the probe core and sliding the jaw back into place enclosing the conductor completely within the probe core. The movable opposing surfaces of the core are polished to micron tolerances to ensure minimum gap.

To achieve optimum performance the current probe and current probe amplifier should be calibrated as a system. The AM 503S system provides a fully calibrated system.

AM 503 CURRENT PROBE AMPLIFIER

The AM 503 operates in any one of the TM 500/TM 5000 power modules and is connected to the A6302 or A6303 probes through a multipin connector.

The illuminated knob skirt indicates current per division for each of the 12 attenuation settings. Bandwidth can be limited to 5 MHz to eliminate unwanted transients. Both AC and DC coupling are provided. AC coupling allows the measurement of low amplitude signals on a high level DC current. A front panel light warns of input currents above 100 A DC with the A6303 or 20 A DC with the A6302. A pushbutton allows degaussing of the probe when it is removed from the circuit and locked in operating position.

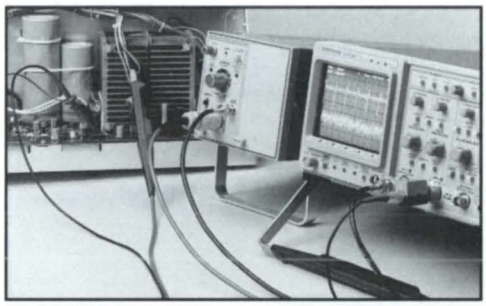


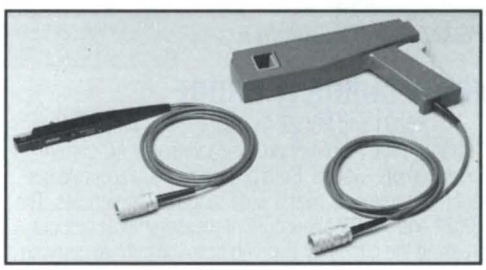
AM 503

The output of the A6303/AM 503 can be displayed on any oscilloscope that has at least a 50-MHz bandwidth and a 10 mV sensitivity. The A6302/AM 503 can be used on a 100-MHz oscilloscope with 10 mV sensitivity to display the probe's full bandpass. The AM 503 output can also be plugged directly into a 50 Ω recording instrument.

A6302/A6303 CURRENT PROBES

The A6302 and A6303 Current Probes are designed to be used with the AM 503 Current Probe Amplifier, any TM 500/TM 5000 Power Module and an oscilloscope. Both probes are used to make SCR, power supply, industrial control and motor start-up current measurements. The A6303 is recommended for measuring current in X-ray tubes to ensure compliance with PL 90-602, the Radiation Control for Health and Safety Act of 1968.


AM 503S (in use)


A6302 (left) and A6303 shown.

CHARACTERISTICS

	A6302/AM 503*[1]	A6303/AM 503*[1]
Sensitivity: Scope @ 10 mV/div Accuracy 3%	1 mA/div to 5 A/div	10 mA/div to 50 A/div
Bandwidth	DC to 50 MHz	DC to 15 MHz
Rise Time	7 ns	23 ns
Max AC Current CW	40 A p-p	200 A p-p
Derated Above	20 kHz 2.5 A @ 10 MHz	20 kHz 12 A @ 10 MHz
Maximum Peak Current Not to Exceed A-S Product	50 A	500 A
A-S Product	100×10^{-6}	$10{,}000 \times 10^{-6}$
Insertion Z	0.1 Ω @ 5 MHz 0.5 Ω @ 50 MHz	0.02 Ω @ 1 MHz 0.15 Ω @ 15 MHz
Max Barewire Volts	500 V	700 V
Max conductor Diameter	0.15 inch	0.83 inch
System Prop Delay	≈30 ns	≈40 ns
Cable Length	2 m	2 m
Tangential Noise	0.3 mA	3 mA
Aberrations	± 5%	± 5%
Magnetic Susceptibility	250 µA/Gauss	25 mA/Gauss
Operating Temp	0 to + 50°C	0 to + 50°C

*[1] *A6302/AM 503 or A603/AM 503 calibrated as a set.*

AM 503S
Current Probe System

TYPICAL APPLICATIONS

- *X-ray Tube Currents*
- *SCR Currents*
- *Power Supply Currents*
- *Motor Start-Up Currents*
- *Industrial Control Currents*
- *Relay Currents*
- *Common-Mode Rejection of DC and AC currents*

FEATURES/BENEFITS

- *20 A/100 A (with A6303) AC and DC Current Measurements*
- *DC to 50 MHz Bandwidth*
- *Peak Pulse Measurements to 50 A, 1,000 A With the CT-4 Current Probe*
- *AC and DC Current Measurements*
- *AC or DC Coupling*
- *Minimal Loading*
- *0.15 or 0.83 inch (A6303) Jaw Opening*
- *For 50 Ω Inputs (from AM 503)*

ORDERING INFORMATION

AM 503S Current Probe System ☎ **$2,200**
Includes: AM 503 Current Probe Amplifier; TM 502A Power Module; A6302 Current Probe; Plug-in tool box (016-0362-02).
Opt. 01 – Adds A6303 Current Probe ☎ **+$1,175**
Opt. 03 – Substitute A6303 for A6302 ☎ **+$550**

AM 503 Current Probe Amplifier **$1,330**
Includes: BNC cable (012-0057-01); 50 BNC termination (011-0049-01); Instruction manual (070-2052-01).
The AM 503 requires one of the TM 500/5000 Series power modules. See page 257.

A6302 2 m Current Probe **$670**
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); Instruction manual (070-3905-01).

A6303 2 m Current Probe **$1,240**
Includes: Carrying case (016-0622-00); Instruction manual (070-3906-01).
Data sheets for the AM503S (60W-7394); A6302 (60W-6649); and A6303 (60W-6648) are available.

☎ Product available through Tek Direct. Call 1-800-426-2200.

P6021

- *120 Hz to 60 MHz*
- *15 A Peak*
- *For 1 MΩ Inputs*
- *Clip-on Capability*
- *Shielded Probe Heads*

P6022

- *8.5 kHz to 120 MHz*
- *6 A Peak*
- *For 1 MΩ Inputs*
- *Clip-on Capability*
- *Shielded Probe Heads*

ORDERING INFORMATION

P6021 5 ft Current Probe With Termination ☎ **$480**
Includes: 5 in (130 mm) Ground lead (175-0124-01); 3 in (75 mm) Ground lead (175-0263-01); Two miniature alligator clips (344-0045-00); Instruction manual (070-0947-00).

P6022 5 ft Current Probe With Termination ☎ **$530**
Includes: Same as the P6021; Instruction manual (070-0948-00).

Opt. 03 – 9 ft with termination **+$30**
Opt. 12 – 5 ft without termination
(P6021) **–$40**
(P6022) **–$65**
Opt. 13 – 9 ft without termination
(P6021) **–$40**
(P6022) **–$65**

134 Current Probe Amplifier ☎ **$720**
Includes: Hanger assembly (014-0029-00); Cable assembly (012-0104-00); Power supply (015-0058-02); Instruction manual (070-0990-01).
Opt. 01 – 230 V Power Supply *1

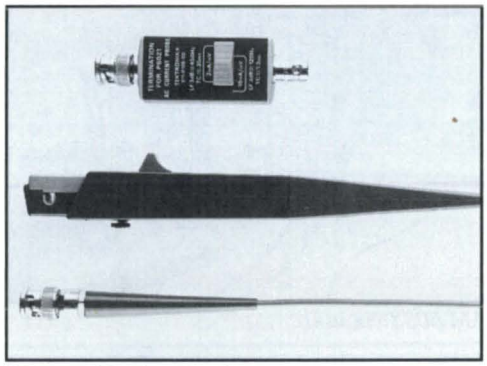
INTERNATIONAL POWER PLUG OPTIONS

134 Opt. 01 A1 – Universal Euro 220 V, 50 Hz. **NC**
134 Opt. 01 A2 – UK 240 V, 50 Hz. **NC**
134 Opt . 01 A3 – Australian 240 V, 50 Hz. **NC**
134 Opt. 01 A4 – North American 240 V, 60 Hz. **NC**
134 Opt. 01 A5 – Switzerland 220 V, 50 Hz. **NC**

OPTIONAL ACCESSORIES

Carrying Case – For P6021 or P6022, and a 134 Amplifier. Order 016-0087-01 *1
Passive Termination –
(P6021) – Order 011-0105-00 **$130**
(P6022) – Order 011-0106-00 **$155**
Power Supply – (110 V AC) Order 015-0058-02 **$165**
Power Supply – (230 V AC) Order 015-0059-02 *1

☎ Product available through Tek Direct. Call 1-800-426-2200.
*1 *Contact your local sales representative.*



P6021 with Termination.

P6021 CURRENT PROBE

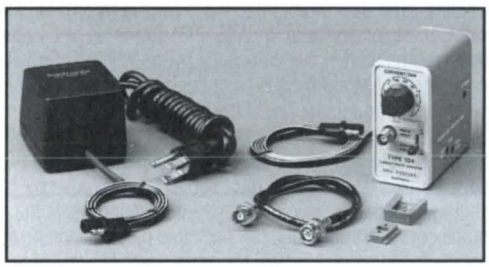
The P6021 and P6022 Current Probes with the 134 Current Probe Amplifier provide a versatile AC current measurement system. Both probes provide accurate current measurements over a wide range of frequencies. The P6021 and P6022 allow current measurements without breaking the circuit by clipping onto the current carrying conductor. Just open the spring-loaded slide, place the conductor into the slot and lock it closed. No electrical connection is required. Shielded probe heads are not grounded when the slides are in their open positions, eliminating accidental grounding of the circuit under test.

P6021 and P6022 data sheet (60W-6647) is available.

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

The extra small size of the P6022 makes it ideally suited to measure current in compact semiconductor circuits. Bandwidth is 935 Hz to 120 MHz. Passive termination is switchable from 1 mA/mV to 10 mA/mV.



134 Current Probe Amplifier

134 CURRENT PROBE AMPLIFIER

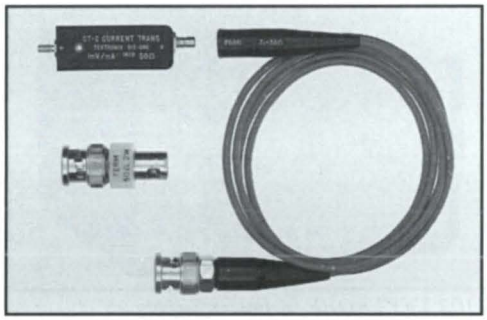
The 134 is used to extend the measurement capabilities and sensitivity of the P6021 or P6022 Current Probes. A Current/Div switch provides calibrated current steps from 1 mA/div to 1 A/div (with the oscilloscope or plug-in unit adjusted for a deflection factor of 50 mV/div). When using a 134 with a P6021 or P6022, a 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.

CHARACTERISTICS

	P6021		P6022		P6021 (w/134)	P6022 (w/134)
Accuracy 3% Sensitivity	2 mA/mV	10 mA/mV	1 mA/mV	10 mA/mV	1 mA to 1 A/div @ 50 mV/div	
Bandwidth Low – 3 dB High – 3 dB	450 Hz 60 MHz	120 Hz 60 MHz	8.5 kHz 100 MHz	935 Hz 120 MHz	12 Hz 38 MHz	100 Hz 65 MHz
Rise Time	5.8 ns	5.8 ns	2.7 ns	1.7 ns	9.2 ns	5.4 ns
Droop TC	0.35 ms	1.3 ms	18.7 µs	0.17 ms	13 ms	1.6 ms
Maximum AC CW From To	15 A peak (1.2 kHz to 5 MHz)	15 A peak (300 Hz to 5 MHz)	6 A peak (10 kHz to 10 MHz)	6 A peak (3 kHz to 10 MHz)	15 A peak (230 Hz to 5 MHz)	6 A peak (1.3 kHz to 10 MHz)
Maximum Peak Current	250 A	250 A	100 A	100 A	250 A	100 A
Amp/Second Product	$500x10^{-6}$	$500x10^{-6}$	$9x10^{-6}$	$9x10^{-6}$	$500x10^{-6}$	$9x10^{-6}$
Maximum DC	0.5 A	0.5 A	0.2 A	0.2 A	0.5 A	0.2 A
Insertion Z (Ω)	0.03 @ 1 MHz 1.0 @ 60 MHz	0.03 @ 1 MHz 1.0 @ 60 MHz	0.03 @ 1 MHz 0.2 @ 120 MHz	0.03 @ 1 MHz 0.2 @ 120 MHz	0.03 @ 1 MHz 1.0 @ 38 MHz	0.03 @ 1 MHz 0.2 @ 65 MHz
Propagation Delay (ns) 5 ft. 9 ft.	 9 15	 9 15	 9 15	 9 15	 9 15	 9 15
Maximum Voltage (Barewire)	600 V	600 V	600 V	600 V	600 V	600 V
Net Weight	≈1 lb.		≈1 lb.		≈5 lb.	
Maximum Conductor Size	0.15 in. dia		0.1 in. dia		0.15 in dia	0.1 in. dia
Operating Temperature	0 to 50°C		0 to 50°C		0 to 50°C	

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.



CT-2 with Probe Cable

CT-1/CT-2 CURRENT PROBES

The CT-1 and CT-2 Current Probes are designed for permanent or semipermanent in-circuit installation. Each probe consists of a current transformer, an interconnecting cable and a termination. The current transformers have a small hole through which a current carrying conductor is passed during circuit assembly. One probe cable can be used to monitor several current transformers that have been wired into a circuit.

The P6041 Probe Cable provides the connection between the CT-1 and CT-2 current transformers with a BNC oscilloscope input. A 50 Ω termination is used to terminate the cable at the high impedance input of an oscilloscope.

The P6040 Probe Cable is also available to connect the CT-1 to a GR scope input. This cable can also be used with other test point connectors such as Amphenol Series 27 Sub-Minax or Sealectro Sub-Miniature RF connectors.

A data sheet (60W-6645) for the CT-1 and CT-2 is available.

CHARACTERISTICS

	CT-1	CT-2
Sensitivity	5 mV/mA	1 mV/mA
Accuracy	±3%	±3%
Rise Time	350 ps	500 ps
Frequency Response*1		
Low: –3 dB	25 kHz	1.2 kHz
High: –3 dB (–1 dB/CT-2)	1 GHz	200 MHz
Insertion Impedance at:		
10 MHz	≈ 1 Ω	0.1 Ω
100 MHz	2 Ω	0.5 Ω
Capacitive Loading Barewire	1.5 pF for #14	1.8 pF for #16
Maximum Barewire Voltage	1000 V	1000 V
DC Saturation Current:		
Current to Reduce LR by X2	75 mA	175 mA
Pulse Current Rating*2	12 A	36 A
Not to Exceed:		
Amp S Product*2	1×10^{-6}	50×10^{-6}
Maximum CW Current*2	450 mA	2.5 A
Cable Length	42 inch	
Prop Delay	6.1 ns	
Cable Connector	BNC	
Operating Temperature	– 25°C to + 65°C	

*1 *System* $B/W = \sqrt{probe\ B/W^2 + scope\ B/W^2}$

*2 *With 50 Ω termination. Values are reduced by a factor of 2 if unterminated.*

CT-4 CURRENT PROBE

The CT-4 is a clip-on high current transformer that extends the measurement capability of the P6021 and A6302 clip-on current probes. Maximum low frequency performance down to 0.5 Hz is obtained using the AM 503S. Pulse current to 1,000 amps may be measured using the A6302 or P6021 (with passive termination) provided the amp/second product ratings are not exceeded. The P6021 and 134 may be used for measurements at normal line frequency and above. (The P6022 and A6303 are not compatible with the CT-4).

The CT-4 has receptacles for current probes in either 20:1 or 1000:1 step-down ratios.

The 1.5 inch square opening makes it possible to clip onto large conductors without breaking the circuit under test. Insulated core and shield assemblies allow measurements on bare wires to 3000 V, and to 10 kV RMS with a high voltage bushing. A dc bucking coil assembly allows up to 300 A of dc to be nullified (derates to 1 MHz B/W). This is very useful for measuring AC signals on top of a DC voltage level.

CHARACTERISTICS

The following are characteristics of the CT-4 using either the AM 503S or P6021/134 combinations.

Rise Time – ≈ 17.5 ns

Insertion Impedance – ≈ ≤ 20 μΩ at 60 Hz and 30 mΩ at 1 MHz.

Current Display Range – 20 mA/div to 100 A/div with AM 503S, and 20 mA/div to 20 A/div with P6021/134 (20:1 step down ratio); 1 A/div to 5 kA/div with AM 503S, 1 A/div to 1 kA/div with P6021/134, (1000:1 step down ratio).

Maximum Current – Up to 1,000 A peak.

Accuracy – ±4% when less than 20 A DC current present.

Maximum Voltage of Circuit Test – 3000 V (barewire). 10 kV RMS with high voltage bushing.

Maximum DC Bucking Current – 300 mA to buck out 300 A DC (using DC bucking coil).

PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	57	2.3
Height	241	9.5
Depth	266	10.5
Weight ≈	**kg**	**lb**
Net	1.8	4.0

CT-1

- *25 kHz to 1 GHz*
- *12 A Max Pulse Current*
- *450 mA Max CW Current*
- *For 50 Ω Input*

CT-2

- *1.2 kHz to 200 MHz*
- *36 A Max Pulse Current*
- *2.5 A Max CW Current*
- *For 50 Ω Input*
- *450 mA Max*

CT-4

- *Pulsed Currents to 1,000 A*
- *Continuous Currents Up to 700 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*

ORDERING INFORMATION

CT-1 Current Probe, Current Transformer and Probe Cable (42 inch). **$260**
Includes: Instruction manual (070-0375-01).
Opt. 08 – Substitute P6040 GR connector Probe Cable. *1
Opt. 09 – Current Transformer only. **–$85**

P6040 Probe Cable (18 inch) only **$120**

CT-2 Current Probe, Current Transformer, Probe Cable, Termination. **$230**
Includes: termination (011-0049-01); instruction manual (070-0406-01).
Opt. 09 – Current Transformer only **–$55**

P6041 – Probe Cable (42 inch) only. **$80**

CT-4 Current Probe With dc Bucking Coil. ☎ **$1,430**
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).

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

*1 *Contact your local sales representative.*

CURRENT MEASUREMENT COMBINATIONS

			Maximum Current	
Product	**Bandwidth**	**A-s Product**	**RMS**	**Peak Pulse**
CT-4/AM 503S	0.5 Hz to 20 MHz	0.1	700 A	1 kA
CT-4/P6021/134	25 Hz to 20 MHz	0.5	700 A	1 kA
CT-4/P6021/Term	120 Hz to 20 MHz	0.5	700 A	1 kA

PROBE POWER SUPPLIES

1101A

- *Powers Up to Two Probes*
- *For Probe Use with Oscilloscopes That Do Not Have Probe Power*
- *Compatible with the P6201, P6202A, and P6230*
- *Overload Protected*

1102

- *Powers Up to Four Probes*
- *For Probe Use with Oscilloscopes That Do Not Have Probe Power*
- *Compatible with P6501, P6511, P6515, and A6501*
- *Overload Protected*

1103

- *Powers Up to Two Probes*
- *For Use with 11000 Series Probes on Non-TEKPROBE™ Interfaced Oscilloscopes*
- *For Use with the P6701/2/3 Optical Probes*
- *For Use with the P6203/ P6204 Active Probes and P6231 Bias-Offset Probe*
- *Overload Protected*

ORDERING INFORMATION

1101A Accessory Power Supply ☎ **$450**
1102 Accessory Power Supply **$300**
1103 TEKPROBE™ Power Supply ☎ **$375**

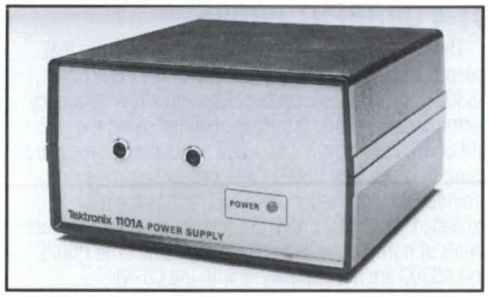
INTERNATIONAL POWER PLUG OPTIONS

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**

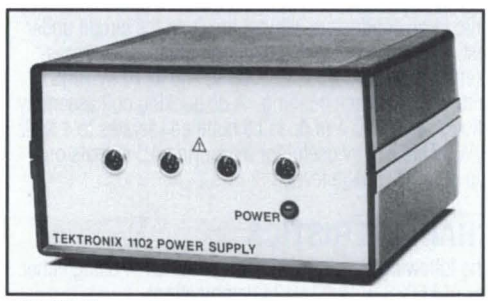
OPTIONAL ACCESSORIES (for 1103)

36 " Precision 50 Ω BNC cable – Order 012-0482-00 **$29**
50 Ω Feedthru Termination – Order 011-0049-01 **$33**

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.



1101A Power Supply



1102A Power Supply

1103 TEKPROBE ™ Power Supply

The 1101A, 1102, and 1103 are accessory power supplies that provide external power to probes, when the oscilloscope used does not have the capability to supply probe power. All power supplies are overload protected. The 1102 and 1103 have a convenient On/Off switch (located on the back panel).

The 1101A has two power receptacles that will power up to two independent probes, such as the P6201, P6202A, or P6230.

The 1102 has four power receptacles that will power up to four independent probes, such as the P6511 or P6515 spring contact probes. With the 174-0943-00 interface cable, the 1102 will power the P6501 microprobe or A6501 buffer amplifier.

The 1103 allows customers to use probes requiring TEKPROBE ™ Interface power with any oscilloscope or digitizer which does not provide TEKPROBE ™ power. The 1103 has dual TEKPROBE ™ inputs, dual BNC signal outputs, and dual voltage offset on/off switches and potentiometers.

The offset control supplies a voltage, adjustable via the front panel potentiometer. This voltage is used to control offset of probes such as the P6701/02/03 optical to electrical converters or the P6203/P6204 Active Probes.

CHARACTERISTICS

ELECTRICAL CHARACTERISTICS

	1101A	1102	1103
Output Voltage ±2%	+15 V +15 V + 5 V	+15 V –15 V + 5 V – 5 V	+15 V –15 V + 5 V – 5 V
Output Current	300 mA	300 mA	300 mA
Ripple	≤ 5 mV (rms)		
Outputs			
Pin 1:	+ 5 V	+ 5 V	n.c.
Pin 2:	Common	+15 V	n.c.
Pin 3:	–15 V	–15 V	+ 5 V
Pin 4:	+15 V	– 5 V	+15 V
Pin 5:		Common	Offset ± 1 V
Pin 6:			– 5 V
Pin 7:			–15 V
Line Voltage	Low Range: 87 VAC to 128 VAC High Range: 174 VAC to 250 VAC		
Line Frequency	48 to 440 Hz		
Power Consumption	≤ 30 W	≤ 35 W	≤ 35 W

PHYSICAL CHARACTERISTICS

	1101A	1102	1103
Dimensions	**cm (in.)**	**cm (in.)**	**cm (in.)**
Depth	16.5 (6.5)	16.5 (6.5)	17.8 (7.0)
Width	15.8 (6.2)	15.8 (6.2)	15.8 (6.2)
Height	8.9 (3.5)	8.9 (3.5)	8.9 (3.5)
Weight	**kg (lb)**	**kg (lb)**	**kg (lb)**
Net	1.6 (3.5)	1.6 (3.5)	1.8 (3.9)

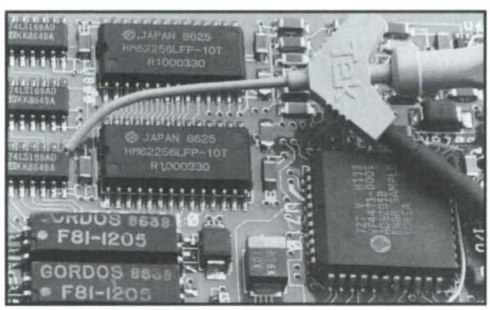
To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

NEW

SURFACE MOUNT DEVICE INTERCONNECTS

A rapidly growing area in Electronic Circuit Boards (ECB) is the incorporation of Surface Mount Technology (SMT). Increased circuit density, increased product reliability, and lower assembly costs are among the many benefits of this new technological trend.

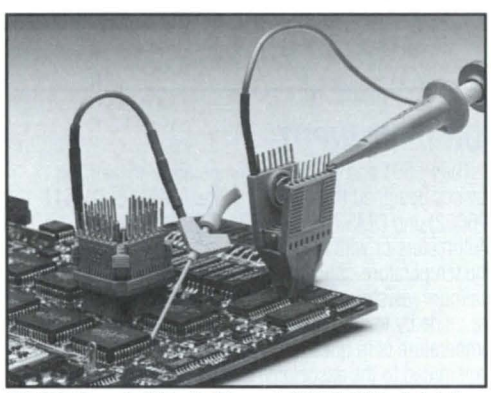
Troubleshooting and device interconnection, however, have become more difficult due to decreased device size, tighter lead spacing and increased ECB densities. These requirements have influenced the new offering of the following SMT interconnect devices.



SMT Grabber Clip

SMT Grabber Clips

The SMT grabber clip is an interface device for attachment of logic and analog probes to today's SMD's, DIP's, and discrete components. The SMT Grabber is capable of attaching to components with maximum lead diameters of 0.095" and stackable on lead centers of 0.050". Dual sided 0.025" lead contacts allow this grabber to be used in multiple signal insertion/ acquisition.



PLCC Quad Clip (left) and SOIC Clip (right).

PLCC Quad Clips

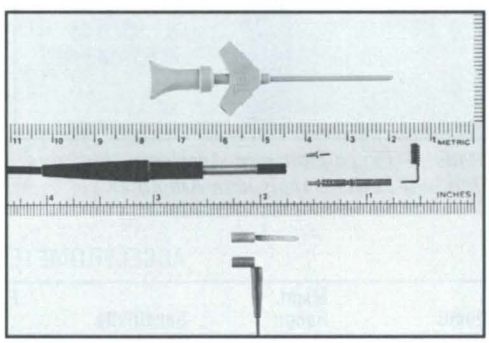
The Snap-Ring design allows for quick and easy interconnection to Plastic Leaded Chip Carriers (PLCC) with "J" leads on 0.050" centers. Test contacts are gold-plated beryllium copper which provide low contact resistance.

SOIC Clips

Provides hands-free testing of onboard Small Outline Integrated Circuits (SOIC). These clips are compatible with gull wing and "J" leads on 0.050" centers. Features gold-plated beryllium copper contacts with glass-filled nylon insulation. Upper contact pins: 0.64 mm (0.025") square pins.

P6562

The P6562 probe has a small, low-mass head/cable for easy access to multiple points. It is designed for use in digital circuitry and telecommunication/computer backplanes. For a complete description and ordering information see page 413.



P6562 with Typical Accessories

SMT Grabber Clips

SMG50/SMGK51/SMGK52

SOIC Clips

SMC8/SMC14/SMC16/SMC20/ SMC24

PLCC Quad Clips

SMQ20/SMQ28/SMQ44/ SMQ52/SMQ68
NEW SMQ84

Engineering Kits

PLCC – SMQK1/SOIC – SMCK1

New P6562

350 MHz
"Micro-Miniature" Probe

TYPICAL APPLICATIONS

- *Research and Design*
- *Manufacturing Test of SMT Circuitry*
- *Servicing of Circuitry with SMT Devices*
- *Prototype Debug and Design*

FEATURES

- *Easier Access to Multiple Point Connections*
- *Access to 0.050" Centers PLCC, SOIC, and other Packages with the SMT Grabber Clip*
- *Signal Insertion and Temporary Lead Jumpers without Soldering*

ORDERING INFORMATION

SMG50 SMT Grabber Clips ☎ $89
Includes: 20 SMT Grabber Clips

SMGK51 SMT Grabber Leads ☎ $30
Includes: 4 SMT Grabbers; 3 Electrical Leads.

SMGK52 SMT Grabber Adapters ☎ $60
Includes: 5 SMT Grabbers; 3 Electrical Leads; 1 Dual Lead Adapter; 1 Flex Tip Adapter.

SMCK1 SOIC Engineering Kit ☎ $90
Includes: 1 each of 8, 14, 16, 20, 24 Pin SOIC Clips plus 4 SMT Grabbers, 8 Electrical Leads w/ (0.025") Square Pin Connectors.

SMC8 SOIC Twin Pack ☎ $39
Includes: 2 each 8 Pin SOIC Clips; 2 each SMT Grabbers; 4 Electrical Leads.

SMC14 SOIC Twin Pack ☎ $40
Includes: 2 each 14 Pin SOIC Clips; 2 each SMT Grabbers; 4 Electrical Leads.

SMC16 SOIC Twin Pack ☎ $41
Includes: 2 each 16 Pin SOIC Clips; 2 each SMT Grabbers; 4 Electrical Leads.

SMC20 SOIC Twin Pack ☎ $43
Includes: 2 each 20 Pin SOIC Clips; 2 each SMT Grabbers; 4 Electrical Leads.

SMC24 SOIC Twin Pack ☎ $47
Includes: 2 each 24 Pin SOIC Clips; 2 each SMT Grabbers; 4 Electrical Leads.

SMQK1 PLCC Engineering Kit ☎ $230
Includes: 1 each of 20, 28, 44, 52, 68, 84 Pin PLCC Clips plus 4 SMT Grabbers, 8 Electrical Leads w/(0.025") Square Pin Connectors.

SMQ20 PLCC Twin Pack ☎ $90
Includes: 2 each 20 Pin PLCC Clips; 2 each SMT Grabbers; 4 Electrical Leads.

SMQ28 PLCC Twin Pack ☎ $92
Includes: 2 each 28 Pin PLCC Clips; 2 each SMT Grabbers; 4 Electrical Leads.

SMQ44 PLCC Twin Pack ☎ $94
Includes: 2 each 44 Pin PLCC Clips; 2 each SMT Grabbers; 4 Electrical Leads.

SMQ52 PLCC Twin Pack ☎ $97
Includes: 2 each 52 Pin PLCC Clips; 2 each SMT Grabbers; 4 Electrical Leads.

SMQ68 PLCC Twin Pack ☎ $99
Includes: 2 each 68 Pin PLCC Clips; 2 each SMT Grabbers; 4 Electrical Leads.

SMQ84 PLCC Twin Pack ☎ *1
Includes: 2 each 84 Pin PLCC Clips; 2 each SMT Grabbers; 4 Electrical Leads.

*1 *Contact your local sales office for additional ordering information.*

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

Accelerometer Kits

TYPICAL APPLICATIONS

- *Structural Analysis*
- *Environmental Testing*
- *Machine Health*
- *Machine Tools*
- *Robotics*

FEATURES

- *Wide Frequency and Acceleration Ranges*
- *Rugged Design*
- *Built-In Charge Amplifiers*
- *Kits Include Power Supplies, Cables and Mounting Accessories*

ORDERING INFORMATION

TAK500 Modally-tuned hammer kit ☎ **$1,750**
Opt. 01 – Substitutes 2 power supplies with 100X gain **+$250**

TAK501 General purpose accelerometer kit ☎ **$599**
Opt. 01 – Substitutes power supply with 100X gain **+$125**

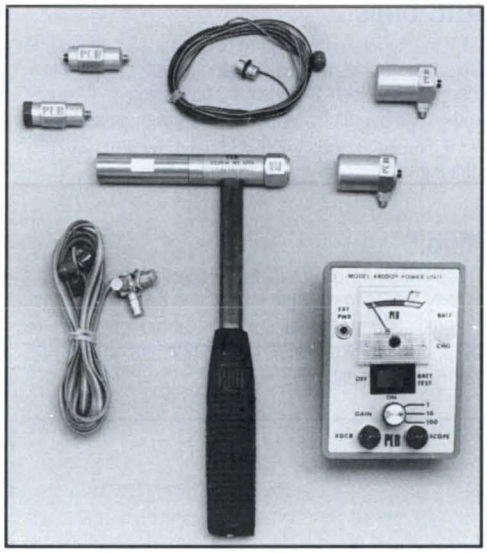
TAK502 Low-mass accelerometer kit ☎ **$450**
Opt. 01 – Substitutes power supply with 100X gain **+$125**

TAK503 Triaxial accelerometer kit ☎ **$1,735**
Opt. 01 – Substitutes 3 power supplies with 100X gain **+$375**

TAK50 High-sensitivity accelerometer kit ☎ **$530**
Opt. 01 – Substitutes power supply with 100X gain **+$125**

TAK5 Ultra-sensitive accelerometer kit ☎ **$650**

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.



Modally–Tuned Hammer, Accelerometers, and Optional Power Supply with Amplifier.

With Tek's accelerometer kits, you can turn your storage oscilloscope or signal analyzer into a powerful structural analysis tool. A tool that lets you make measurements ranging from characterizing the effects of shock and vibration at a single point to performing the complete modal analysis of a structure.

Each accelerometer kit comes complete with a battery operated power supply, all cables, magnetic, beeswax and screw thread mounting accessories, carrying case manual and calibration certificate. The TAK500 hammer kit also contains a general-purpose 500g accelerometer, a low-mass 500g accelerometer and 2 power supplies. The TAK503 triaxial accelerometer kit contains 3 power supplies.

ACCELEROMETER CHARACTERISTICS

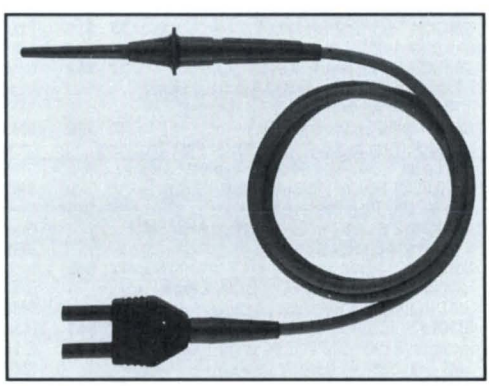
Model	Msmt. Range	Sensitivity	Freq. Range (±10%)	Resonant Freq.	Max. Shock	Weight
TAK501	0.01-500 g	10 mV/g	0.7 Hz-1 kHz	45 kHz	5000 g	25 gm
TAK502	0.01-500 g	10 mV/g	0.7 Hz-20 kHz	70 kHz	2000 g	2 gm
TAK503	0.01-500 g	10 mV/g	1 Hz-1 kHz	7 kHz	2000 g	22 gm
TAK50	0.001-50 g	100 mV/g	0.7 Hz-6 kHz	25 kHz	5000 g	87 gm
TAK5	0.0005-5 g	1000 mV/g	1.5 Hz-5 kHz	25 kHz	200 g	65 gm

P6601/P6602 Temperature Probes

ORDERING INFORMATION

P6601 Temperature Probe **$270**
Includes: Instruction manual (070-2620-00)

P6602 1.5 m Temperature Probe **$275**
Includes: Instruction manual (070-4377-00)



P6602 (shown).

FOR DMM INPUT

The P6601 and P6602 are temperature-measuring devices designed to operate with the DM5110, DM511 (P6602) and DM501A, DM502A (P6601) Digital Multimeters or with the 2236A oscilloscope (P6602). The temperature-sensing element consists of a thin-film platinum resistor on the tip of the probe. Measurements are made by touching the probe tip to the surface whose temperature is in question. The thermal signal is transmitted to the associated digital multimeter through a two-conductor cable.

The probes are totally immersible except in liquids that are not compatible with Dow Corning 308 molding compound (P6601), Polyset 410B molding compound (P6602), BeO, silicone rubber, or epoxy adhesives. The sensor and tip are limited to a maximum of 240°C (230°C for P6602), and the cable is limited to a maximum of 140°C.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

MODULAR PROBE REPLACEMENT SUBASSEMBLIES

Probe	Size*2	Length(m)	Connector/ Comp Box	Price	Probe Cable	Price	Probe Head	Price	Probe Tip/ Hybrid Tip	Price
P6055A*9	Com.	1.5	N/A		N/A		206-0419-00*6*9	*6	206-0419-00*6*9	*6
P6055A*10			N/A		N/A		206-0415-00*6*10	*6	206-0415-00*6*10	*6
Opt. 33*11			N/A		N/A		206-0416-01*6*11	*6	206-0416-01*6*11	*6
P6101A	Min.	1	103-0189-00	$20.00	174-0975-00	$18.00	206-0223-02	$20.00	206-0191-03*3	$21.00
		2	103-0189-00	$20.00	174-0976-00	$21.00	206-0223-02	$20.00	206-0191-03*2	$21.00
		3	103-0189-00	$20.00	174-0977-00	$23.00	206-0223-02	$20.00	206-0191-03*2	$21.00
P6102A	Min.	2	206-0352-00	$45.00	174-0976-00	$21.00	206-0302-00	$24.00	206-0338-01*4	$33.00
P6103*7	Min.	1	N/A		174-0394-00	$18.00	206-0365-03	$25.00	131-3723-03*1	$10.00
		2	N/A		174-0395-00	$20.00	206-0361-03	$25.00	131-3723-03*1	$10.00
		3	N/A		174-0396-00	$22.00	206-0367-02	$25.00	131-3723-03*1	$10.00
P6105A	Min.	1	206-0331-00	$65.00	174-0975-00	$18.00	206-0328-00	$24.00	206-0336-01*4	$33.00
		2	206-0334-00	$65.00	175-0976-00	$21.00	206-0301-00	$24.00	206-0337-01*4	$33.00
		3	206-0320-02	$60.00	174-0977-00	$23.00	206-0302-00	$24.00	206-0338-01*4	$33.00
P6106A	Min.	1	206-0313-01	$90.00	174-0975-00	$18.00	206-0328-00	$24.00	206-0336-01*4	$33.00
		2	206-0319-01	$90.00	174-0976-00	$21.00	206-0301-00	$24.00	206-0337-01*4	$33.00
		3	206-0320-01	$90.00	174-0977-00	$23.00	206-0302-00	$24.00	206-0338-01*4	$33.00
P6107A	Min.	2	206-0247-02	$70.00	174-0976-00	$21.00	206-0217-02	$23.00	206-0339-02*4*6	*6
P6108A	Min.	1	206-0332-01	$45.00	174-0975-00	$18.00	206-0303-00	$20.00	206-0336-01*4	$33.00
		2	206-0318-02	$50.00	174-0976-00	$21.00	206-0304-00	$22.00	206-0337-01*4	$33.00
		3	206-0333-00	$45.00	174-0977-00	$23.00	206-0305-00	$20.00	206-0338-01*4	$33.00
P6109*7	Min.	1.5	N/A		174-0714-00	$18.00	206-0372-02	$35.00	131-3723-03*1	$10.00
		2	N/A		174-0715-00	$21.00	206-0360-03	$35.00	131-3723-03*1	$10.00
		3	N/A		174-0393-00	$23.00	206-0366-02	$35.00	131-3723-03*1	$10.00
P6119	Min.	2	N/A		174-0395-00	$20.00	206-0405-00	$40.00	131-3723-03*1	$10.00
		3	N/A		174-0396-00	$22.00	206-0412-00	$40.00	131-3723-03*1	$10.00
P6121	Min.	1.5	206-0311-00	$65.00	174-0967-00	$18.00	206-0323-00	$26.00	206-0341-01*4	$38.00
P6122	Min.	1.5	206-0312-00	$55.00	174-0967-00	$18.00	206-0324-00	$23.00	206-0342-01*4	$33.00
		2	206-0318-00	$50.00	174-0968-00	$20.00	206-0325-00	$21.00	206-0343-01*4	$31.00
		3	206-0318-01	$50.00	174-0969-00	$21.00	206-0326-00	$21.00	206-0344-01*4	$31.00
P6127	Min.	1.5	206-0404-00*6	*6	174-1650-00*6	*6	174-1650-00*6	*6	131-3723-03*1	$10.00
		2	206-0410-00*6	*6	174-1825-00*6	*6	174-1825-00*6	*6	131-3723-03*1	$10.00
P6130	Sub.	1.5	206-0313-00	$85.00	174-0970-00	$23.00	206-0270-10	$15.00	206-0270-10*5	$15.00
		2	206-0319-00	$85.00	174-0971-00	$27.00	206-0270-12	$15.00	206-0270-12*5	$15.00
		3	206-0320-00	$85.00	174-0972-00	$32.00	206-0270-11	$12.00	206-0270-11*5	$12.00
P6131	Sub.	1.3	206-0314-00	$95.00	174-0973-00	$23.00	206-0265-10	$15.00 BL	206-0265-10*5	$15.00
		2	206-0321-00	$90.00	174-0971-00	$27.00	206-0265-12	$15.00 YEL	206-0265-12*5	$15.00
		3	206-0322-00	$90.00	174-0972-00	$32.00	206-0265-11	$15.00 Red	206-0265-11*5	$15.00
P6133	Sub.	2	206-0350-00	$70.00	174-0971-00	$27.00	206-0265-12	$15.00	206-0265-12*5	$15.00
Opt.01	Sub.	1.3	206-0349-00	$70.00	174-0973-00	$23.00	206-0265-13	$15.00	206-0265-13*5	$15.00
Opt.03	Sub.	3	206-0351-00	$70.00	174-0972-00	$32.00	206-0265-11	$15.00	206-0265-11*5	$15.00
Opt.25	Com.	1.3	206-0349-00	$70.00	174-0973-00	$23.00	206-0393-00	$15.00	206-0393-00*5	$15.00
P6134	Sub.	1.5	206-0363-00	$90.00	174-0245-01	$22.00	206-0265-13	$15.00	206-0265-13*5	$15.00
P6134C	Com.	1.5	206-0420-00	*6	174-1081-04	$39.00	206-0418-00	*6	206-0418-00*5*6	*6
P6135	Sub.	1.5	206-0368-00	$95.00	174-0707-01*8	$85.00	206-0369-00	$18.00	206-0369-00	$18.00
P6135A	Com.	1.5	N/A		N/A		206-0416-00*6*8	*6	206-0416-00*6*8	*6
P6136	Sub.	1.3	206-0359-00	$95.00	174-0978-00	$25.00	206-0265-10	$15.00	206-0265-10*5	$15.00
Opt. 25	Com.	1.3	206-0359-00	$95.00	174-0978-00	$25.00	206-0392-00	$15.00	206-0392-00*5	$15.00
P6137	Com.	1.5	206-0389-01	$90.00	174-1081-04	$39.00	206-0378-00	$15.00	206-0378-00*5	$15.00
P6149A	Min.	2	206-0255-02	$70.00	174-0976-00	$21.00	206-0217-02	$23.00	206-0339-03*4	$25.00
P6156	Com.	1.5 10X	N/A		N/A		N/A		206-0380-00*5	$60.00
Opt.25		adds 100X tip	N/A		N/A		N/A		206-0381-00*5	$60.00
Opt.26		adds 20X tip	N/A		N/A		N/A		206-0379-00*5	$60.00
Opt.27		adds 1X tip	N/A		N/A		N/A		206-0382-00*5	$60.00
P6202A	Min.	2	N/A		N/A		N/A		206-0230-03*3	$25.00
P6203	Min.	1.5	N/A		N/A		206-0391-00	$150.00	131-4280-00	$.95
P6204	Min.	1.5	N/A		N/A		206-0390-00	$550.00	131-4280-00	$.95
P6230	Sub.	1.6	N/A		N/A		206-0279-10	$15.00	206-0279-10*5	$15.00
P6231	Sub.	1.5	N/A		N/A		206-0279-10	$15.00	206-0279-10*5	$15.00
P6420	Min.	1	N/A		174-0975-00	$18.00	206-0236-00*6	*6	206-0230-03*3	$25.00
		2	N/A		174-0976-00	$21.00	206-0236-00*6	*6	206-0230-03*3	$25.00
		3	N/A		174-0977-00	$23.00	206-0236-00*6	*6	206-0230-03*3	$25.00

*1 *Package of 5 tips*

*2 *Min. (Miniature), Com. (Compact), Sub. (Subminiature)*

*3 *Probe tips in package of ten*

*4 *Probe hybrid tip assemblies in packages of five*

*5 *Probe hybrid tip assembly in quantities of one*

*6 *Contact your local Sales Engineer for information*

*7 *Probe sleeve cover for compensation adjus. is P/N 200-3342-00*

*8 *Consists of a matched pair*

*9 *20 pF inputs*

*10 *47 pF inputs*

*11 *15 pF inputs*

PROBE ACCESSORIES SELECTION GUIDE

MONOLITHIC PROBE ACCESSORIES
(For probes with # 6-32 Screw Tips)

Part Number	Description	Price
013-0052-00	Bayonet ground assembly	$11.00
013-0054-00	Probe screw tip to BNC adapter	$18.00
013-0056-00	Probe screw tip to BNC adapter for P6028	$22.00
013-0071-00	Retractable hook tip	$5.00
013-0071-01	Retractable hook for P6008 environmental probe	$5.00
134-0013-00	Banana tip (#6-32)	$1.50
134-0016-00	Banana Tip ((P6015 only) #10-32	*1
166-0428-00	Insulating ground cover for P6009	$1.55
175-0124-01	5 inch ground lead	$2.75
175-0125-01	12 inch ground lead	$3.00
175-0263-01	3 inches ground lead	$2.75
179-0192-00	6" ground lead (P6015 only)	*1
206-0015-00	Straight tip (0.055 in dia)	$2.00
206-0060-00	Spring tip (0.08 in dia)	$3.25
206-0061-00	Spring tip (accepts 0.065 in dia pin)	$2.30
206-0100-00	Calibration tip (0.063 in dia)	$13.00
206-0104-00	Long straight tip (0.032 in dia)	$1.50
206-0105-00	Hook tip	$2.00
206-0134-03	Pin tip (accepts 0.025 in IBM SLT pin)	$7.00
206-0137-01	Ground lead adapter (0.025 in square pin closing)	$4.00
206-0168-00	Spring Tip (accepts 0.068 in dia pin)	$4.25
206-0185-00	Right angle hook tip	$2.00
206-0203-00	IC test tip	$2.00
344-0005-00	Alligator clip, # 10-32 screw thread (P6015 only)	$5.25
344-0045-00	Alligator clip	$1.25
344-0046-00	Miniature alligator clip with boot	$2.75

IC CLIPS (Not Shown)

Part Number	Description	Price
003-0709-00	16-Pin DIP, clothes pin style	$17.00
003-0823-00	24-pin DIP, clothes pin style	$35.00
003-0801-00	40-pin DIP, clothes pin style	$50.00

CABLE MARKER SETS (Not Shown)

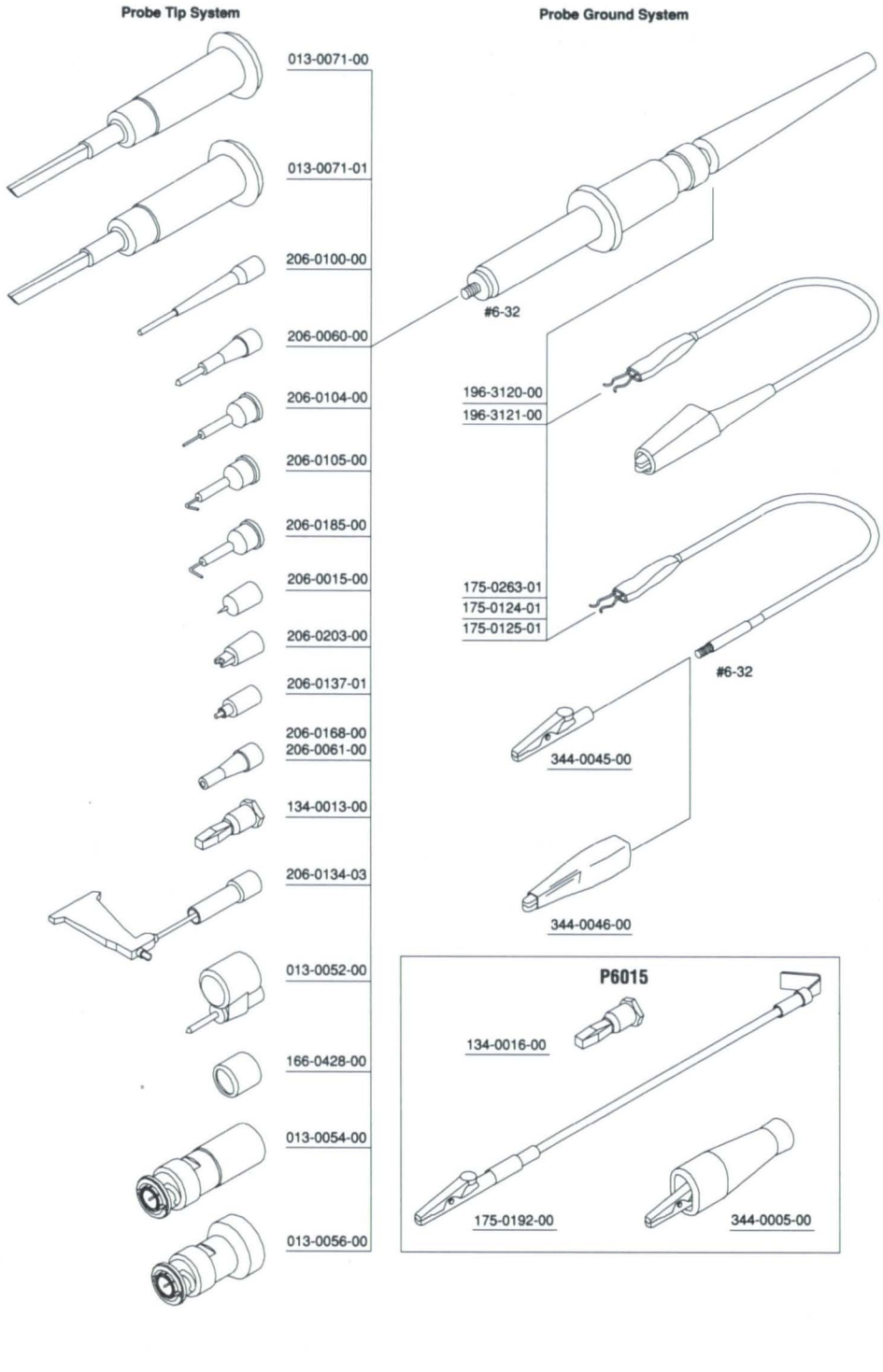
Part Number	Description	Price
016-0130-00	For 1/8 in. dia. cable (P6053B/P6062B/ P6063B/P6075)	$8.50
016-0127-00	For 3/16 in. dia. cable	$8.50
016-0633-00	For all modular cables (P610X/A, P612X/P613X/ P6230 Families)	$4.50

PROBE HOLDERS (Not Shown)

Part Number	Description	Price
352-0351-00	P610X/A, P6102X, P613X, Black	$4.50
352-0687-00	P610X/A, P6102X, P613X, Gray	$1.15
352-0090-00	P600X	$.50
352-0068-00	P600X probes to Scope Chassis	$.35

*1 *Contact your local sales representative.*

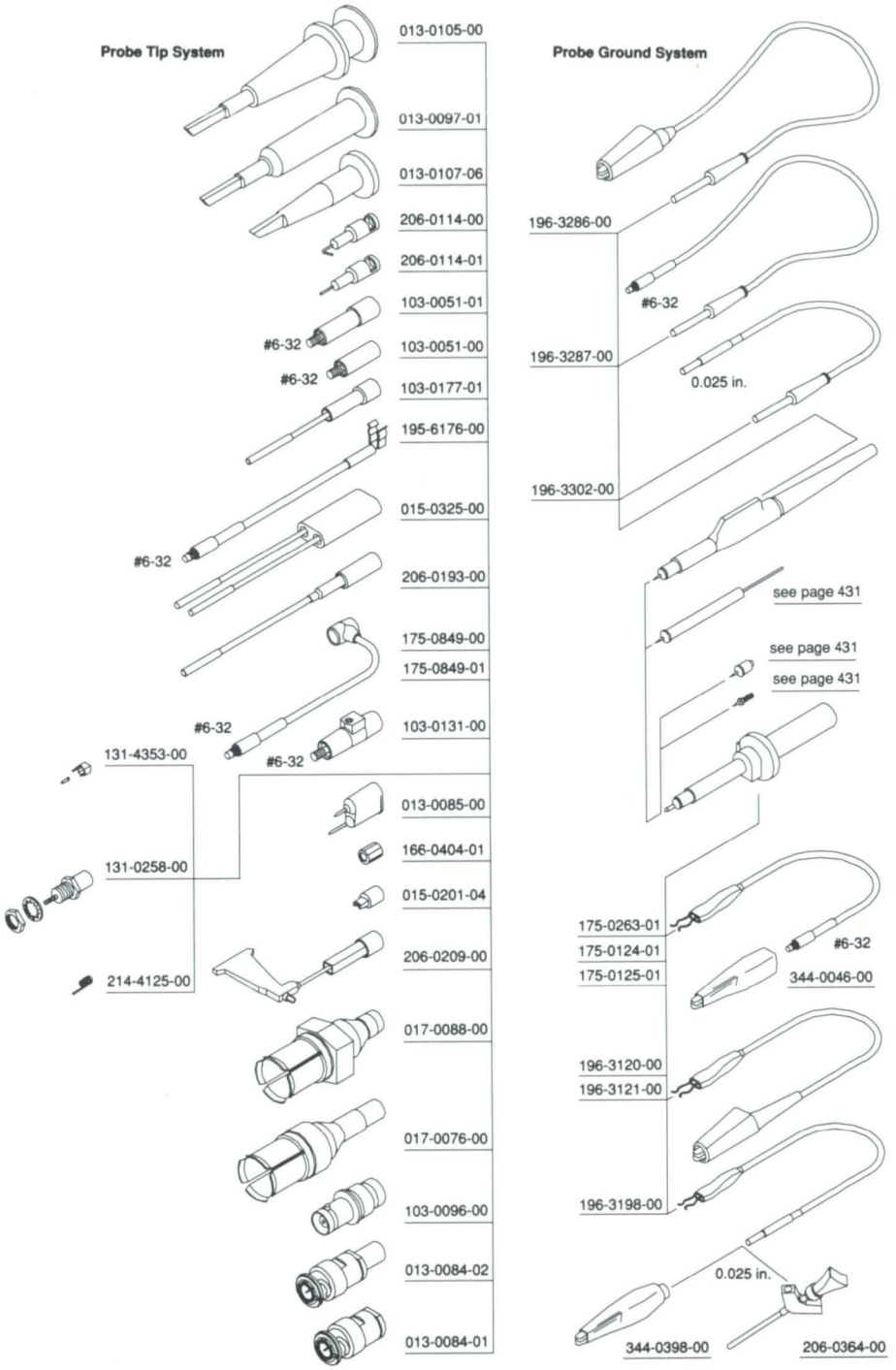
P6006, P6007, P6008, P6009, P6028 and P6060
Monolithic Series



To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

PROBE ACCESSORIES SELECTION GUIDE

MINIATURE TIP SERIES– P6053B, P6048, P6055, P6056, P6057, P6062B, P6063B, P610X/A Family, P612X Family, P6148/A, P6149/A, P6103, P6109, and P6202A.



MINIATURE PROBE ACCESSORIES

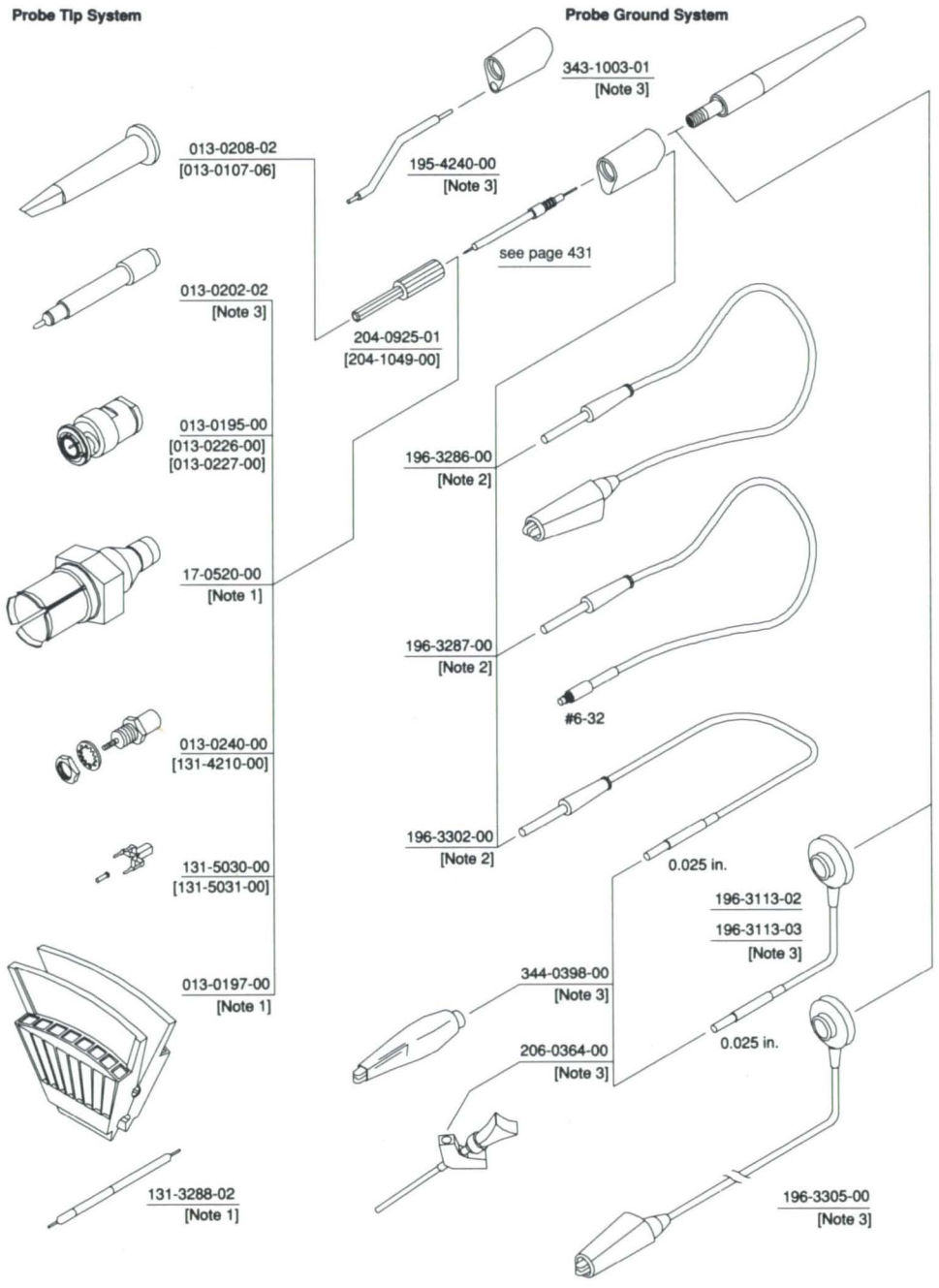
Part Number	Description	Price
013-0084-01	Miniature probe tip to BNC adapter	$10.00
013-0084-02	Miniature probe tip to BNC adapter for all except P6202A, P6420, and P6201 adapter.	$12.00
013-0085-00	Bayonet ground assembly	$10.00
013-0097-01	Retractable hook tip for P6202A and P6420	$12.00
013-0105-00	Retractable hook tip (except P612X)	$10.00
013-0107-06	Retractable hook tip (for all except P6202A and P6420)	$3.75
015-0201-04	IC Test ground cover, black. Package of 10	$7.50
015-0201-05	Package of 100	$25.00
015-0201-07	IC Test ground cover, gray. Package of 10	$7.50
015-0201-08	Package of 100	$20.00
015-0325-00	Dual lead adapter (accepts 206-0364-00 SMT Clip or 0.025 in, square pin.)	$15.00
017-0076-00	Miniature probe tip to GR adapter	$90.00
017-0088-00	Miniature probe tip GR 50 Ω termination adapter	$85.00
103-0051-00	Screw tip (#6-32 for P6202A and P6420)	$5.50
103-0051-01	Screw tip (#6-32)	$5.50
103-0096-00	Miniature probe tip to BNC female adapter	$15.00
103-0131-00	Screw tip with ground connection (#6-32)	$12.00
103-0177-01	Flexible tip (accepts 206-0364-00 SMT Clip)	$8.25
131-0258-00	Chassis mount test jack	$3.15
131-4353-00	Circuit board test point, package of 25	$45.00
166-0404-01	Insulating ground cover	$1.50
175-0124-01	5" clip on ground lead with #6-32 screw end	$2.75
175-0125-01	12" clip on ground lead with #6-32 screw end	$3.00
175-0263-01	3" clip on ground lead with #6-32 screw end	$2.75
196-3120-00	6" clip on ground lead	$3.10
196-3121-00	12" clip on ground lead	$3.10
196-3198-00	6" clip on ground lead (with 0.025 in. pin receptacle)	$4.90
196-3286-00	8" ground lead	$7.50
196-3287-00	#6-32 thread ground lead	$7.75
196-3302-00	6" slip on ground lead (with 0.025 in. pin receptacle)	$7.50
206-0114-00	Hook tip	$4.00
206-0114-01	Straight tip	$4.00
206-0193-00	Flex tip for 0.025 in square pin	$12.00
206-0209-00	Pin tip (accepts 0.025 in IBM SLT pin	$5.25
206-0364-00	SMT Grabber Clip (used with 0.025 pin receptacles)	$4.90
SMG 50	Package of 20 each SMT clips.	$89.00
214-4125-00	Electrical contact ground	$2.50
344-0046-00	#6-32 Thread alligator ground clip	$2.75
344-0398-00	Slip on alligator ground lead (use with 0.025 pin receptacle)	$3.25
195-6176-00	3 in. probe tip clip-on lead for all miniature size probe tips.	$7.25
175-0849-00	3 in. probe tip cap lead for all miniature size probe tips.	$8.00
175-0849-01	6 in. probe tip cap lead for all miniature size probe tips.	$8.25

PROBE ACCESSORIES SELECTION GUIDE

SUBMINIATURE AND COMPACT
(Bracket P/N pertain to Compact Tip Probes only.)

Part Number	Description	Price
013-0107-06	Retractable hook tip for compact tip probes	$3.75
013-0195-00	Subminiature probe tip to BNC adapter	$10.00
013-0197-00	KLIP-KIT (includes two 16-pin DIP clips and four signal/ground pins) (Not compatible with P6137, P6156, or P6133/36 Opt. 25	$46.00
013-0202-02	Subminiature/Compact to-miniature probe tip adapter (allows use of miniature probe tip accessories. See page 433)	$5.00
013-0208-02	Retractable hook tip for subminiature tip probes	$3.50
013-0226-00	Compact probe tip to BNC adapter	$10.00
013-0227-00	Compact probe tip to BNC 50 Ω termination adapter	$65.00
013-0240-00	Subminiature probe tip Chassis mount test jack	$5.00
017-0520-00	Subminiature probe tip to GR 50 Ω termination adapter	$70.00
131-3288-02	Signal/ground pins for KLIP-KIT (includes eight pins)	$35.00
131-4210-00	Compact probe tip chassis mount test jack	$5.00
131-5030-00	Subminiature probe tip circuit board test points (pkg. 25)	$45.00
131-5031-00	Compact probe tip circuit board test points (pkg. 25)	$45.00
195-4240-00	Low impedance ground contact	$2.75
196-3286-00	8" alligator ground lead (not compatible with P6137 or P6156)	$7.50
196-3287-00	12" slip on ground lead (not compatible with P6137or P6156)	$7.75
196-3113-02	6" slip on ground lead	$8.00
196-3113-03	3" slip on ground lead	$8.00
196-3302-00	6" alligator ground lead (not compatible with P6137 or P6156)	$7.50
196-3305-00	6" alligator ground lead	$8.00
204-0925-01	Subminiature probe tip attenuator tip cover	$1.00
204-1049-00	Compact probe tip attenuator tip cover	$.75
206-0364-00	Slip on SMT Grabber Clip	$4.90
343-1003-01	Ground collar	$2.80
344-0398-00	Slip on alligator ground clip	$3.25

SUBMINIATURE TIP (P6130/P6131/P6133/P6134/P6135/P6136/P6230/P6231) AND COMPACT TIP (P6137, P6156, P6134C, P6135A, P6055A, P6133 Opt. 25 and P6136 Opt. 25) PROBE ACCESSORIES
[Bracket P/N's pertain to Compact Tip Probes only.]

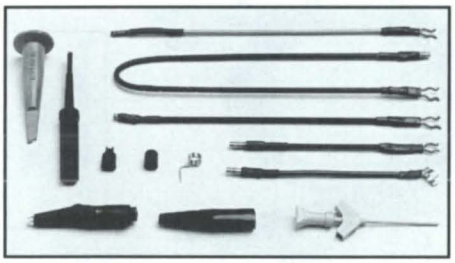


Note 1: Not compatible with Compact Tip Probes.
Note 2: Not compatible with P6137, P6156, P6055A, P6134C, and P6135A.
Note 3: Use same part number as subminiature probe, also see page 433 for other compatible tip accessories.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

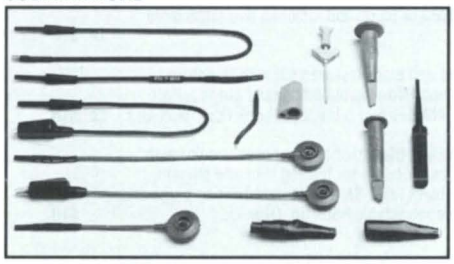
PROBE ACCESSORY PACKS/CONVERSION KITS SELECTION GUIDE

ACCESSORY PACK/MINIATURE PROBE TIPS



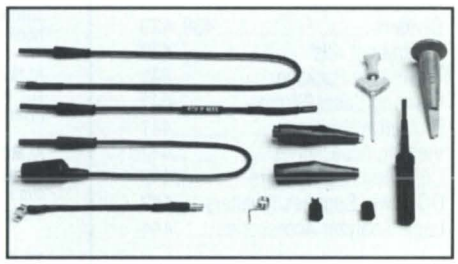
Order 020-1724-00 **$29.00**
Includes: Screwdriver (003-1433-00); Retractable hook tip (013-0107-06); Ground cover (166-0404-01); 6 in. ground lead (196-3198-00); 5 in. ground lead (175-0124-01); 12 in. ground lead (175-0125-01); 3 in. ground lead (175-0263-01); IC Grabber Tip (206-0364-00); Alligator clip for 0.025" connector (344-0398-00); Alligator clip for #6-32 Thread (344-0046-00); IC Test Tip (see page 433); 3.5 in ground lead (195-6176-01); Spring ground (214-4125-00).

ACCESSORY PACK/P613X COMPACT AND SUBMINIATURE

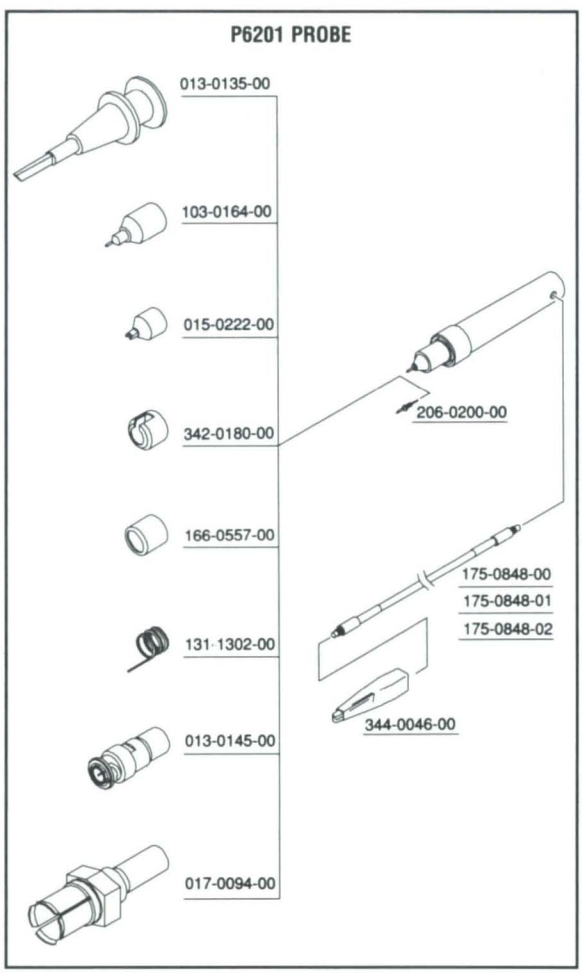


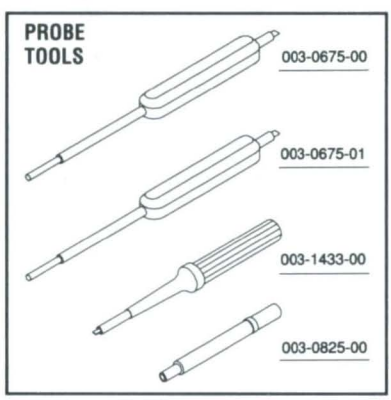
Order 020-1835-00 *1
Includes: Screwdriver (003-1433-00); Retractable hook tip (013-0107-06); Retractable hook tip (013-0208-02); 2 in. ground lead (195-4240-00); 3 in. ground lead (196-3113-03); 6 in. ground lead (196-3113-02); 12 in. #6-32 stud ground lead (196-3287-00); 8 in ground lead (196-3286-00); IC Grabber Tip (206-0364-00); Ground collar (343-1003-01); Alligator clip 0.025" connector (344-0398-00); 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).

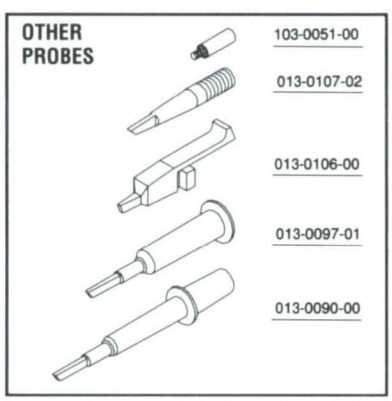
ACCESSORY PACK FOR P612X PROBE TIPS



Order 020-1836-00 *1
Includes: Screwdriver (003-1433-00); IC Test Tip (see page 433); Tip insulator (166-0404-01); 3.5 in. ground lead (195-6176-01); 6 in. ground lead (196-3302-00); 8 in. ground lead (196-3286-00); 12 in. ground lead (196-3287-00); Retractable hook tip (013-0107-06); Alligator clip #6-32 connector (344-0046-00); IC Grabber Tip (206-0364-00); Spring ground (214-4125-00); Alligator clip for 0.025" connector (344-0398-00).







6201 PROBE

Product Number	Description	Price
013-0135-00	Retractable hook tip	$8.25
013-0145-00	Probe tip to BNC adapter	$25.00
015-0222-00	IC Test ground cover	$.60
017-0094-00	Probe tip to GR 50 Ω termination adapter	$95.00
103-0164-00	Probe tip to miniature probe tip adapter (See page 433 for compatible accessories).	$12.50
131-1302-00	Ground contact	$1.25
166-0557-00	Insulating ground cover	$1.50
175-0848-00	3 in. ground lead	$4.00
175-0848-01	5 in. ground lead	$2.80
175-0848-02	12 in. ground lead	$3.20
206-0200-02	Replaceable probe tip	*1
342-0180-00	Ground contact insulator	$1.75
346-0046-00	#6-32 Thread alligator ground clip	*1

PROBE TOOLS

Part Number	Description	Price
003-0675-00	Adjustment tool P6055	$2.85
003-0675-01	Adjustment tool P6202A	$2.50
003-0825-00	Tip extractor for miniature probes (except for P610X "A" version and P612X family probes)	$1.75
003-1433-00	Adjustment tool for P601X/A, P612X, and P613X family. Individual unit.	$1.00
003-1433-01	Package of 5 each of 003-1433-00, above.	$4.25

OTHER PROBES

Part Number	Description	Price
013-0090-00	Retractable hook tip (for P6010/P6048)	$7.50
013-0097-01	Retractable hook tip (for S-3A/P6202A/P6420	$12.00
013-0106-00	Retractable hook tip (for 7A11/P6401)	$19.00
013-0107-02	Retractable hook tip (for 211/121/213/ 214/221 scope probes)	$3.50
103-0051-00	Screw tip (#6-32 for P6045/P6046/ P6202A/7A11/S-3A)	$5.50

*1 *Contact your local sales representative.*

OTHER ACCESSORIES
TEST LEADS, COAXIAL CABLES, INTERFACE CABLES

Contents

Test Leads 436
Coaxial Cables 436
Interface Cables 436
Adapters/Connectors 437
Attenuators/Power Dividers 438, 439
Rackmount Kits 440
Travel Line Package 441
Carrying Cases/Straps 441
Protective Covers 441
Viewing Accessories 442
CRT Mesh/Light Filters 442
DC power Supplies/Inverters 443
Logic Analyzer Accessories 444

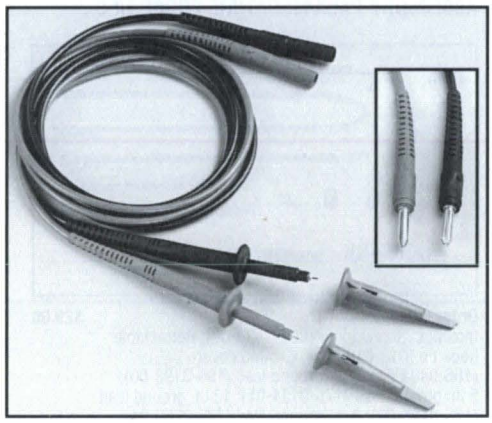
TEST LEADS SELECTION GUIDE

ALM01 UL approved red and black test lead set with minature size probe tips. Incorporates shrouded banana plugs and includes two retractable hook tips. ☎ $18

ALM02 Red and black test lead set with minature size probe tips. Non-shrouded banana plugs (photo inset) and includes two retractable hook tips. (Non-UL) ☎ $18

ALM03 Red and black test lead set (not shown) with minature size probe tip for the red lead and alligator clip for the black lead. Non-shrouded banana plugs and includes one retractable hook tip. (Non-UL) $18

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

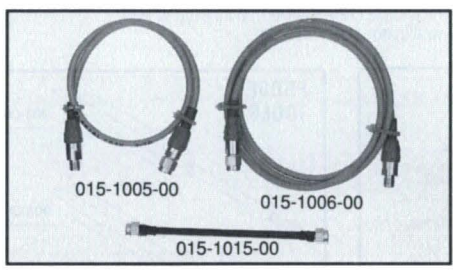


ALM01 and ALM02 (inset)

COAXIAL CABLES AND INTERFACE CABLES SELECTION GUIDE

COAXIAL BNC CABLES

50 Ω		
10 in. male to male	012-0208-00	$20
18 in. male to male	012-0076-00	$20
24 in. male to male	012-1342-00	$20
36 in. male to male	012-1341-00	$20
36 in. precision (l%) male to male	012-0482-00	$29
42 in. male to male	012-0057-01	$20
18 in. male to female	012-0104-00	$27
10 in. BNC male to BSM female	012-0128-00	$26
18 in. BNC male to BSM female	012-0127-00	$35
75 Ω		
24 in. male to male	012-1339-00	$20
36 in. male to male	012-1338-00	$20
42 in. male to male	012-0074-00	$20
60 in. male to male	012-1337-00	$20
93 Ω		
42 in. male to male	012-0075-00	$36



COAXIAL SMA (3mm) 50 Ω CABLES

General Purpose Flexible Cables		
12 in. male to male	174-1364-00	$21
20 in. male to male	174-1427-00	$45
60 in. male to male	174-1428-00	$50
Precision, Flexible Delay Cables		
1 ns. male to female	015-1019-00	$155
2 ns male to female	015-1005-00	$135
5 ns. male to female	015-1006-00	$190
1 ns. male to male	015-0562-00	$260
2 ns. male to male	015-0560-00	$290
5 ns. male to male	015-0561-00	$350
Semirigid Delay Cables		
500 ps., 4.5., male to male	015-1015-00	$30
750 ps., male to male	015-1017-00	$46

COAXIAL GR 50 Ω CABLES
(not shown)

10 ns., RG58A/U	017-0501-00	$140
5 ns., RG213/U	017-0502-00	$210
2 ns., RG58A/U	017-0505-00	$190
5 ns., RG58/U	017-0512-00	$145

COAXIAL N 50 Ω CABLES
(not shown)

6 ft. male to male	012-0114-00	$32

PATCH CORDS
(not shown)

BNC to BNC, 18 in.		
Red	012-0087-00	$16.25
Black	012-0086-00	$9.00
BNC to banana plug-jack, 18 in.		
Red	012-0091-00	$8.25
Black	012-0090-00	$8.25
Banana plug-jack to banana plug-jack, 18 in.		
Red	012-0031-00	$11.50
Black	012-0039-00	$11.50
Pin-jack to pin-jack, 0.08 in.dia-pin		
Red, 8 in.	012-0179-00	$4.25
Black, 8 in.	012-0181-00	$4.50
Red, 18 in.	012-0180-00	$4.55
Black, 18 in.	012-0182-00	$6.00

INTERFACE CABLES
(not shown)

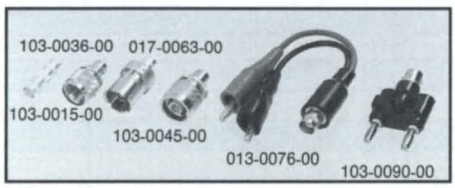
GPIB		
1m, double-shielded	012-0991-01	$140
2m, double-shielded	012-0991-00	$160
4m, double-shielded	012-0991-02	$210
Centronics		
8 ft. Male Centronics to PC 25-pin D	012-1250-00	$45
9 ft. Male to Male	012-1284-00	$75
10 ft., 4695 to Terminal	012-0555-00	$125
RS-232C		
10 ft. DB25 male – DB25 female, straight through	012-0911-00	$100
9 ft. DB25 male – DB25 female, null modem	012-1285-00	$40
9 ft. DB25 male – DB9 female, null modem	012-1298-00	$35
DB25 male – DB25 male gender changer	131-4923-00	$15

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

ADAPTERS, CONNECTORS AND ADAPTER KITS SELECTION GUIDE

BNC ADAPTERS

BNC Male to UHF Female	103-0032-00	$6.50
BNC Male to GR	017-0064-00	$105.00
BNC Male to N Female	103-0058-00	$9.50
BNC Male to Binding Post	103-0033-00	$7.00
BNC Male to Dual Binding Post	103-0035-00	$18.25



BNC Female to BSM Male	103-0036-00	$18.00
BNC Female to UHF Male	103-0015-00	$6.00
BNC Female to GR	017-0063-00	$60.00
BNC Female to N Male	103-0045-00	$8.50
BNC Female to Clip Leads	013-0076-00	$41.00
BNC Female to EZ Ball	013-0076-01	$24.00
BNC Female to Dual Banana	103-0090-00	$11.00

BNC Female to GR	017-0063-00	$60.00
BNC Male to GR	017-0064-00	$105.00
BNC Male to GR, 50 Ω Thruline Termination	017-0083-00	$110.00

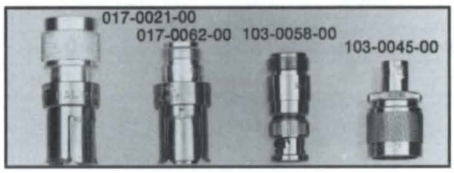
SMA ADAPTERS
(not shown)

SMA Female to BNC Male	015-0572-00	$19.25
SMA Male to BNC Female	015-0554-00	$27.00
SMA Male to GR	015-1007-00	$145.00
SMA Female to GR	015-1008-00	$160.00
SMA Male to N-Male	015-1009-00	$35.00
Threaded Female to Male slip on connector	015-0553-00	$34.00
Male to Female connector saver*1	015-0549-00	$150.00

NEW 3.5 mm ADAPTERS
(not shown)

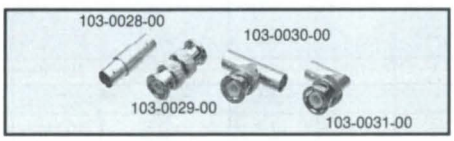
Male to Male	015-0551-00	*2
Female to Female	015-0550-00	*2
Male to Female connector saver*1	015-0552-00	*2

*1 *Used permanently installed on instrument to prolong life of instrument connector.*



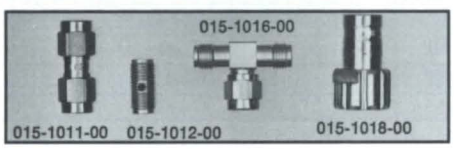
N STYLE ADAPTERS

N Male to GR	017-0021-00	$85.00
N Female to GR	017-0062-00	$75.00
N Female to BNC Male	103-0058-00	$9.50
N Male to BNC Female	103-0045-00	$8.50



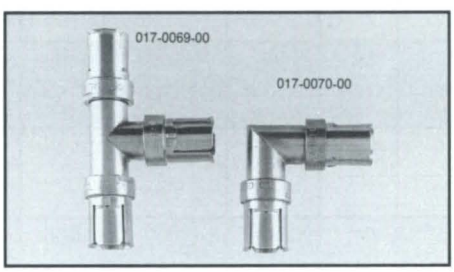
BNC CONNECTORS

BNC Female to BNC Female	103-0028-00	$7.00
BNC Male to BNC Male	103-0029-00	$10.00
BNC T	103-0030-00	$10.00
BNC Elbow Male to Female	103-0031-00	$9.00



SMA CONNECTORS

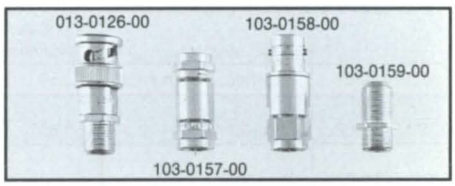
SMA Male to Male	015-1011-00	$28.00
SMA Female to Female	015-1012-00	$12.00
SMA T	015-1016-00	$30.00
SMA Male to BNC Female	015-1018-00	$11.00



GR CONNECTORS

GR T	017-0069-00	$205.00
GR Elbow	017-0070-00	$165.00

*2 *Contact your local sales representative.*

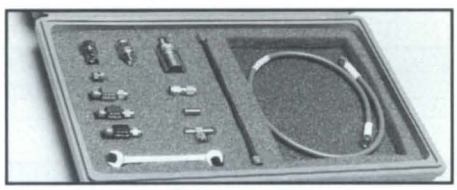


MISC. CONNECTORS

"F" Female to BNC Male	013-0126-00	$20.00
"F" Male to "F" Male	103-0157-00	$7.50
"F" Male to BNC Female	103-0158-00	$6.00
"F" Female to "F" Female	103-0159-00	$7.50

BNC ADAPTER KIT

AK01 BNC Adapter Kit ☎ $390
Includes: 50 ohm feed-through termination 011-0049-01; 50 ohm 10X attenuator 011-0059-02; 50 ohm, 5X attenuator 011-0060-02; 50 ohm, 6 dB attenuator 011-0069-02; 50 ohm, coax cable, 42 in. (2 each), 012-0057-01; GR to BNC female adapter 017-0063-00; BNC female to BNC female adapter 103-0029-00; BNC "T" 103-0030-00; BNC elbow male to female 103-0031-00.



SMA ADAPTER KIT

AK02 SMA Adapter Kit ☎ $975
Includes: 4.5 in. semirigid cable w/male connectors 015-0015-00; 1 m, flexible, 50 ohm cable w/male connectors 174-1341-00; 2X 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 ohm termination 015-1022-00; SMA female to BNC male adapter 015-0572-00.

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

ATTENUATORS SELECTION GUIDE

BNC 50, 75, and 93 OHM (See photo next page)

	Type	Impedance (Ohms)	Z-Tol. (Ohms)	Atten.	Atten. (db)	Tol. (db)	Freq. (dc to)	Avg. Power (Watts)	Peak Power (Watts)	Max. VSWR	Price
011-0049-01	Feed-through termination	50	±1	NA	NA	NA	1 GHz	2	300	1.2-dc to 1 GHz	$33
011-0059-02	Attenuator	50	±1	10X	20	±0.4 to1 GHz ±0.6 1-2 GHz	2 GHz	2	500	1.1-dc to 1 GHz 1.2-1 to 2 GHz	$45
011-0060-02	Attenuator	50	±1	5X	14	±0.4 to1 GHz ±0.6 1-2 GHz	2 GHz	2	500	1.1-dc to 1 GHz 1.2-1 to 2 GHz	$46
011-0069-02	Attenuator	50	±1	2X	6	±0.3 to1 GHz ±0.5 1-2 GHz	2 GHz	2	500	1.1-dc to 1 GHz 1.2-1 to 2 GHz	$45
011-0076-02	Attenuator	50	±1	2.5X	8	±0.3 to1 GHz ±0.5 1-2 GHz	2 GHz	2	500	1.1-dc to 1 GHz 1.2-1 to 2 GHz	$45
011-0099-00	Feed through termination	50	±0.5	NA	NA	NA	200 MHz	5		1.1-dc to 100 MHz 1.2-100 to 200 MHz	$60
011-0055-01	Feed through termination	75	±1	NA	NA	NA	100 MHz	1	300	1.1-dc to 100 MHz	$33
011-0056-01	Feed through termination	93	±1	NA	NA	NA	100 MHz	1	300	1.1-dc to 100 MHz	$33
011-0057-01	Min. loss attenuator	50-75		2.3X	7.2	±0.5	100 MHz	.5		1.1-dc to 100 MHz	$45
011-0058-01	Min. loss attenuator	50-93		2.3X	7.2	±0.5	100 MHz	1.2		1.1-dc to 100 MHz	$41
011-0061-00	Attenuator	75		10X	20			.5			$36
011-0062-00	Attenuator	93		10X	20			.5			$37
011-0092-00	Feed through termination	600	±1	NA	NA	NA	1 MHz	1			$35
011-0112-00	Min loss attenuator	75-50						2		(ac coupled)	$65
011-0129-00	Feed through termination	50	±0.05	NA	NA	NA	100 kHz				$140
011-0102-00	Coax termination	75	±0.5	NA	NA	NA		.5			$20
011-0103-00*1	Return loss bridge	75	±0.5	NA	NA	NA					$25

*1 *011-0103-00 red color body; 011-0103-01 green color body; 011-0103-02 white color body.*

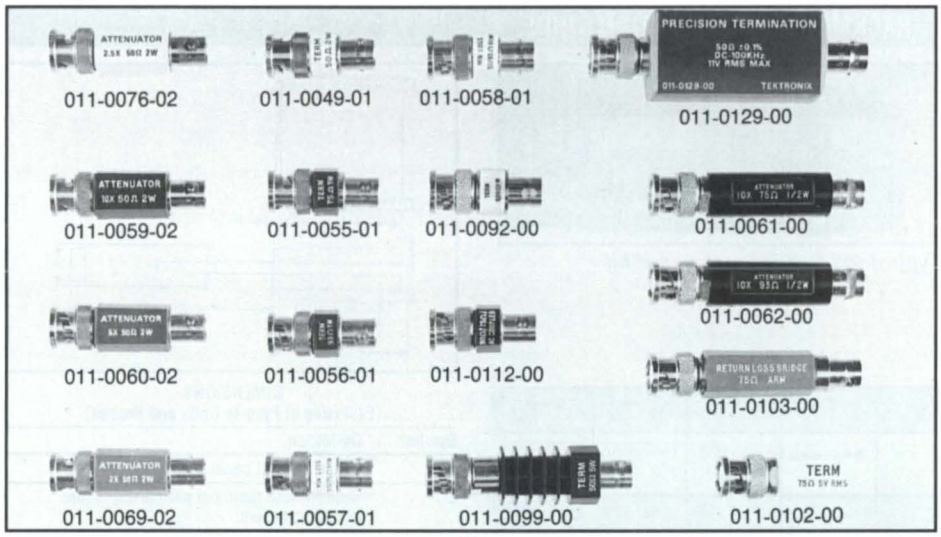
SMA (3 mm) 50 OHM (see photo on next page)

	Type	Impedance (Ohms)	Z-Tol (Ohms)	Atten.	Atten. (db)	Tol. (db)	Freq. (dc to)	Avg. Power (Watts)	Peak Power (Watts)	Max. VSWR	Price
015-1001-00	Attenuator	50	±1.0	2X	6	±0.3	18 GHz	1	500	1.15-dc to 4 GHz 1.25-4 to 12.4 GHz 1.35-12.4 to 18 GHz	$150
015-1002-00	Attenuator	50	±10	5X	14	±0.5	18 GHz	1	500	1.15-dc to 4 GHz 1.20-4 to 8 GHz 1.25-8 to 12.4 GHz 1.35-12.4 to 18 GHz	$155
015-1003-00	Attenuator	50	±1.0	10X	20	±0.5	18 GHz	2	500	1.15-dc to 4 GHz 1.20-4 to 8 GHz 1.25-8 to 12.4 GHz 1.35-12.4 to 18 GHz	$155
015-1004-00	Termination (female)	50	±0.5	NA	NA	NA	18 GHz	0.5	200	1.05-dc to 4 GHz 1.10-4 to 12.4 GHz 1.15-12.4 to 18 GHz	$75
015-1020-00	Short-circuit termination (male)	0		NA	NA	NA	18 GHz	NA	NA		$27
015-1021-00	Short-circuit termination (female)	0		NA	NA	NA	18 GHz	NA	NA		$29
015-1022-00	termination (male)	50	±0.5	NA	NA	NA		0.5	100		$41

N CONNECTOR 50 OHM (see photo on next page)

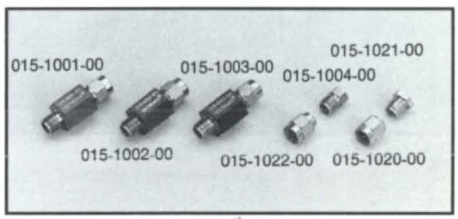
	Type	Impedance (Ohms)	Z-Tol (Ohms)	Atten.	Atten. (db)	Tol. (db)	Freq. (dc to)	Avg. Power (Watts)	Peak Power (Watts)	Max. VSWR	Price
011-0085-00	Attenuator	50		3X	10	±0.5	12.4 GHz	2	300	1.2-DC to ≥ 4 GHz 1.3-4 to ≥ 8 GHz 1.4-8 to ≥ 12.4 GHz	$95
011-0086-00	Attenuator	50		10X	20	±1	12.4 GHz	2	300	1.4 – dc to 12.4 GHz	$95
011-0087-00	Attenuator	50		100X	40	±1	12.4 GHz	2	300	1.4 – dc to 12.4 GHz	$120

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

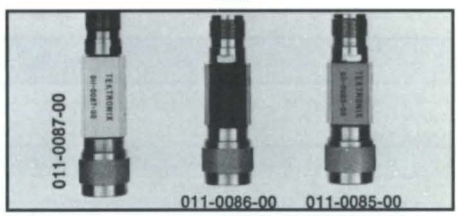


BNC

GR



SMA



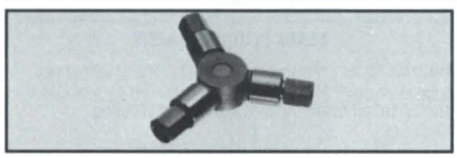
N

GR 50 OHM SELECTION GUIDE (see photo on this page)

	Type	Impedance (Ohms)	Z-Tol (Ohms)	Atten.	Atten. (db)	Tol. (db)	Freq. (dc to)	Avg. Power (Watts)	Peak Power (Watts)	Max. VSWR	Price
017-0078-00	Attenuator	50	±0.5	10X	20	±1.5%-dc GHz ±2% to 1 GHz ±5% to 2 GHz	4 GHz	1	1000	1.1-dc to 1 GHz 1.1-1 2 GHz 1.2- to 4 GHz	$450
017-0079-00	Attenuator	50	±0.5	5X	14	Same	4 GHz	1	1000	Same	$350
017-0080-00	Attenuator	50	±0.5	2X	6	Same	4 GHz	1	1000	Same	$250
017-0081-00	Termination end-line	50	±0.5	NA		Same	4 GHz	1	1000	Same	$510

3.5 MM TERMINATIONS (not shown)

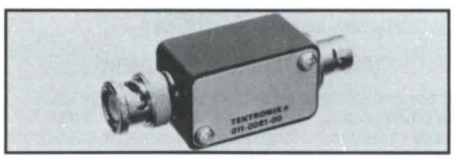
Female 50 Ω	011-0149-00	*1	Female short-circuit	011-0150-00	$250
Male 50 Ω	011-0148-00	*1	Male short-circuit	011-0151-00	*1



50 Ω POWER DIVIDER

SMA Female connector	015-0565-00	$230
SMA Male connector	015-1014-00	$280
GR connectors	017-0082-00	$825

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.



ACCESSORY HOUSING

Accessory Housing	011-0081-00	$60

Accessory housing without electrical components is useful for applications requiring special circuitry.

50 Ω COUPLING CAPACITORS

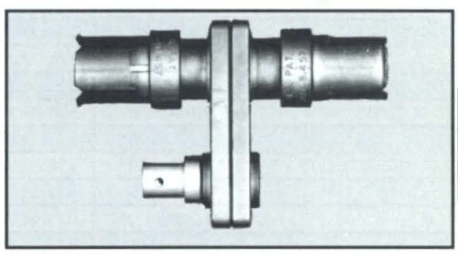
Coupling Capacitor SMA	015-1013-00	$235
Coupling Capacitor GR	017-0028-00	$130

The coupling capacitor is a short length of coaxial line with a disk capacitor (4700 pF ± 20%) in series with the inner conductor. High frequencies are transmitted with small reflection, but dc and low frequencies are blocked. Voltage rating is 200 V (015-1013-00), 500 V (017-0028-00).

50 Ω AIR LINE

50 Ω Air line	017-0084-00	$240

The 200 mm, 50 Ω air line is useful as a time-delay device and as an absolute impedance in a time-domain reflectometer system. The characteristic impedance is 50 Ω ± 0.4%. Time delay is 0.6698 ns ± 0.4%.



CT-3 SIGNAL PICKOFF

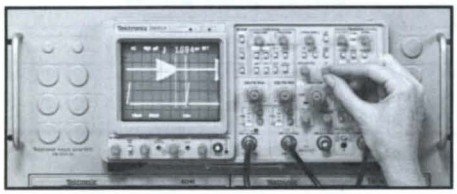
CT-3 Signal Pickoff 017-0061-00 $215

The CT-3 Pickoff provides a convenient means of picking off a signal in a 50 Ω system.
Sensitivity – 10% of the voltage under test, into a 50 Ω load.
Decay Time Constant – 4.5 µs at 0 dc current.
Rise Time – <0.4 ns.
Frequency Response – 50 kHz to 875 MHz at 0 dc current.
Insertion Impedance – With 50 Ω termination is 1 Ω shunted by 4.5 µH, 2 Ω shunted by 4.5 µH without a 50 Ω termination.
VSWR – <1.2 at 1.5 GHz.
Voltage Rating – AT 0 V dc is 25 V RMS. 1 kV pulse peak.

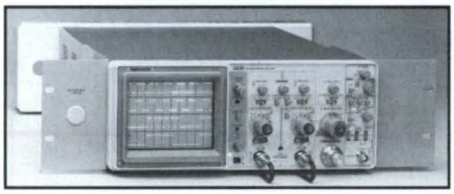
*1 *Contact your local sales representative.*

RACKMOUNT KITS

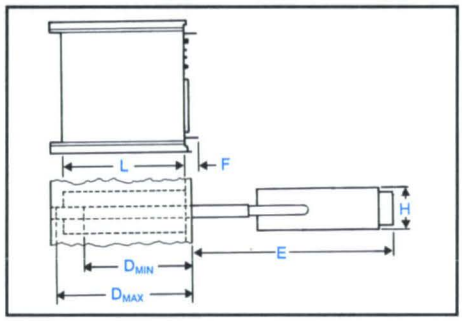
RACKMOUNT KIT SELECTION GUIDE



Typical 2400 series rackmount kit.



Typical 2200 series rackmount kit



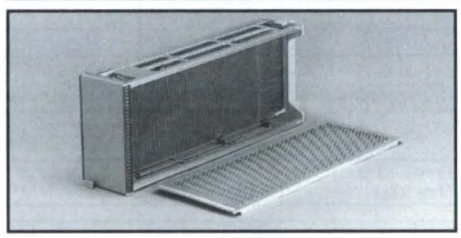
Instrument	Part Number	H in.	H cm	L in.	L cm	F in.	F cm	E in.	E cm	D Min. in.	D Min. cm	D Max. in.	D Max. cm
DSA 601, DSA 602, 1201/A, 11301/A,11302/A, 11401, 11402/A, 11403	040-1279-00	12.25	31.1	24.3	61.7	2.4	6.1	31.7	80.5	14.63	37.2	27.75	70.49
11801, 11802, CSA 803, SM11	040-1214-00	8.75	22.3	21.6	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	–	–	–	–
2782	016-0844-01	8.75	22.3	–	–	–	–	–	–	–	–	–	–
2710	016-0901-00	5.25	13.3	16.3	41.4	1.84	4.67	–	–	–	–	–	–
2710	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
2235	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	016-0015-00	5.25	13.3	16.3	41.4	1.8	4.5	–	–	7.5	19.1	24.5	62.2
2235 Opt. 01	016-0833-00	5.25	13.3	16.3	41.4	1.8	4.5	–	–	7.5	19.1	24.5	62.2
2235A	016-1062-00	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	016-1003-00	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	016-1023-00*2	5.25	13.3	16.3	41.4	1.8	4.5	–	–	7.5	19.1	24.5	62.2
2201, 2205, 2225, 2815	016-0819-00*2	5.25	13.3	16.3	41.4	1.8	4.5	–	–	7.5	19.1	24.5	62.2
1240, 1241	016-0789-00	8.75	22.3	17.75	45.1	1.13	2.9	–	–	–	–	–	–
1230	1230F05	8.75	22.3	17.75	45.1	1.13	2.9	–	–	–	–	–	–
490 Series	016-0844-01*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	040-0982-00	7.0	17.8	18.0	45.7	–	–	–	–	–	–	–	–
TM5003	040-1257-00	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



BLANK PLUG-IN CHASSIS

Available for all Tektronix mainframes. The 11000 Series provides a blank plug-in only. The 7000 Series provides a printed circuit board, plug-in frame, and securing hardware.

11000 Series	016-0829-00	$115
7000 Series	040-0553-03	*1
5000 Series	040-0818-03	$140
TM 500 Series	040-0652-05	$135

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.

7000 Series	016-0155-00	$65
5000 Series	016-0452-00	$33
TM 500/TM 5000 Series	016-0195-03	*1

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).

Plug-in Storage Comp.	016-0362-02	$80

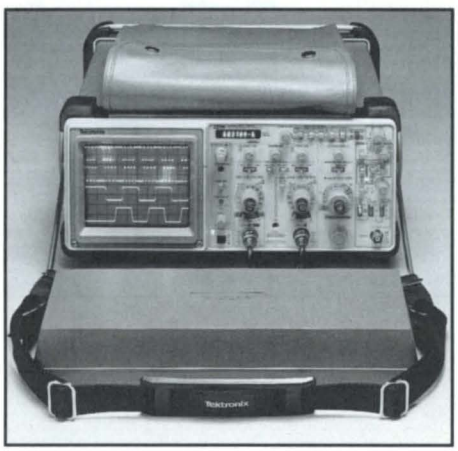
*1 *Contact your local sales representative.*

INSTRUMENT TRAVEL ACCESSORIES

TRAVEL LINE PACKAGE

Avoid Scope Damage and Improve Portability

- *Impact-Resistant Packaging*
- *Pouch and Cover*
- *Carrying Strap*
- *Rubber Shock-absorbing Bumpers*



Portable Oscilloscope

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 convienient 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).

TRAVEL LINE PACKAGE

Order Option 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

Includes: Replacement cabinet and rear cover with the rubber moldings installed.

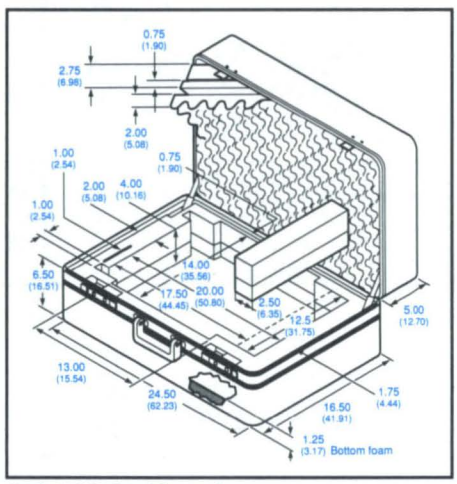
2235A	Order 140-1188-02	*1
2236A	Order 040-1187-01	*1
2221, 2224, 2232	Order 040-1187-01	*1

*1 *Contact your local sales representative.*

PORTABLE INSTRUMENT TRANSIT/CARRYING CASES

Special Protection for Transporting and Shipping Portable Instruments.

- *High Strength*
- *Foam Padding*
- *Custom Fit*



016-0792-01 (shown)

Rugged transit cases molded of high strength glass-epoxy. Protects 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.

HARD SIDED CASE

2750	Order 016-0692-00	$43
2710, 2400 Series, 2200 Series	Order 016-0792-01	$280
490 Series, OF150, OF235	Order 016-0658-00	$990
TM 503A	Order 016-0565-01	$620
TM 504	Order 016-0608-00	$805
TM 515	Order 016-0643-00	$730
C-50 Series	Order 016-0177-00	$345

SOFT SIDED CASE

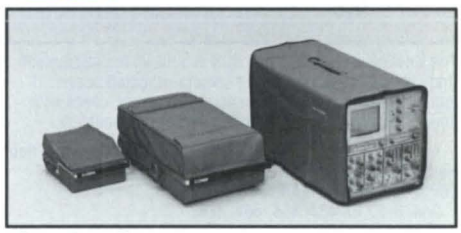
490 Series, OF150, OF235	Order 016-0659-00	$140
HC100	Order 016-0707-00	*1

CARRYING STRAP

2200/2300 Series	Order 346-0199-00	$19.25

PORTABLE INSTRUMENT PROTECTIVE COVERS

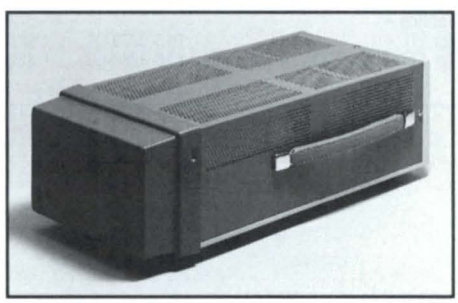
- *Custom Fit*
- *Waterproof Vinyl for Complete Enclosure or High Impact Plastic for Front Panel Enclosure*



Complete 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.

7704A/7900/7854/7104	016-0531-00	$15
7300/7400/7600 Series	016-0192-01	$20
5000 Series	016-0544-00	$18
2200 Series	016-0848-00	$18
200 Series	016-0512-00	$21
490	016-0659-00	$140
465/465B/475/485	016-0554-00	$19.25
453A/454A/491	016-0074-01	$18
434/464/466	016-0365-00	$27
326	016-0532-00	$60
323/324/1401A/ 1401A-1/1501	016-0112-00	*1
314/335	016-0612-00	$90
TM 504	016-0621-00	$45
TM 503	016-0620-00	$35



Front Covers Only

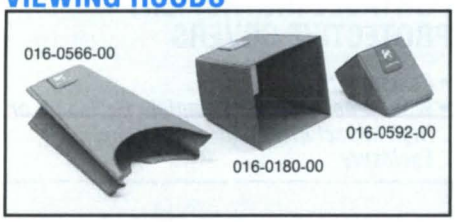
Snap-on front cover, molded of high-impact plastic, is available for most portable oscilloscopes, spectrum analyzers, and TM 500/5000 mainframes.

2400 Series	200-3199-01	$9.75
2245A, 2246A, 2247A	200-3232-00	$7.00
2235A, 2236A/2710	200-2520-00	$6.00
2201, 2205, 2211, 2225	200-3397-00	$5.00
TM 506	200-1728-00	$21
TM 504	200-1727-00	$20
TM 503A	200-3554-00	$26

VIEWING HOODS AND LIGHT FILTERS

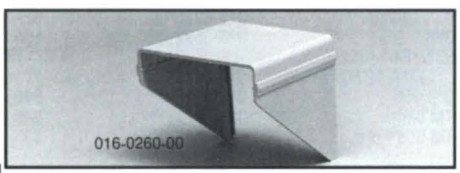
SELECTION GUIDE

VIEWING HOODS

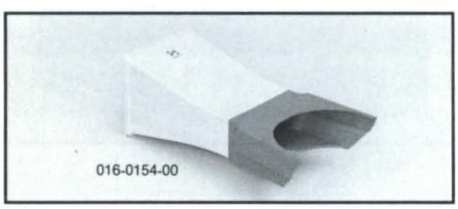


The viewing accessories normally mount on the instrument graticule cover. Some may fit camera-mounted bezels. If you intend using a camera on your instrument, check with your Tek Sales Engineer for bezel-viewer compatibility.

	Part No.	Price
Folding Binocular –		
For 2200 series 2445A/B, 2465A/B, 2467B, 2710, 434, 455, 464, 466, 465B, 475, 475A	016-0566-00	$21
For 422, 453A, 454A, 485, 491	016-0082-00	$21
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, 2710, 432, 434, 455, 465/B, 475, 464, 466 (polarized)	016-0180-00	$60
For 2200 series, 2445A/B, 2465A/B, 2467B, 2710, 464, 466, 455, 465, 465B, 475 (non polarized)	016-0592-00	$15
For 422, 453, 454A, 485, 491 (non polarized)	016-0274-00	$19



	Part No.	Price
Folding –		
For 576,	016-0259-00	$25
For 577, 5000, 7000, 11000 Series	016-0260-00	$30



	Part No.	Price
Non-collapsible –		
For older Tek 5-inch oscilloscopes	016-0001-01	$200
Molded – gray polystyrene with polyurethane eyepiece.		
For 5000 and 7000 series, 528, 577	016-0154-00	$49
For 576	016-0153-00	$55

CATHODE-RAY TUBE LIGHT FILTERS

Instrument*1	Color	Part Number	Price
200 Series	Blue	378-0691-00	$2.85
324/335	Blue	378-2016-01	$1.85
490	Amber	378-0115-01	$3.30
	Gray	378-0115-02	$6.00
	Blue	378-0115-00	$3.10
434	Blue	378-0678-01	$2.30
455/465M	Blue	337-2122-00	$6.50
465/465B	Blue	337-1674-00	$8.00
475	Clear	337-1674-01	$7.25
464/466	Smoke-grey filter	337-1674-07	$9.50
540/550 Series	Smoke-gray*2	378-0567-00	$14.25
	Green	378-0568-00	$14.25
565/575	Blue	378-0569-00	$11.50
	Amber	378-0570-00	$14.25
576	Blue*2	378-0616-00	$6.00
603/604	Clear (603*2)	337-1440-00	$4.25
	Green	337-1440-01	$4.65
	Amber	337-1440-02	$3.50
	Blue	337-1440-03	$3.85
	Gray	337-1440-04	$4.50
	Graticule (8 x 10 div)	331-0303-00	*3
605/606/ 607	Blue	337-1674-00	$8.00
	Graticule	337-1674-10	$10.00
	Clear Shield	337-1674-13	$14.75
	Gray*2	337-1674-06	$5.00
	Graticule (8 x 10 div)	331-0391-00	$9.00
608	Amber	378-0704-00	$10.00
	Graticule*2	337-2126-02	$10.00
2200 Series	Blue*2	337-2775-00	$4.20
	Clear	337-2775-01	$1.95
	Gray w/TV Graticule	035-0175-00	*3
2300 Series	Blue Implosion Shield*2	337-2760-00	$2.25
	Clear Implosion Shield*2	337-2781-00	$4.40
2400 Series	Blue*2	378-0199-03	$3.00
	Clear Implosion Shield*2	378-0208-00	$1.50
2710	Smoke Gray	337-2775-02	$2.35
5100 & 5400 Series (except 5441)	Clear	337-1440-00	$4.25
	Green	337-1440-01	$4.65
	Amber	337-1440-02	$3.50
	Blue	337-1440-03	$3.85
	Gray	337-1440-04	$4.50
5441	Clear*2	337-1674-01	$7.25
	Gray	337-1674-07	$9.50
	Graticule (8 x 10 div)	331-0391-00	$9.00
7603	Blue	378-0684-00	$8.50
	Amber	378-0684-01	$7.00
	Gray	378-0684-02	$7.00
	Green	378-0684-03	$10.00
	Spectrum Analyzer Graticule	337-1439-01	$9.75
	Blue Implosion Shield*2	337-1700-01	$6.00
	Clear Implosion Shield	337-1700-04	$5.50
7613/7623/ 7623A/ 7633	Spectrum Analyzer Graticule	378-0625-07	$14.50
	Green (UV)	378-0625-08	$5.00
7844/7313	Blue*2	378-0625-00	$7.00
7700 Series/ 7613/ 7623/7100 Series/ 7900	Amber	378-0625-01	$9.50
	Gray	378-0625-02	$6.75
	Green	378-0625-03	$5.00
	Gray TV Graticule NTSC	378-0625-06	$12.00
	Clear Shield Spectrum Analyzer Graticule	337-1159-02	$9.75

*1 *For both cabinet and rackmount instruments unless rackmount version is listed.*
*2 *Standard filter supplied with instrument.*
*3 *Contact your local sales representative.*

CRT MESH/EMC FILTERS

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.

Instrument*1	Part Number	Price
314/326/335	378-0063-00	$65
432/434	378-0682-00	$65
422/491/453A/ 454A/485	378-0648-00	$60
465/465B/475/ 464/466/434	378-0726-01	$90
2710	378-0227-01	$85
7400/7603	378-0696-00	$70
7100/7500/7700/ 7800/7900 Series/ 7613/7623/A/7633	378-0603-00	$90

*1 *For both cabinet and rackmount instruments.*

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.
Toll free: 1-800-426-2200, Ext. 99.

POWER ACCESSORIES FOR PORTABLE OSCILLOSCOPES

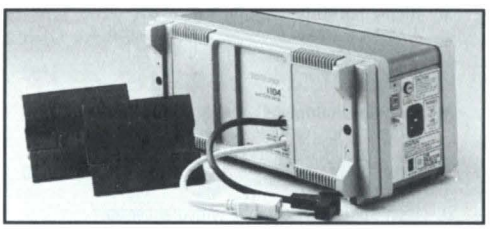
Tektronix power accessories offer true field use portability and operating freedom at service and maintenance sites where conventional ac power sources are not available. They let your scopes go where you need them–and have enough power for your testing and troubleshooting tasks.

Instrument	Recommended Power Accessory
2221, 2224, 2232, 2236A, 2235A (1107 mounting kits ordered separately)	1107/1106
2201, 2205, 2211, 2245A, 2246A, 2247A (no mounting kits are available)	
2300 Series, 2400 Series Analog	
314, 335, 336A,	1105
2225 Requires Opt. 07	1104

Contact local sales office for details on how to use 1104 with other scopes.

1104 BATTERY PACK

The 1104 battery pack mechanically couples to the rear of the 2225 Option 07 oscilloscope, providing a dc power source for two hours of uninterrupted operation in the absence of ac power. It has an integrated charger that allows scope operation during the charge cycle.



Battery Capacity – 12 V, 124 Ah (sealed lead acid-gel cell).
Line Voltage Range – 95 Vac to 128 Vac or 185 Vac to 250 Vac (48 Hz to 440 Hz).
Charge Time – 16 hours.
Cycle Life – 200 Cycles.
Charger Type – Trickle.
Weight – 14 lbs/6.5 kg.
Safety – U.L. Listed, CSA Certified.

1105 POWER SUPPLY

Internal Battery Voltage Range – 22 V to 28 V.
External DC Input Voltage Range – 24 V to 30 V.
Output – Waveform: 60 Hz square wave.
Maximum Recommended Output Current – Standard: 0.9 A. Option 01: 0.45 A.
Minimum Operating Time – 50 W hours at full charge
Battery Charging Time – 14-16 hours from full discharge at 0°C to + 40°C.
Battery Charging Rate – Full: 600 mA. With thermal cutout open: 254 mA.
Maximum Consumption from AC Source – 40 W.

ENVIRONMENTAL

Ambient Temperature – Operating: 0°C to + 40°C. Non-Operating: – 40°C to + 60°C.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width	165	6.5
Height	250	9.8
Depth	216	8.5
Weight	**kg**	**lb**
Net	8.8	19.4

1106 BATTERY PACK

DC Power Output – + 22 V to + 24 V for 7 ampere hours.
Minimum Operating Time – 75 W hours at full charge.
Charging Time – See 1105.
Charging Rate – Full 620 mA. With Thermal cutout open 60 mA.
AC Charging Frequency Range – 50 Hz to 400 Hz.
Max. AC Power Consumption – 40 W.

ENVIRONMENTAL

Ambient Temperature – Operating: 0°C to + 40°C. Non-Operating: – 40°C to + 60°C.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width	292	11.5
Height	66	2.6
Depth	432	17.0
Weight	**kg**	**lb**
Net	7.3	16.0

1107 DC INVERTER

Output Frequency – 60 Hz
Output Voltage & Timing – 12 V mode 60 W. 24 V mode 100 W.
Rated Output Power – @12 V = 70 W, @ 24 V = 100 W.
Overload Protection – Audible tone and shutdown when ac load exceeds 100 W.
Input Voltage Selection – Automatic between 12-24 V.

ENVIRONMENTAL

The 1107 DC Inverter meets environmental requirements of MIL-T-28800C for Type III, Class III, Style C equipment with humidity and temperature requirements defined in paragraphs 3.9.2.2, 3.9.2.3, 3.9.2.4 (except Electromagnetic Compatibility which is based on radiation emission requirements per VDE 0871 Class B). Contact sales office for details.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width	276	10.9
Height	119	4.7
Depth	84	3.3
Weight	**kg**	**lb**
Net	1.8	4.3

Engineered Power Accessories to Extend the Uses of Your Oscilloscope

- *UL Listed; CSA Certified*
- *Recharge During Operation*
- *Rugged Design*

ORDERING INFORMATION

BATTERY PACKS

1107 DC Inverter **$1,530**
Includes:
dc Power cord, (161-0095-00);
manual, (070-5056-00).

1106 Battery Pack **$2,030**
Includes: Manual (070-1713-00).

1105 Battery Pack **$2,690**
Includes:
dc power cord, (161-0094-00);
manual, (070-1479-01).
Opt. 01 230V ac operation **NC**

1104 Battery Pack **$350**
for 2225 Opt. 30. For use with 2225 Opt. 07 (see page 138).
Includes: dc Power cord; two mounting clamps, instruction manual, 1 year warranty.
(All 2225 accessories are compatible with the 2225 Option 30 and Option 07, excluding the rackmount kit.)

MOUNTING KITS

(For the 1107 rear mount)
1107 and 1106 will electrically work with all 2200-Series products, but mounting kits are only available for the following instruments:
2221, 2224, 2232, 2235A, 2236A
(cannot be used with Travel Line Package Option.
Order 016-0785-00 **$60**
2300 Series Order 016-0786-00 **$60**
2445A, 2455B, 2465B, 2467B
Order 016-0783-01 **$75**

LOGIC ANALYZERS LEAD SETS

A. Individual Hook-Tip Lead Set – 10 leads, 16 inch, color coded with E-Z Micro Hook Tips. Order 012-0670-00 **$95**

B. Flying Lead Set – 10 wide comb, 10 inch, color coded, connects to 0.025-inch square pins, grabber tips not included. Order 012-0747-00 **$40**

C. Harmonica Lead Set – 10 wide comb to 10 position single-row connector, for 0.025-inch square pins on 0.1-inch centers, 10 inch, color coded. Order 012-0800-00 **$40**

D. Pattern Generator Lead Set – 10 + 2-wide comb, 9 inch, twisted pairs, color coded, connects to 0.025-inch square pins, grabber tips not included. Used with P6455, P6456, P6457 pattern-generator probes. Order 012-0926-00 *2

E. High-Speed Pattern Generator Lead Set – 10 + 2 wide comb to 20-position double-row connector, for 0.025-inch square pins on 0.15-inch centers, 5 inch, color coded. Used with P6455, P6456, P6457 pattern generator probes. Order 012-0551-00 **$145**

F. Sense Leads – Package of ten, 2-wide comb to Pomona Hook Tip, 5 inch, black for ground or VL. Order 012-0989-01 **$125**

G. Grabber Tip – Package of 12, for general-purpose probing with various lead set.
(Single-sided grabber tips)
Order 020-1386-00 *2
(Double-sided grabber tips)
Order 020-1456-00 *2

*1 **Flying Lead Set** – 10 inch, 10 channel, color coded. For use with the P6440 and P6441 Data Acquisition Probes.

Lead Set with Black Ends –
Order 174-0752-00 **$30**

Lead Set with Red Ends –
Order 174-0763-00 **$30**

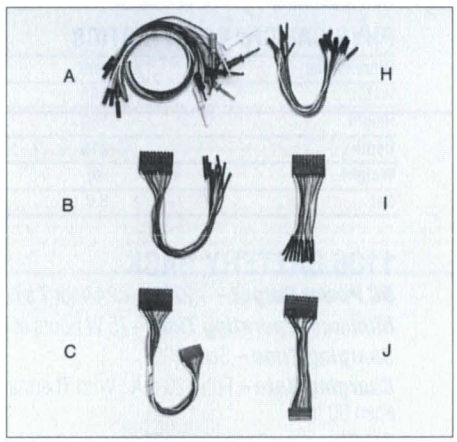
Lead Set with White Ends –
Order 174-0764-00 **$30**

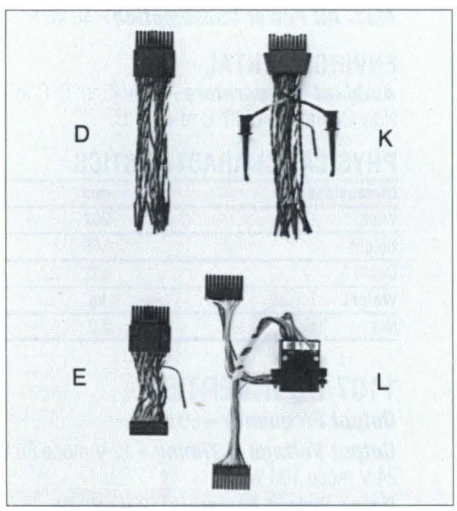
*1 **Flying Lead Set** – 10 inch, 10 channel, color coded. For use with the P6443 and P6444 Data Acquisition Probes

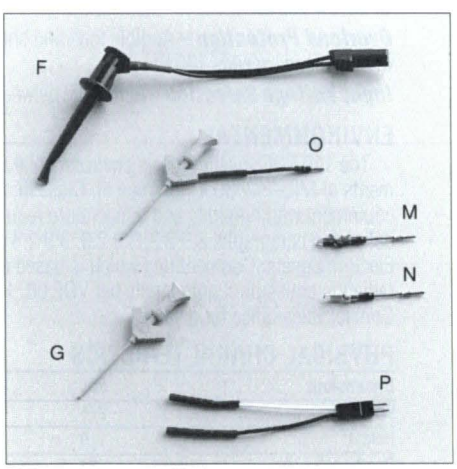
Lead Set with Black Ends – Order 174-1264-00 **$30**

Lead Set with Red Ends – Order 174-1265-00 **$30**

Lead Set with White Ends – Order 174-1266-00 **$30**







H. Individual Lead Set – 10 leads, 8 inch, color coded, connects to 0.025-inch square pins, grabber tips not included. Order 012-0655-02 **$235**

*1 **Individual Lead Set** – 10 leads, 16 inch, color coded, connects to 0.025-inch square pins, grabber tips not included. Order 012-0655-01 **$195**

I. Flying Lead Set – 10 wide comb, 5 inch, color coded, connects to 0.025-inch squre pins, grabber tips not included. Order 012-0987-00 **$30**

J. Harmonica Lead Set – 10-wide comb to 10-position single-row connector, for 0.025-inch square pins on 0.1-inch centers, 5 inch, color coded. Order 012-0968-00 **$115**

K. Pattern Generator Lead Set – 10 + 6-wide comb with VH and VL Pomona Hook Tips, 9 inch, twisted pairs, color coded, connects to 0.025-inch square pins, grabber tips not included. Used with P6455, P6456, P6457 pattern generator probes. Order 012-1053-00 **$155**

L. GPIB Adapter – Two 10-wide combs to IEEE Standard 488 Bus Connector, 10 inch. Order 103-0209-00 **$250**

M. High-Speed Grippers – Package of ten, 1.75 inch, for flat packages with 0.05-inch lead spacing, use with P6453 or P6454. Order 195-1943-06 **$150**

N. High-Speed Grippers – Package of ten, 1.75 inch, for Dip packages with 0.1-inch lead spacing, use with P6453 or P6454. Order 195-2234-06 **$150**

O. High-Speed Clock Lead – With grabber tip, package of two, for use with P6453 or P6454. Order 195-3659-02 **$19.25**

P. Lead Set – For use with Podlets. Acquisition probes P6461/E and HS8. Order 196-3047-00 *2
Pattern generator probes P6464/P6465.
Order 196-2963-00 **$9.75**

*1 **Pattern Generator Flying Lead Set** – 10 inch, 17 twisted pair leads, color coded. For use with the P6463 Pattern Generator Probe. Order 012-1236-00 **$45**

*1 *Not Shown*
*2 *Contact your local sales office for information*

CABLES IC CLIPS & ADAPTERS /CONNECTORS SELECTION GUIDE

CABLES

RS-232 Cable – Male-to-female. 20 inch, wires: 1-1, 2-2, 3-3, 4-4, 5-5, 6-6, 7-7, 8-8, 11-11, 12-12, 15-15, 17-17, 19-19, 20-20-, 22-22. Used with 1200C01 modem interface DAS 9200 mainframe to terminal or DAS 9100 line printer and communications interface. Order 012-0911-00 **$100**

RS-232 Cable – Male-to-female, 2 meter, 25 wires; 1-1, 2-2, 3-3, thru 25-25. General purpose. Order 012-0815-00 **$95**

Null Modem Cable – Female-to-female, 60 inch, wires: 1-1, 2-3, 3-2, 4-5, 5-4, 7-7, 8-20, 11-11, 12-12, 19-19, 20-8. General Purpose. Order 012-0820-00 **$405**

Null Modem Cable – Female-to-female, 60 inch, wires: 1-1, 2-3, 3-2, 4-8, 5-8, 6-20, 7-7, 8-4, 8-5, 20-6. Used with 1200C01 Serial Printer interface. Order 012-0530-00 **$90**

Parallel Interface Cable – Two meter, for Centronix-type printer interface. Order 012-0997-00 **$90**

GPIB Cable – Two meter. Order 012-0630-01 **$105**

75 Ω Coaxial Cable – BNC to BNC, 42 inch, used with video hard copy interface. Order 012-0074-00 **$20**

75 Ω Coaxial Cable – BNC to BNC, 120 inch, used with video hard copy interface. Order 175-2753-00 **$28**

Sync Out Cable – Miniature Phone Plug to BNC, 79 inch, for 91A24 sync output. Order 175-8165-00 **$38**

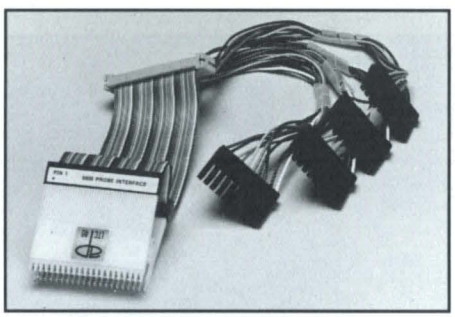
91AE04A Coaxial Jumper Cables Replacements – 3 inch, SMA connectors to connect 91A04A to 91AE04A. Order 175-6425-00 **$18.50**

91AE24 Jumper Cable Replacements – Package of seven, twisted pair, 2-position connectors, 3 inch. Order 175-8167-00 **$4.80**

Probe Extender Cable – Male to Female 34-position double-row connectors compatible with P6452, P6463, P6455, P6456, P6462, 6 feet. Order 012-1012-01 **$125**

Flat Cable Mounts – Adhesive Back for securing and organizing probes with flat ribbon cables. Order 343-1048-00 **$.95**

IC CLIPS & ADAPTERS /CONNECTORS



A. UPIK 40, Universal Probe Interface Kit – For 40-pin dip packages. Allows user to configure interconnect from 6 probes or less to a clothes pin style 40-pin IC clip. Order UPIK 40 **$175**

40-Pin Adapter – 40 position double row header with 0.025-inch square pins on 0.1-inch centers, interfaces the PM 101 or flying lead sets to low-profile dip clip above. Order 380-0560-05 **$16.50**

40-Pin Dip Socket Female Adapter – 40 position double-row head with 0.025-inch square pins on 0.1-inch centers to 40-pin dip socket, for interfacing 40-pin low-profile dip clips to PM 100 series probes. Order 380-0647-01 **$49**

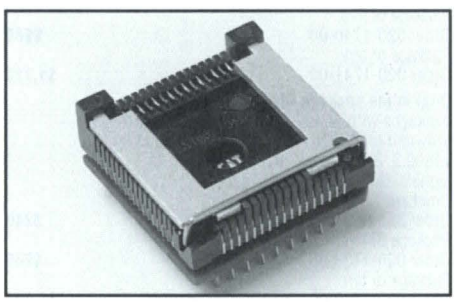
IC Clip – 16-pin dip, clothespin style. Order 003-0709-00 **$17**

IC Clip – 24-pin dip, clothespin style. Order 003-0823-00 **$35**

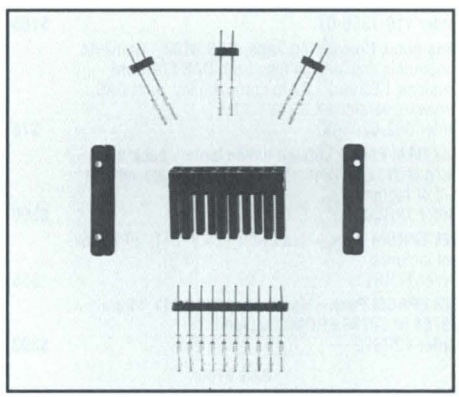
IC Clip – 40-pin dip, clothespin style. Order 003-0801-00 **$50**

Low Profile Dip Clip – 40-pin dip to 40-position double row connector, for 0.025-inch square pins on 0.1-inch centers, 4 inch (requires male adapter below). Order 015-0339-02 **$49**

Low-Profile Dip Clip – 40 pin, same as above except 12 inch. Order 015-0339-00 **$49**



B. LCC (Leadless Chip Carrier) to PGA (Pin Grid Array) Adapter – 68-pin package, for adapting 80286 (LCC) packages to 80286 (PGA) package. Order 015-0494-00 **$44**



C. Circuit Board Mounted Probe Connector Kit – 10 + 6-wide comb to 0.025-inch square pins on 0.15-inch centers, with mounting tabs, for PC mounting, mounting hole dimensions 0.80 inch wide x 0.95 inch long. Interfaces to the following probes: P6452, P6455, P6456, P6457, P6460 and P6462. Seven piece kit. Order 020-1027-00 **$36**

LOGIC ANALYZERS ACCESSORIES

LOGIC ANALYZERS ACCESSORIES SELECTION GUIDE

DAS 9200

Circuit Board Ejector Tools – For removal of circuit boards from the DAS 9200 Mainframe (2 required).
Order 105-0985-00 **$2.50**

Deskew Adapter – For use with the DAS 92A60/90 to deskew the channel groups.
Order 010-0456-00 **$165**

Training Aid Board – For use with DAS 9200, connects acquisition probe leadset to patter generation leadset*1 *1

General Purpose Leadset – For use with the DAS 92A60/90, flying leads can be connected to 0.025 square pins or optional grabber tips.
Order 012-1165-00 **$450**

Podlet Gang Connector – For use with P6461/P6461E, 10 wide, pkg of 2, NOT for use with P6464 or P6465.
Order 020-1442-00 **$35**

Retainer Clamps – Kit of 4. (P6461E) Order 020-1483-00 (P6460/P6464/P6465, DAS 9200.
Order 020-1484-00 *1

MEDIA

For DAS 9200, DAS 9100, and 1240/1241.

Flexible Disk – 360k, 5.25-inch, 48 TPI, package of 10.
Order 119-1583-01 **$36**

Tape Cartridges, DC-100 Type – Package of five used on DAS 9100 Option 01.
Order 119-1350-01 **$185**

Mnemonic Conversion Tape, DAS 9100 – Converts mnemonic and all type files from DAS firmware versions 1.05 and 1.07 to compatibility with DAS firmware versions 1.09 or 1.11.
Order 062-6705-00 **$75**

64k RAM Pack – Lithium iodide battery back-up, used with 1240/1241. Must have firmware version 5-2 or higher.
Order 12RS02 **$500**

32k EPROM Pack – Used with 1240/1241. EPROMs not included.
Order 12RS11 **$85**

32k EPROM Pack – Used with 1240/1241, four 68764 or 68766 EROMs included.
Order 12RS12 **$300**

DAS 9100

Service Maintenance Kit – Includes board and cable extenders for DAS modules, power supplies, CRT, and keyboard.
Order 067-0980-01 **$1,600**

Set-Up and Hold-Time Test Fixture –
Order 067-1037-00 **$1,550**

High-Speed Acquisition Test Fixture – For verification of DAS 91A04, DAS 91AE04, DAS 91A04A, and DAS 91AE04A modules.
Order 067-1139-00 **$345**

Circuit Board Ejector Tool – For removing DAS 9100 module cards.
Order 214-3154-00 **$5.75**

High-Speed Lead Connectors – Package of ten, gold-plated contact pins that interface to podlet lead receptacles on P6453 or P6454.
Order 131-2729-02 **$30**

Diagnostic Lead Set – 10-wide comb to 10-wide comb, and two-wide ground jumper, 10-inch, for connecting pattern generator probes to data acquisition probes.
Order 012-1000-00 **$60**

*1 *Contact your local sales office for information*

RACKS AND RACKMOUNT KITS

Rackmount Kit – For DAS 9100. Order 016-0463-00 **$270**
Rackmount Kit – For DAS 9200. Order 016-0845-00 **$495**
Rackmount Kit – For 1240/41 Order 016-0789-00 **$490**
Rackmount Kit – For 92HS8/91HS8.
Order 016-0884-00 **$330**
Rackmount Kit – For 1230. Order 1230F05 **$450**

1240/1241

Service Maintenance Kit – Includes 1240 Service Manual with 1241 Service Addendum, 12RD01 Diagnostic ROM Pack, Diagnostic Lead Sets, Extender Card for Acquisition Cards, and Extender Card for the Trigger, Display, and Processor Cards.
Order 067-1103-03. **$2,225**

Diagnostic Lead Set, 1240/1241 – 10-wide comb with 2-wide ground to 12-position double-row connector, for 0.025-inch square pins on 0.1-inch centers, 10 inch, color coded.
Order 012-0556-00 **$50**

Probe Retainer Kit – (For use with P6460 only) Includes a probe guide panel, four probe retaining brackets and screws. Secures probe plugs to probe guide panel on the side of 1240/1241.
Order 020-1678-00 **$50**

1230/1205

Demo/Test Circuit – For use with 1205 and 1230. A convenient tool to aid in gaining experience and confidence with the use of a logic analyzer. Can also be used to do a simple demonstration of the uses of a logic analyzer.
Order 671-0049-00 **$50**

Service Maintence Kit – Includes 1230 Service Manual, Extender Card for 1230E1 module, and cable assemblies.
Order 020-1674-00 **$1,500**

LV 500 ACCESSORIES

Pin Grid Array DUT Card – For 0.1 center-to-center device sockets. 256 channels routed to a connection area surrounding a 21 by 21 matrix of holes for mounting the device socket.
One card.
Order 388-9551-00 **$240**
Package of five.
Order 020-1740-00 **$960**
Package of ten.
Order 020-1741-00 **$1,720**

Dual Inline package DUT card – For DIP packages with up to 64 signal pins. Pins are prewired to LV 500 channels. For DIP sockets with 0.3, 0.4, 0.6, or 0.9 inch centers. All signals can be series-terminated.
One card.
Order 388-9552-00 **$240**
Package of five.
Order 020-1738-00 **$960**
Package of ten.
Order 020-1739-00 **$1,720**

Quick Connect PGA DUT Card – For quick interface to up to 19 by 19 PGA devices. Wire device pins to tester channels via insulation displacement terminal strips. Includes ZIF socket, termination resistors, wiring strips, wire insertion tool, and wire.
Order 020-1777-00 **$950**

Coaxial Cable DUT Card – For interface to probers, chip handlers, and custom test fixtures. Includes DUT card, 75 ohm/60 cm coaxial cables, cable clamp, and power supply ribbon cable. Coax cables connect to standard 0.1 inch center square pins.
DUT card and 64 coax cables.
Order 020-1801-00 **$1,960**
DUT card and 128 coax cables.
Order 020-1802-00 **$3,110**
DUT Card and 256 coax cables.
Order 020-1803-00 **$5,380**
DUT Card only.
Order 020-1804-00 **$850**

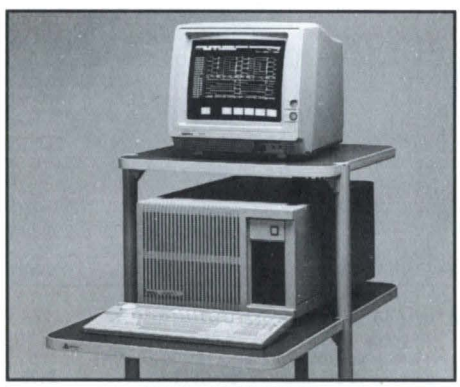
Scratch Pad DUT Card – 0.1 center-to-center grid for developments of custom device interfaces. Grid area is 5.5 inches in diameter.
One card. Order 389-0639-00 **$240**
Five cards. Order 020-1809-00 **$960**
Ten cards. Order 020-1810-00 **$1,720**

Static Grounding Wrist Strap –
Order 006-7248-00 **$19.25**

CARTS

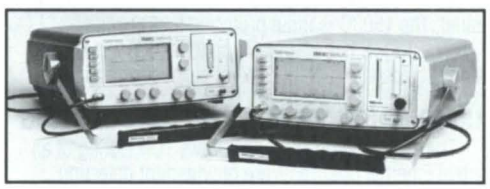
92 Cart – AnthroCart for DAS 9200.
Order 92 Cart **$355**

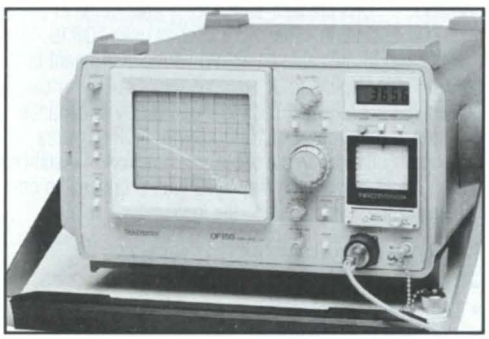
K217 Cart – See Cart section page 400 for complete description. For DAS 9100. 1240/1241, and 1230.
Order K217 **$570**



OTHER ACCESSORY

Accessory Pouch – Convenient for carrying manual and other accessories.
Order 016-0707-00 *1





Tektronix Telecommunications Test Equipment. An array of equipment working with a wide array of communications environments.

TELECOMMUNICATIONS TEST EQUIPMENT

Tektronix Telecommunications test equipment is designed to monitor, document, or troubleshoot your communications network.

METALLIC CABLE TESTING

The 1502C and 1503C MTDRs are metallic cable testers for installation and troubleshooting of metallic cables. The MTDRs detect a wide range of faults, including opens, shorts, crimps, taps, water, and more. Distance to the fault is shown in feet or meters. Options let you configure an instrument perfectly suited to your needs, whether it be for LAN, telephony, CATV, aviation, or another testing application.

The TMA802 is a Media Analyzer that provides quick and easy LAN testing.

OPTICAL CABLE TESTING

Finding faults in optical cable is quick and easy with the new TFS2020 FiberScout™. Revolutionary in its design, the FiberScout combines small size, light weight, and an intuitive user interface to provide the first true optical fault locater at a surprisingly low cost.

The OF150 and OF235 OTDRs are optical fiber testers. With these OTDRs, you can easily check for splice loss, breaks, and end-to-end loss. Whether you require high-resolution or long-distance testing, Tektronix provides an OTDR for you.

For bandwidth testing, Tektronix provides the OF192 Bandwidth Test Set. The OF192 measures bandwidth and loss.

DATA COMMUNICATIONS TESTING

The Tektronix 830 Series protocol analyzers are advanced diagnostic tools that help you find problems with communication protocols and interfaces. The many features and options allow you to find an analyzer that cleanly matches your configuration.

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

Contents

METALLIC CABLE TESTING

1502C High Resolution MTDR 448
1503C General Purpose MTDR 448

LAN MEDIA TESTING

1503C General Purpose MTDR, Option 06, Ethernet Testing 448
TMA802 Media Analyzer 449

OPTICAL CABLE TESTING

TFS2020 FiberScout ™ 450
OF150 Multimode OTDR 450
OF235 Singlemode OTDR 451
OF192 Bandwidth Test Set 451

DATA COMMUNICATIONS TESTING

TC 2000 Protocol Analyzer 452
NEW TC 1000 Protocol Analyzer 453
834 Protocol Analyzer 454
835 Protocol Analyzer 454
836 Protocol Analyzer 454
NEW 2410 Digital Interface Test System 455

1502C/1503C

Easy-to-use, portable testers for telephony, LAN, CATV, power company field testing, and more.

ORDERING INFORMATION

1502C Metallic TDR	**$6,200**
1503C Metallic TDR	**$4,850**

Each instrument includes the following accessories: AC PowerCord; 50 Ω BNC Terminator; Precision 50 Ω Cable; Female-to-female BNC Connector; Spare Fuse; Operator's Manual; Accessory Pouch; OptionPort Cover; Calculator Slide Rule.

OPTIONS

Opt. 03 – Internal Battery	**+$195**
Opt. 04 – YT-1 Chart Recorder	**+$950**
Opt. 05 – Metric Version	**NC**
Opt. 06 – Ethernet Testing (1503 only)	**+$295**
Opt. 08 – Token Ring Adapter	**+$150**
Opt. 09 – USOC Adapter (1503 only)	**+$150**
Opt. 10 – Token Ring Interface	**+$350**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1-A5 – Available. See page 488 for description.	**NC**

OPTIONAL ACCESSORIES

Internal Battery – Order 040-1276-00	*1
YT-1 Chart Recorder	**$950**
SP232 – RS-232 Interface Module	**$495**
Token Ring Adapter – Order 015-0500-00	**$150**
USOC Adapter – Order 015-0579-00	**$150**
Starlan Adapter – Order 015-0578-00	**$100**
Chart Paper –	
(1 roll) Order 006-7647-00	**$6.00**
(25 rolls) Order 006-7677-00	**$140**
(100 rolls) Order 006-7681-00	**$520**
Service Manual –	
(1503C) Order 070-7170-00	**$100**
(1502C) Order 070-7168-00	**$100**
Adapter – (Direct Current) Order 015-0327-00	**$310**
Adapter – (50/125Ω) Order 017-0090-00	**$245**
Adapter – (50/75Ω) Order 017-0091-00	**$245**
Adapter – (50/93Ω) Order 017-0092-00	**$245**

A wide range of other connectors are available, in addition to those listed here. For information on these connectors, additional information on options, or other assistance, call 1-800-833-9200.

*1 *Contact your local sales representative*

1502C/1503C METALLIC TDR CABLE TESTERS

TIME DOMAIN REFLECTOMETRY (TDR)

The portable, rugged 1502C and 1503C TDR Cable Testers are portable maintenance tools that are simple to operate and will test most dual conductor metallic cables under virtually any condition. A high-contrast LCD, waveform storage, and PC controllability make the 1502C and 1503C TDRs are well-suited for a wide range of testing applications. The 1500C Series uses TDR to identify and locate cable faults. When the instrument is connected to the line to be tested it sends out electrical pulses that are reflected back to the tester by impedance changes in the cable. The 1500C Series TDRs display impedance changes in the cable as a function of distance. Moving the cursor to the displayed fault produces an on-screen readout of distance to the fault.

TYPICAL CABLE MEASUREMENTS

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

1502C HIGH RESOLUTION MTDR

The 1502C transmits 200 ps rise time step pulses down the cable under test. The reflected energy is displayed on the LCD and the user can then determine the type of fault. When testing 50 ohm cable with a velocity of propagation equal to 0.66, the 1502C Metallic TDR allows the determination of 0.5 ohm cable faults. Multiple faults as close together as 0.6 inches can be resolved.

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

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

1503C GENERAL PURPOSE MTDR

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

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

1503C OPTION 06 FOR ETHERNET TESTING

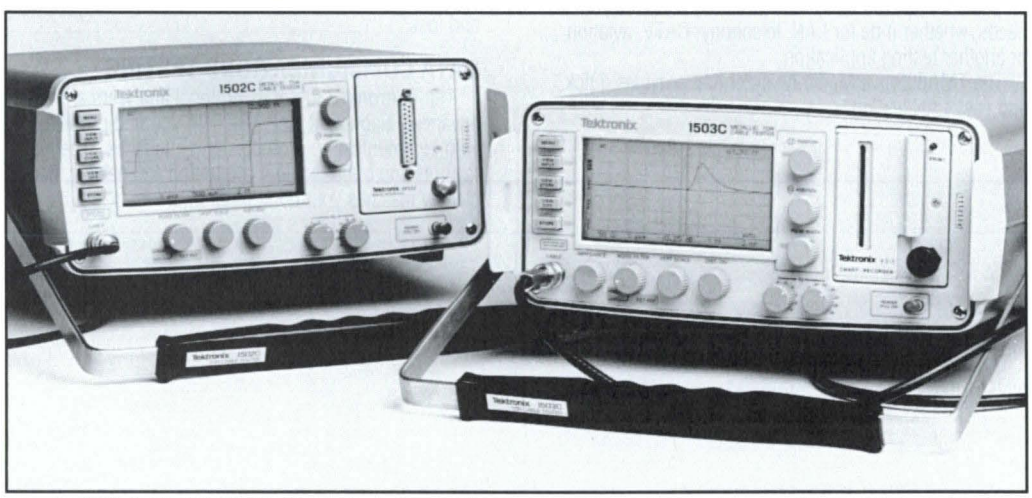
The 1503C with Option 06 allows TDR testing of an active Ethernet bus. Tests are provided for detecting transceivers that ignore the collision signal (babbling transceivers) and transceivers that ignore the carrier signal.

MENU SELECTIONS

The 1502C and 1503C offer menus to access a variety of parameters and information. The main menu gives you access to Help Screens; Velocity of Propagation Values; Impedances of Different Cables; Instrument/Front Panel Configurations; and Instrument Diagnostics.

YT-1 CHART RECORDER

For permanent records of cable tests, the Option 04 (YT-1) chart recorder is available for both the 1502C and 1503C.



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.

1502C METALLIC TDR CHARACTERISTICS

Test Signal – Step rise.
Amplitude – 300 mV nominal into 50 W load.
System Risetime – 10%-90% 200 ps (1.15 in./2.92 cm).
Output Impedance – 50 ohms.
Electrostatic Discharge Protection – 1 Kv/500 pF capacitor/1 K resistor.
DC Input Protection – ±1 amp.
Maximum Range – 2,000 ft/625 meters.
Distance Readout Resolution – 0.05 inch/0.12 cm.
Noise Filtering – 1 to 128 averages.
Vertical Scale – 0.5 mr/div to 500 mr/div.
Vertical Accuracy – ±3% of full scale.
Dist/Div – 0.1 to 200 ft/div; 0.025 to 50 m/div.
Horizontal Accuracy – 1.6 inches (.041 m) or ±1% of measured distance, whichever is greater at $V\rho = 0.66$.

1503C METALLIC TDR CHARACTERISTICS

Test Signal – 1/2 sine.
Amplitude – 2.5 V Terminated. 5.0 V Unterminated.
Pulsewidths – 2nsec, 10nsec, 100nsec, 1000nsec.
Output Impedance – 50Ω, 75Ω, 93Ω, 125Ω.
Input Protection – ±400 V (DC + peak AC) to a maximum of 440 Hz.
Maximum Range – 50,000 feet/15,000 meters.
Distance Readout Resolution – 0.04 ft/0.01 m.
Noise Filtering – 1 to 128 averages.
Vertical Scale – 0 dB to 63.75 dB gain.
Vertical Accuracy – ±3% of full scale.
Dist/Div – 1 to 5000 ft/div; .25 to 1000 m/div.
Horizontal Accuracy – 2% ± 0.02 feet of measured distance plus uncertainty in $V\rho$.

COMMON CHARACTERISTICS: 1502C AND 1503C

ENVIRONMENTAL CHARACTERISTICS

Meets capabilities of a Type III, Class 3, Style C instrument (except EMI where it meets FCC: Part 15,3,A, and VDE: 0871, Class B) as prescribed by MIL-T-28800C.

POWER REQUIREMENTS

AC Power – Line Voltage: 115 V AC (90 to 132 V AC) and 230 V AC (180 to 250 V AC). Line Frequency: 45 to 440 Hz.

DC Power – Battery Operation (Option 03): At least 8 hours (15 to 25C charge and discharge temperature), including 30 chart recordings.
Full Charge Time – 20 hours maximum.

PHYSICAL CHARACTERISTICS

Width 315 mm (12.4 in), Height 127 mm (5.0 in), Depth 475 mm (18.7 in); Net weight,without front cover or accessories, 7.3 kg (15 lb).

TMA802 MEDIA ANALYZER

LAN Testing with the TMA802 Media Analyzer

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

The TMA802 media analyzer operates in three modes: Standalone, Scope, and Monitor Mode.

Standalone Mode

Standalone mode lets you quickly and easily pinpoint the location of any major cable fault in the network. Simply set the proper impedance value, the velocity of propagation value, connect the cable to be tested, and press the Test button. In Standalone mode, the TMA802 reports test results in plain English on its 16-character LCD. For example:

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

Scope Mode

When you need a more detailed inspection of the network, the TMA802 can be coupled with an oscilloscope. This combination provides a TDR trace of the cable under test, showing locations of transceivers, terminators, and faults.

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

Monitor Mode

The TMA802 provides a direct indication of Ethernet and Starlan network utilization. The TMA802 monitors network traffic without disturbing the network (nonintrusive test) so it can be left on the network to monitor indefinitely. Network utilization is reported as a percentage of the network bandwidth being used during a specific period.

ELECTRICALCHARACTERISTICS

Pulse Width – 15, 150, 1100, 3700 ns.
Pulse Amplitude – 2 V.
Output Impedance – 50Ω, 75Ω, 100Ω, 150Ω.
Accuracy – 4 ft to 1000 ft.
EMI – FCC Part 15, Subpart J, Class A, VDE 0871, Class B.

BATTERY CHARACTERISTICS

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

PHYSICAL CHARACTERISTICS

Width 315 mm (12.4 in), Height 127 mm (5.0 in), Depth 475 mm (18.7 in); Net weight, without front cover or accessories, 7.3 kg (15 lb)

TMA802
MEDIA ANALYZER

An affordable, portable, easy-to-use instrument with many uses:

- *Coax or Twisted Pair LAN Network Testing*
- *Ethernet, Cheapernet, Starlan, Broadband, USOC, and Token Ring*
- *Use with 50 MHz Scope to View the Network*
- *Applications for Multiple Networks*

The TMA802 Media Analyzer.

ORDERING INFORMATION

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

INTERNATIONAL BATTERY CHARGERS

Opt. 1C – Univer. Euro, 220 V, 50Hz **NC**
Opt. 2C – UK 240 V, 50 Hz **NC**
Opt. 3C – Canada 115 V, 60 Hz **NC**

OPTIONAL ACCESSORIES

Scope Connector/Cable Kit –
Opt. 01. Order 016-0912-00 **$60**
Ethernet/Cheapernet Network Kit –
Opt. 02. Order 016-0913-00 **$90**
Map Broadband Network Kit –
Opt. 03. Order 016-0911-00 **$75**
Token Ring Network Kit –
Opt. 04. Order 015-0500-00 **$150**
Starlan Network Kit –
Opt. 05. Order 015-0578-00 **$100**
USOC Network Kit –
Opt. 06. Order 015-0579-00 **$150**
Token Ring Interface –
Opt. 07. Order 015-0600-00 **$350**
C7 Scope Camera – with Flash **$630**
Physical Adapter Kit. –
(2200 Series) Order 014-0066-00 **$70**
(2400 Series) Order 014-0067-00 **$70**
Carrying Case –
Order 016-0817-00 **$50**

For additional information, call 1-800-833-9200.

FIBER OPTIC CABLE TESTERS

TFS2020
FiberScout™

An easy-to-understand handheld instrument for optical fault finding and restoration.

ORDERING INFORMATION

TFS2020 FiberScout Fault Finder	*1
Opt. 01 – Long/Short Range	+$7,800
Opt. 02 – Long Range	+$6,200
Opt. 03 – Short Range	+$4,900
(Specify connector when ordering)	
CONNECTOR OPTIONS	
Biconic Long Range, Option 20; Short Range, Option 30	*1
FC – Long Range, Option 21; Short Range, Option 31	*1
D4 – Long Range, Option 22; Short Range, Option 32	*1
ST Compatible – Long Range, Option 24; Short Range, Option 34	*1
DIN 47256 – Long Range, Option 25 Short Range, Option 35	*1
OPTIONAL ACCESSORIES	
Service Manual – 070-7166-00	*1
Battery Charger –	
(US/Canada) Order 118-8497-00	*1
(Europe) Order 118-8498-00	*1
(UK) Order 118-8501-00	*1
Power Supply –	
(110V AC) Order 119-2731-00	$30
(220V AC) Order 119-2712-00	$45
(240V AC) Order 119-2713-00	$45

OF150

Multimode OTDR
Portable, rugged, and easy.

ORDERING INFORMATION

OF150 Fiber Optic Time Domain Reflectometer (Specify connector)	$14,350
OPTIONS	
Opt. 01 – XY1 Output Module	+$300
Opt. 04 – Chart Recorder	+$1,050
Opt. 20 – AT&T Biconic Connector	NC
Opt. 22 – FC Connector	NC
Opt. 23 – SMA Connector	NC
Opt. 26 – ST Connector	NC
Opt. 27 – Deutsch Connector	NC
INTERNATIONAL POWER PLUG OPTIONS	
Opt. A1 – A5 Available	NC
See page 488 for description.	
OPT. ACCESSORIES (OF150, OF235)	
Chart Recorder – Order 016-0506-07	$1,400
Chart Paper –	
(One roll) Order 006-3618-00	$12
(25 rolls) Order 006-3618-01	$270
(100 rolls) Order 006-3618-02	$900
XY1 – Output Module	$350
Receptacle Connector, Optical – (Deutsch) Ten each Order 013-0207-02	$720
Accessory Kit – Deutsch Tools and Plugs Order 015-0474-00	$350
Sun Visor – Order 016-0653-00	$35
C-5C – Camera	$530
C-7 – Camera	$630
Cases –	
(Transit) Order 016-0658-00	$990
(Soft) Order 016-0659-00	$140

*1 *Contact your local sales representative*

TFS2020 FiberScout OPTICAL FAULT FINDER

The TFS2020 FiberScout is a handheld optical fault finder designed to locate major attenuation-induced events in single mode optical cable systems. Its low-cost, compact design allows wider deployment of fault finding equipment to cover optical cable restoration requirements. Wider deployment means faster response time and minimum system downtime.

INNOVATIVE DESIGN MAXIMIZES PRODUCTIVITY

The TFS2020 FiberScout combines small size, light weight, and an intuitive user interface to provide owners and users of fiber optic links with the first true optical fault locater. The innovative design uses graphics to represent the fiber cable and fiber cable faults, making information about the cable easy to understand and interpret.

The front panel of the FiberScout presents the operator with four simple buttons. Just two of the buttons are used for making a measurement (*Power* and *Start Test*). The other two buttons control cursor movements and allow you to review parameter setups.

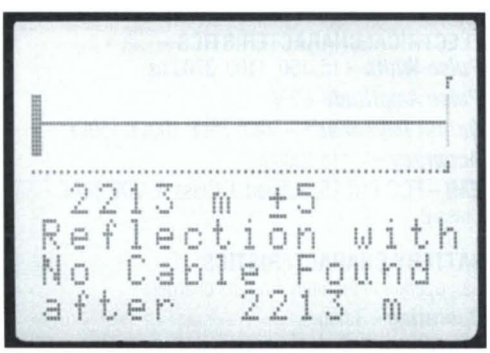
For maximum portability, the FiberScout is small and light weight. Take it anywhere; it fits anywhere.

LOW COST FOR WIDER DEPLOYMENT

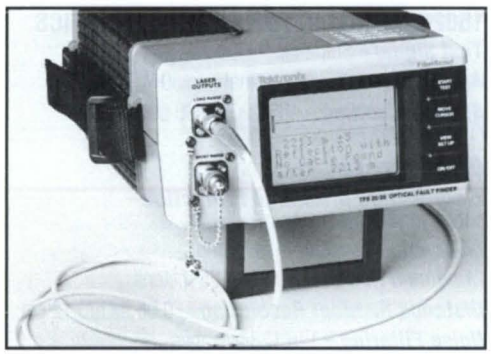
The TFS2020 FiberScout is a restoration tool, designed to supplement your OTDR.

Because OTDRs are relatively expensive, they are usually placed in service in strategically selected areas. This means that a single OTDR may cover a wide serving area, taking a lot of valuable time to deploy in the event of a break.

The low cost of the TFS2020 FiberScout allows it to be deployed in larger numbers. More equipment deployed means a faster restoration response and minimum system downtime.



The FiberScout's symbolic display is easy to understand. It minimizes interpretation, maximizes productivity.



The handheld, lightweight TFS2020 FiberScout easily goes wherever it's needed.

A simple four-button interface makes the FiberScout extremely easy to operate.

CUSTOMER-SELECTABLE FEATURES

The TFS2020 allows you to redefine a number of features to customize the instrument for your specific application.

Fault threshold can be defined as 1, 2, 3 or 4 dB, according to your specific needs.

A selected set of instrument defaults can be redefined to better suit your application or to customize an instrument for a particular user.

Enhanced features are available for higher skilled users.

All these features are available through a limited-access menu.

FOR LONG RANGE OR SHORT RANGE USE

The TFS2020 FiberScout comes in one of three optional forms: optimized for long range use, optimized for short range use, or configurable for both.

The maximum range of the short range FiberScout is 3 kilometers, at an accuracy of ±3 meters.

The maximum range of the long range FiberScout is 20 kilometers, with an accuracy of ±20 meters.

The dual-range FiberScout can locate faults on practically any single mode fiber optic communications cable.

Specify the range capabilities you require when placing your order (see Ordering Information at left).

STANDARD ACCESSORIES ENHANCE PORTABILITY

Ready for the road, each TFS2020 FiberScout comes equipped with its own Travel Case (016-1024-00), Accessory Pouch (016-0993-00), Operator Manual (070-7167-00), Battery Pack (146-1000-00), and Reference Label (062-9360-00). A Battery Charger is available as an optional accessory (see the Ordering Information at left for the appropriate part number). The FiberScout is available with a variety of connectors: Biconic, FC, D4, ST*1, and DIN 47256.

PHYSICAL DIMENSIONS

Width 159 mm (6.25 in), Height 82.5 mm (3.25 in), Depth 260 mm (10.25 in); Net Weight 2.3 kg (5.0 lb)

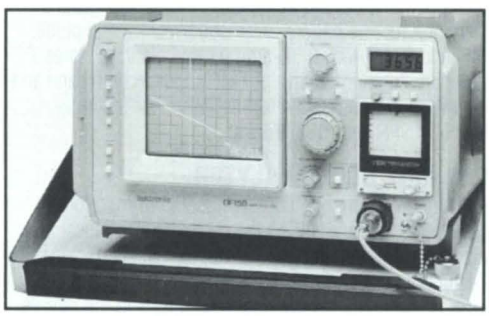
BATTERY

NiCad rechargeable battery pack.

In addition, the instrument can operate with any external 3 to 28 vdc power supply.

COMPLIANCE

The TFS2020 FiberScout complies with Mil-T-28800C, Type III, Class 5, Style C requirements.



The OF150 Multimode OTDR.

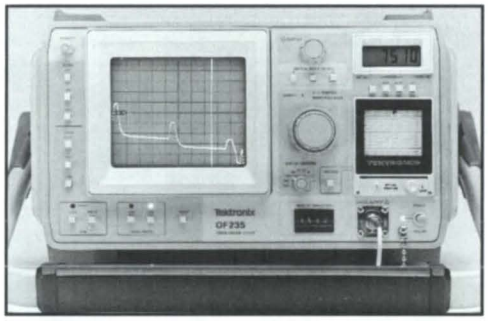
OF150 MULTIMODE OTDR

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

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

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

**1 ST is a registered trademark of AT&T.*



The OF235 Singlemode Dual Wavelength OTDR.

OF235 SINGLEMODE DUAL WAVELENGTH OTDR

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

OF235 OPTIONAL WAVEFORM STORAGE

The OF235 allows storage of 400 waveforms in the optional EFM101 memory module.

OF192 MULTIMODE BANDWIDTH TEST SET

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

FOR MORE INFORMATION

For additional information on the metallic or optical fiber TDRs, contact your local Tektronix sales representative or call 1-800-833-9200.

OF235

Singlemode Dual Wavelength OTDR

- *1300/1550 nm Wavelengths (Switchable)*
- *1 m Resolution*
- *GPIB*

ORDERING INFORMATION

OF235 Fiber Optic Time Domain Reflectometer **$28,500**
Includes Diamond 3.5 Connector.

OPTIONS

Opt. 01 – XY1 Output Module **+$300**
Opt. 02 – EFM101 Waveform Storage Module **+$950**
Opt. 04 – Chart Recorder **+$1,050**
Opt. 07 – Delete 1550 nm Laser **–$8,000**
Opt. 08 – Delete 1300 nm Laser **–$3,000**
Opt. 12 – 17 m Short Pulse **NC**
Opt. 20 – AT&T Biconic Connector **NC**
Opt. 22 – FC Connector **NC**
Opt. 23 – NEC-D4 Connector **NC**
Opt. 24 – Diamond 2.5 Connector **NC**
Opt. 25 – Radial Connector **NC**
Cable Assemblies –
(Diamond 3.5 to AT&T Biconic)
Order 175-9708-00 **$720**
(Diamond to FC)
Order 175-9707-00 **$625**
(Diamond to Diamond)
Order 175-9695-00 **$535**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – A5 Available. **NC**
See page 488 for description.

OPT. ACCESSORIES

See ordering information on page 450.

For more information or other assistance, call 1-800-833-9200.

OF192

Multimode Bandwidth Test Set

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

ORDERING INFORMATION

OF192 Fiber Optic Bandwidth Test Set **$32,000**
Includes: Two AC Power Cords; Two Calibration Cables; AT&T Connector; Diamond 3.5 Connector; FC Connector; Operator Manual.

OPTIONS

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

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – A5 Available **NC**
See page 488 for description.

TC 2000 *MULTI-FUNCTION TEST SYSTEM*

FEATURES

- ***20 MB Hard or Removable Disk***
- ***640K RAM***
- ***5 1/4" 360K or 3 1/2" 720K Floppy Disk Drive***
- ***Serial Port for External Printer***
- ***7-inch Hi-Resolution CRT***
- ***RGB Interface for External Multi-sync Color Monitor***
- ***IBM-compatible PC/XT with MS-DOS***

ORDERING INFORMATION

A TC 2000 system is configured by adding subsystems and options to a main system function.

TC 2000–B1 T1/PCM/BERT Analyzer	**$13,750**
TC 2000–C1 CEPT/PCM/ BERT Analyzer	**$13,750**
TC 2000–B2 Protocol Analyzer	**$13,750**
TC 2000–B3 TIMS	**$13,750**
TC 2000–C3 TIMS CCITT)	**$13,750**
TC 2000–B6 ISDN/SS7 Analyzer	**$24,590**
TC 2000–C6 CEPT/ISDN/ SS7 Analyzer	**$24,590**
TC 2000–B7 LAN Protocol (Ethernet)	**$18,500**
TC 2000–B8 LAN Protocol (Token Ring)	**$18,500**
TC 2020–B1T1/PCM/ BERT Subsystem	**$9,350**
TC 2020–C1 CEPT/PCM/ BERT Subsystem	**$9,350**
TC 2020–B2 Protocol Analyzer Subsystem	**$9,350**
TC 2020–B3 TIMS Subsystem	**$9,350**
TC 2020–B7 LAN Protocol (Ethernet)	**$10,950**
TC 2020–B8 LAN Protocol (Token Ring)	**$10,950**
TC 2020–B5 Signalling Subsystem	**$1,700**
TC 2030–03 Internal 1200/ 2400 baud modem	**$500**
TC 2030–44 StarLAN Adapter Board	**$520**
TC 2060–10 Remote Software (TC 2000)	**$500**
TC 2060–11 Remote Software (PC AT/XT)	**$750**
TC 2060–12 Enhanced Macro (TC 2000)	**$650**
TC 2060–13 Enhanced Macros (PC AT/XT)	**$650**

INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 – A5 Available **NC**

See page 488 for description.

For additional information, call 1-800-826-8675.

The TC 2000 is a multi-function network test set designed specifically for high performance testing of analog and digital communications networks.

The TC 2000 is a software-based modular test system. This modularity allows the TC 2000 to be configured with one or all of the following test functions:

- PCM / BERT Analysis for 1.544 Kbps T1 or 2.048 Kbps CEPT Lines
- Protocol Analysis for Data Traffic
- TIMS and Voice Band Spectrum Analysis for Analog VF Lines
- Signalling/Addressing/Supervision Functions
- ISDN/SS7Analysis for Basic and Primary Rate Data Traffic
- LAN Protocol Analysis for Local Area Network Traffic
- Programmable Auto-routine Capability for TIMS and PCM Remote Operation

PCM/ BERT ANALYZER

The TC 2000-B1 T1/PCM Analyzer provides extensive testing capabilities for simultaneous DS1 and DS0 analysis which includes: dual T1 support, drop and insert for data and voice, DS1 statistics, full error/alarm analysis and emulation, framing modes (D1D, D2, D3/4, ESF), frame capture, slip and delay measurements, digital TIMS, DS1/DS0 BERT framed and unframed, full remote and macros.

The TC 2000-C1 CEPT/PCM Analyzer provides the same features for the 2.048 Kbps CCITT configuration.

PROTOCOL ANALYZER

The TC 2000-B2 provides full-duplex, dual-port monitoring of data communications networks at speeds up to 72 Kbps and emulation up to 64 Kbps. Supports all standard protocols: SDLC, SNA, HDLC, X.25, DDCMP, IPARS, and ISDN protocols: LAP-D, CCIS7, and Q.931. Features include: detailed protocol decoding, split screen display, filtering, emulation/statistic/graphic programming, time stamping on character basis to 0.1 ms, 1 Mb capture buffer, lead state analysis, automatic line configuration, BERT, event trapping, multi-page freeze buffer, data recording (up to 18 Mb) and playback, 256 Kb bit recording and playback, full remote, and four interface ports of any combination: RS-232C, RS-449, V.35, MIL-188, X.21.

ISDN/SS7 ANALYZER

The TC 2000-B6 contains both the powerful features of the TC 2000 Protocol Analyzer and the TC 2000 PCM/ BERT Analyzer. To this is added the ISDN features of 2B+D and 23B+D analysis, extensive decoding of SS7 and Q921/Q931, and NT/TE emulation.

The TC 2000-C6 provides analysis for the CCITT version of ISDN primary rate.

TRANSMISSION IMPAIRMENT MEASURING SET (TIMS)

The TC 2000-B3 is a wideband test set compliant with Bell Pub. 41009 and IEEE 743, operating from 20 Hz to 110 KHz. Provided is the full range of analog transmission measurements: PA/R, level frequency, envelope delay, noise, phase and amplitude jitter, intermodulation distortion, all transients and return loss. Also available is a voice band spectrum analyzer with a 70 dB dynamic range. Additional features: self test, macros, data storage, plotting, and full remote.

The TC2000-C3 is the CCITT version compliant with CCITT "O" series recommendations.

SIGNALLING/SUPERVISION/ADDRESSING

The TC 2020-B5 subsystem is combined with the TIMS test set to provide features which include: battery and ground, SF, E and M Types I-V, loop start/ground start, and reverse battery. Also send/receive dial pulse, MF, and DTMF tones; 32-digit receive display (stores 7 numbers, 32 digits each). All MF codes in both send and receive modes makes the test set useful for testing CAMA, TSPS and IDDD trunks.

LAN PROTOCOL ANALYZER

The LAN Protocol Analyzer is useful for monitoring, simulating, and measuring the performance of local area network traffic operating at 10 Mbps (baseband). Features include: decoding of TCP/IP, XNS and DecNet, error reporting, extensive packet filtering and full remote. Support is available for Ethernet versions 1.0 and 2.0 and the IEEE 802.3 standard (TC 2000-B-7), StarLan (TC 2030-44) and Token Ring (TC 2000-B8).

ENHANCED MACROS

The TC 2060-12 (for a TC 2000) and the TC 2060-13 (for IBM-compatible PC/XT/AT) options allow you to auto-routine the functions of the TIMS and PCM Analyzers, store the results in a predefined or user-defined data base, then generate reports and graphs. Enhanced macros can also be used to control DACS, PBXs, and analog or digital switches. Operates in a local or remote environment.

REMOTE COMMUNICATIONS

The TC 2060-10 (for a TC 2000) and the TC 2060-11 (for IBM-compatible PC/XT/AT) provide full remote RS-232 or DDD operation, attended or unattended, of allthe main TC 2000 functions. Additional features include remote file transfer and remote software update.

WARRANTY

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

SINGLE-FUNCTION TEST SYSTEM TC 1000

NEW

The TC 1000 test sets provide a complete range of single-function network test instruments designed specifically for high performance testing of analog and digital communications networks.

Each TC 1000 is a dedicated test instrument, factory configured to perform one of the following major network test functions:

- PCM /BERT Analysis for 1.544 Kbps T1 or 2.048 Kbps CEPT Lines
- Protocol Analysis for Data Traffic
- TIMS and Voice Band Spectrum Analysis for Analog VF Lines
- ISDN-BRI Analysis for Basic Rate Data Traffic
- LAN Protocol Analysis for Local Area Network Traffic
- Programmable Auto-routine Capability for TIMS or PCM Remote Operation

PCM/BERT ANALYZER

The TC 1000-B1 T1/PCM Analyzer provides extensive testing capabilities for simultaneous DS1 and DS0 analysis which includes: dual T1 support, drop and insert for data and voice, DS1 statistics, full error/alarm analysis and emulation, framing modes (D1D, D2, D3/4, ESF), frame capture, slip and delay measurements, digital TIMS, DS1/DS0 BERT framed and unframed, full remote and macros.

The TC 1000-C1 CEPT/PCM Analyzer provides the same features for the 2.048 Kbps CCITT configuration.

PROTOCOL ANALYZER

The TC 1000-B2 provides full-duplex, dual-port monitoring of data communications networks at speeds up to 72 Kbps and emulation up to 64 Kbps. Supports all standard protocols: SDLC, SNA, HDLC, X.25, DDCMP, IPARS, and ISDN protocols: LAP-D, CCIS7, and Q931. Features include: detailed protocol decoding, split screen display, filtering, emulation/statistic/graphic programming, time stamping on character basis to 0.1 ms, 1 Mb capture buffer, lead state analysis, automatic line configuration, BERT, event trapping, multi-page freeze buffer, data recording (up to 18 Mb) and playback, 256 Kb bit recording and playback, full remote, and two interface ports of any combination: RS-232C, RS-449, V.35, MIL-188, S.21.

ISDN-BRI ANALYZER

The TC 1000-B6 takes the powerful features of the TC 1000 Protocol Analyzer and adds the ISDN features of 2B+D analysis, extensive decoding of SS7 and Q921/Q931, and NT/TE emulation.

TRANSMISSION IMPAIRMENT MEASURING SET (TIMS)

The TC 1000-B3 is a wideband test set compliant with Bell Pub. 41009 and IEEE 743, operating from 20 Hz to 110 kHz. Provided is the full range of analog transmission measurements: PA/R, level frequency, envelope delay, noise, phase and amplitude jitter, intermodulation distortion, all transients and return loss. Also available is a voice band spectrum analyzer with a 70 dB dynamic range. Additional features: self test, macros, data storage, plotting, and full remote.

The TC 1000-C3 is the CCITT version compliant with the CCITT "O" series recommendations.

LAN PROTOCOL ANALYZER

LAN Protocol Analyzer is useful for monitoring, simulating, and measuring the performance of local area network traffic operating at 10 Mbps (baseband). Features include: decoding of TCP/IP, XNS and DecNet, error reporting, extensive pocket filtering and full remote. Support is available for Ethernet versions 1.0 and 2.0 and the IEEE 802.3 standard (TC 1000-B7), StarLAN (TC 2030-44) and Token Ring (TC 1000-B8).

ENHANCED MACROS

The TC 2060-12 (for a TC 1000) and the TC 2060-13 (for IBM-compatible PC/XT/AT) options allow you to auto-routine the functions of the TIMS and PCM Analyzers, store the results in a pre-defined or user-defined data base, then generate reports and graphs. Enhanced macros can also be used to control DACS, PBXs, and analog or digital switches. Operates in a local or remote environment.

REMOTE COMMUNICATIONS

The TC 2060-10 (for a TC 1000) and the TC 2060-11 (for IBM-compatible PC/XT/AT) provide full remote RS-232 or DDD operation, attended or unattended, of all TC 1000 functions. Additional features include remote file transfer and remote software update.

WARRANTY

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

FEATURES

- *20MB Hard Disk*
- *640K RAM*
- *37-Pin Serial Port for External 3 1/2" 720K Floppy Disk Drive*
- *Serial Port for External Printer*
- *600 by 400 Pixel High Resolution Plasma Display*
- *RGB Interface for External Multi-sync Color Monitor*
- *IBM-compatible PC/XT with MS-DOS*

ORDERING INFORMATION

Following is the base system price for each TC 1000 and a partial list of options. Additional options may be required.

BASE SYSTEMS	
TC 1000–B1 T1/PCM/BERT Analyzer	**$7,500**
TC 1000–C1 CEPT/PCM/BERT Analyzer	**$7,500**
TC 1000–B2 Protocol Analyzer	**$7,000**
TC 1000–B3 TIMS	**$7,900**
TC 1000–C3 TIMS (CCITT)	**$7,000**
TC 1000–B6 ISDN-BRI	**$8,990**
TC 1000–B7 LAN Protocol (Ethernet)	**$15,600**
TC 1000–B8 LAN Protocol (Token Ring)	**$15,600**
OPTIONS (PARTIAL LISTING)	
TC 2020–B7 LAN Protocol Board (Ethernet)	**$10,950**
TC 2020–B8 LAN Protocol Board (Token Ring)	**$10,950**
TC 2030–03 Internal 1200/2400 Baud Modem	**$500**
TC 2030–44 StarLAN Adapter Board	**$520**
TC 2060–10 Remote Software (TC 1000)	**$500**
TC 2060–11 Remote Software (PC AT / XT)	**$750**
TC 2060–12 Enhanced Macros (TC 1000)	**$650**
TC 2060–13 Enhanced Macros (PC AT / XT)	**$650**
INTERNATIONAL POWER PLUG OPTIONS	
Opt. A1 – A5 Available See page 488 for description.	**NC**

For additional information, call 1-800-826-8675

830 SERIES

Fully programmable instruments for simulation, monitoring, and BERT Testing.

- *Lightweight, Rugged, Portable*
- *Three-year Warranty*

ORDERING INFORMATION

836 Protocol Analyzer	**$3,700**
835 Protocol Analyzer	**$2,995**
834 Protocol Analyzer	**$2,125**
INTERFACE OPTIONS	
Opt. 02 – Current Loop Interface	**+$400**
Opt. 03 – RS-449 (RS-422/RS-423) Interface	**+$400**
Opt. 04 – MIL-STD-188C Interface	**+$400**
Opt. 05 – Two-Wire Direct Interface	**+$400**
Opt. 06 – V.35 Interface	**+$400**
Opt. 09 – X.21 Physical Interface	**+$400**
TV ANALYZERS	
836TV Television Production Protocol Analyzer Includes: 836; 836L18; A6746; Case	**$4,625**
836L18 Television Production Library Pack Includes: TV Software (Ampex, Sony BVU-800/BVH-2000, GVG 100/300, EBU/SMPTE)	**$430**
A6746 EBU/SMPTE Bus Interface	**$400**
ROM PACKS	
830RDA ROM Development Aid	**$150**
830R01 Asynchronous ROM Pack	**$150**
834R02A Bisynchronous (EBCDIC) ROM Pack	**$150**
830R02B Bisynchronous ROM Pack	**$250**
830R03 Link Test ROM Pack	**$150**
830R03B Link + Async ROM Pack	**$250**
834R04 HDLC/X.25 ROM Pack	**$150**
834R05 Extended Instruction ROM Pack	**$70**
834R06 Bisynchronous (ASCII) ROM Pack	**$150**
830R0 PARS/IPARS ROM Pack	**$150**
830R10 SDLC/SNA (FID2) ROM Pack	**$150**
830R10B SNA (FID2) ROM Pack	**$250**
834R11 Extended Monitor ROM Pack	**$150**
830R13 SDLC/SNA (FID3) ROM Pack	**$150**
830R31 Multipurpose ROM Pack	**$250**
INTERNATIONAL POWER PLUG OPTIONS	
Opt. A1 – A5 Available See page 488 for description.	**NC**
OPTIONAL ACCESSORIES	
Service Manual Order – Order 070-5600-00	**$100**
Carrying Case – Order 016-0672-00	**$50**
Large Carrying Case – Order 016-0812-00	**$110**
Ribbon 'T' Cable – Order 175-7176-00	**$95**
RS-232 V.24 Tri-State Break-Out Box – A6743	**$265**
Interface Adaptors –	
(RS-449 Interface) A6741	**$400**
Two-Wire (A6742)	**$400**
V.35 (A6744)	**$400**
Current Loop (015-0361-00)	**$550**
X.21 Physical Interface (A6747)	**$400**

830 SERIES PROGRAMMABLE COMMUNICATIONS ANALYZERS

DATA COMMUNICATIONS TESTING

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

834/835/836 Protocol Analyzers

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

835/836 Protocol Analyzers

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

836 Protocol Analyzer

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

MODES OF OPERATION

Monitor

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

DCE Simulation

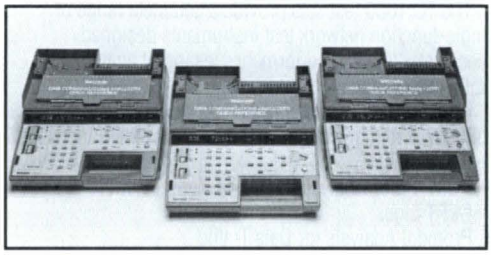
In this mode the 830 Series functions as DCE equipment for testing of DTE equipment. Messages can be sent and received for testing the DTE equipment. The sequence of events can be controlled by a user-developed program or from tests stored in the optional ROM packs.

DTE Simulation

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

BERT Mode

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



The Tektronix 830 Series Protocol Analyzers.

SOFTWARE APPLICATION PACKS

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

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

For information on these ROM packs or any other features of the 830 Series, contact your local Tektronix sales representative.

PROGRAMMING FOR SOLUTIONS

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

INTERFACE ADAPTERS

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

836TV TELEVISION PRODUCTION PROTOCOL ANALYZER PACKAGE

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

FOR MORE INFORMATION

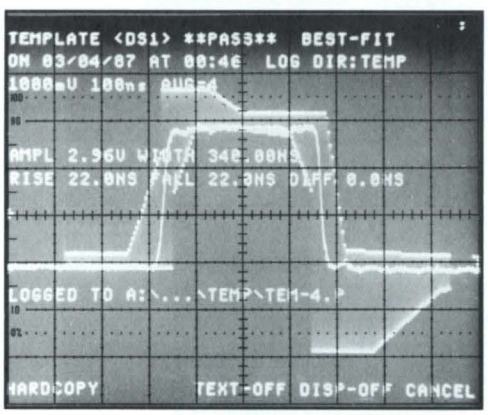
For additional information on any of the 830 Series programmable communications analyzers, contact your local Tektronix representative, or call 1-800-833-9200.

The 2410 Digital Interface Test System is a fully integrated hardware and software package that allows you to quickly and accurately test digital carrier pulses to ANSI or CCITT specifications.

- ***Monitor live traffic***
- ***ANSI and CCITT tests:***
  - ***Pulse Shape***
  - ***Pulse Balance***
  - ***Pulse Spectral Power***
- ***Portable, rugged system***

TEST "TELECOM" SIGNALS AT THE DIGITAL SIGNAL CROSS-CONNECT.

All tests are based on ANSI T1.102-1987 and CCITT Red Book Standard, Volume Three, Recommendation G.703. The 2410 performs pulse shape, pulse symmetry, and pulse spectral power tests. The system also allows multi-test looping, user-defined template generation, and can operate at the monitor jack on live traffic.



Pulse shapes can be compared against ANSI or CCITT standards.

PULSE SHAPE TESTING

Tests are performed, with Tektronix-supplied templates, to ANSI DS1 (1.5 Mb) including Pub. 43802 old and new equipment specifications, DS1-C (3 Mb), DS2 (6 Mb), or DS3 (44 Mb), or CCITT 2 Mb, 8 Mb, or 34 Mb. The T-Carrier Trigger unit captures an isolated "1" for this test. The 2410 can log each failure with a date and timestamp for unattended monitoring of signal lines.

PULSE SYMMETRY (BALANCE) TESTING

Power imbalance is tested to within 0.5 dB as required by ANSI. For CCITT, the 2410 tests amplitude-versus-width ratio.

PULSE SPECTRAL POWER TESTING

The 2410 selects five sequential pulses, then compares power in the second harmonic against power in the fundamental.

GENERATING TEMPLATES WITH TGEN

The 2410 includes TGEN, a Microsoft Windows-based program for template generation. Standard templates may be modified, or you can create templates based on your own signals.

WARRANTY INFORMATION

Hardware: The 2400-Series Digitizing Oscilloscope carries a 3-year warranty, and *Warranty-Plus* service extensions are available. See 2440 Ordering Information, page xxx. 2402 TekMate has a 1-year warranty, with *Warranty-Plus* available. See 2402 Ordering Information, page 121.

Software: 90-day warranty covering software media (floppy disks) for materials and defects. Software operation carries no warranty.

ORDERING INFORMATION

2410 Digital Interface Test System for ANSI T-Carrier tests **$19,020**
Includes: T-Carrier Trigger, software for ANSI tests and all ANSI test templates, TGEN template generation software, 2440 Opt. 11 Digital Oscilloscope, 2402 TekMate

HARDWARE OPTIONS

Opt. 30 – Substitute 2430A opt. 11 Oscilloscope **–$4,210**
Opt. 32 – Substitute 2432A opt. 11 Oscilloscope **–$2,085**
Opt. 03 – Word Recognizer Option for oscilloscope **+$475**
Opt. 05 – Video Trigger Option for oscilloscope **+$1,255**
Opt. 1R – Rackmount **+$520**
Opt. 1C – Transit Cart (016-1013-00) **+$110**
Opt. 1T – Transit Case (202-0302-00) **+$450**
Opt. 1P – HC100 Color Plotter with GPIB cable (U.S. power) **+$990**
Opt. 2P – HC100 Color Plotter with GPIB cable (Euro power) **+$1,015**

SOFTWARE OPTIONS

Opt. 4B – Add CCITT Software **+$630**
Opt. 4C – Replace ANSI with CCITT Software. Deletes T-Carrier Trigger and Option 11 from oscilloscope. **–$1,480**
Opt. 4X – Delete MS-DOS **–$25**
Opt. 28 – Microsoft Windows and MS Mouse for IBM or compatible computers. Required for TGEN program. Requires Color Monitor (118-7444-03) and keyboard (118-7073-00). U.S. only. **+$235**
Opt. 41 – DSO Program Development System **+$1,315**
See TekMate Option 41, page 120.

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

SOFTWARE PRODUCTS

S37J101 – CCITT Test Software
Includes: all CCITT templates **$2,590**
S37J102 – T-Carrier Trigger, ANSI Test Software
Includes: all ANSI test templates **$3,835**
S37J103 – T-Carrier Trigger, ANSI and CCITT Test Software
Includes: all ANSI and CCITT test templates **$4,455**

SOFTWARE PRODUCT OPTIONS

Opt. 28 – Microsoft Windows and MS Mouse for IBM or compatible computers. Required forTGEN program. Requires Color Monitor (118-7444-03) and keyboard (118-7073-00). U.S. only. **+$235**
Opt. 41 – DSO Program Development System **+$1,295**
See TekMate Option 41, page 120.

VM700 and VM700A

- ***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***

ORDERING INFORMATION

VM700 Automatic Video Measurement Set	**$15,000**
Opt. 01 – NTSC Measurement	**+$3,000**
Opt. C1 – Cabinet Version	**+$300**
Opt. P1 – Epson LQ-850 Printer	**+$875**
VM700A Automatic Video Measurement Set	**$15,000**
Opt. 11 – PAL Measurement	**+$3,000**
Opt. 1C – Cabinet Version	**+$300**

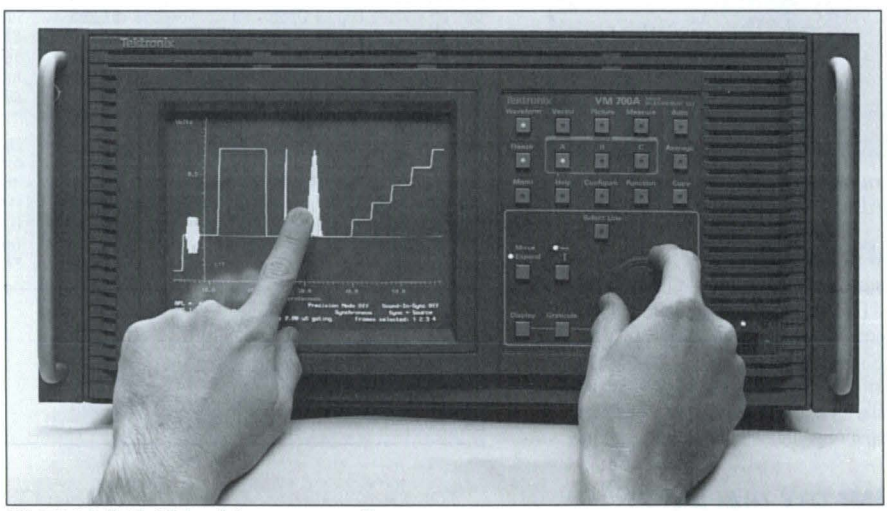
The VM700 and VM700A are complete video monitoring and measuring instruments which can be used for automatic measurements and monitoring, as well as for manual measurements. The user can select a display of numeric values to confirm the quality of the signal path, or may select graphic displays for more detailed analysis.

The VM700 Auto Mode makes standard video measurements automatically, including those specified in RS-250B/EIA-250C, NTC-7, and RS-170A. These measurements can be compared with user-defined limits.

The VM700A Auto Mode makes standard video measurements automatically, including those specified in CCIR Rep. 624-1, Rec. 567, and Rec. 569. These measurements can be compared with user-defined limits.

With the VM700 and the VM700A, a caution or alarm message is generated when these limits are violated. Reports can be made and printed automatically at operator scheduled times.

Emmy Award Winning VM700 Video Measurement Set

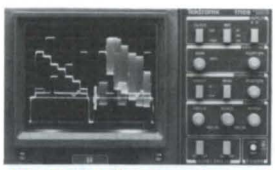


VM700A PAL Video Measurement Set

For complete product and ordering information, please complete the business reply card on page 505 for a TV Products Catalog.

1780/81R 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 and 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

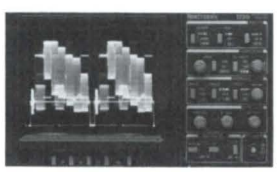


1710/11B Waveform Monitors

- Easy operation/cost effective
- Burst phase indicator
- Dual filter display
- Bright CRT display
- Available in NTSC or PAL standards

1720/21 Vectorscopes

- Performance and economy
- Simultaneous channel A & B display
- Stereo audio phase measurement
- Available in NTSC or PAL standards

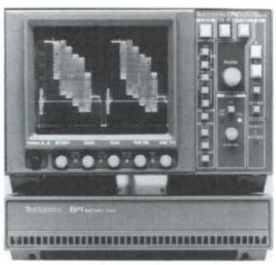


1730/31 and 1730/31D2 Waveform Monitors

- Performance and economy
- Complete line select
- Simultaneous channel A & B display
- Differential gain measurement
- One button front panel recall
- Dual filter display
- Available in NTSC or PAL
- Digital D-2 input available

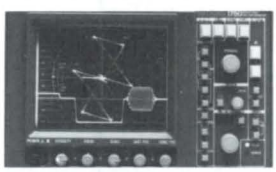
1730HD Waveform Monitor

- HDTV sweep speeds
- Full 30 MHz bandwidth
- Six video input channels
- Parade and overlay displays
- Complete line select
- Accepts most HDTV formats



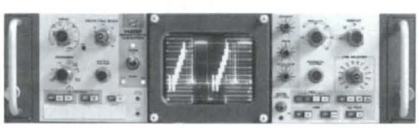
1740/41/42 Waveform/Vector Monitors

- Two instruments in one
- R-Y (V axis)
- Available in NTSC, PAL and PAL-M



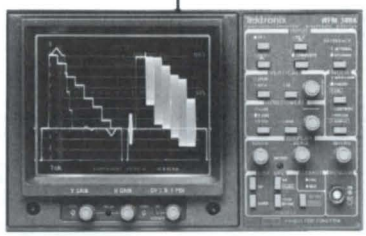
1750/51 Waveform/Vector/SCH Phase Monitors

- SCH Phase
- Simultaneous displays
- Dual filter display
- R-Y (V axis) mode
- Available in NTSC and PAL
- VITS line select



1480 Series Precision Waveform Monitor

- Bright CRT especially suitable for vertical interval testing
- Amplitude measurement accuracy approaching 0.2%
- Digital selection of line and field
- Differential gain measurement
- Available in NTSC, PAL and PAL-M



WFM300A Component/Composite 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

ORDERING INFORMATION

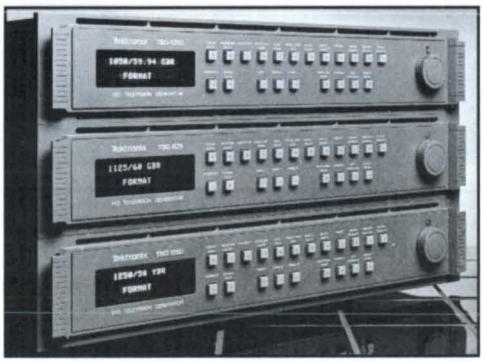
1780/81R Waveform/Vector Monitor	**$9,900**
1710/11B Waveform/Vector Monitor	**$1,745**
1720/21 Waveform/Vector Monitor	**$2,250**
1730/31 Waveform/Vector Monitor	**$2,250**
Opt. 16 – D2 90/100 Hz Sweep	**NC**
1730/31D2 Waveform/Vector Monitor	**$2,850**
1730HD Waveform/Vector Monitor	**$5,900**
1740/41 Waveform/Vector Monitor	**$3,970**
Opt. 05 – Internal Waveform Graticule, External Vector Graticule	**+$60**
Opt. 07 – Adds DC Power Operation Capability, must be installed during manufacture.	**+$200**
Opt. 16 – D-2 90/100 Hz Sweep	**NC**
1742 Waveform/Vector Monitor	**$4,370**
Opt. 07 – Adds DC Power Operation Capability, must be installed during manufacture	**+$200**
Opt. 16 – D-2 90 Hz Sweep	**NC**
1750/51 Waveform/Vector Monitor	**$5,900**
1480C/R NTSC Waveform Monitor	**$6,900**
1481C/R PAL Waveform Monitor	**$6,900**
1482R PAL-M Waveform Monitor	**$7,450**
1485C/R PAL/NTSC Waveform Monitor	**$7,150**
1480 Series Options	
Opt. 01 – Probe Input	**+$300**
Opt. 06 – 124 Ω Input (1480R only)	**+$2,075**
Opt. 07 – Slow Sweep (included with Opt. 06)	**+$510**
Opt. 08 – Secam Field Identification (1481C, 1481R, 1485C, 1485R only)	**+$315**
WFM300A Waveform/Vector Monitor	**$3,900**
Opt. 05 – Delete Color Shutter	**–180**
Opt. 10 – For Betacam Transcoder	**NC**
Opt. 14 – For MII Transcoder	**NC**

For complete product and ordering information, please complete the business reply card on page 505 for a TV Products Catalog.

TSG-170A/TSG-170D/ TSG-271/TSG-371/ TSG-422/1910/ TSG-100

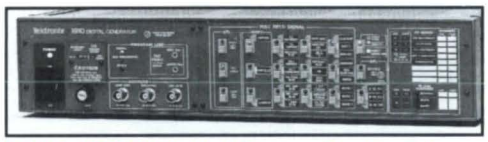
ORDERING INFORMATION

TSG-170A Generator	**$4,995**
Opt. 01 Adds Separate SMPTE Bars Output with 12 Character ID, Audio Tone Output and Tape Leader Countdown.	**+$1,000**
TSG-170D Generator	**$5,600**
TSG-271 Generator	**$4,950**
Opt. 01 Adds Character ID, Audio Tone, and Tape Leader Countdown.	**+$635**
TSG-370/TSG-371 Generator	**$4,800**
TSG-422 Generator	**$5,500**
1910 NTSC Digital Generator/ Inserter	**$7,500**
TSG-100 Generator	**$1,250**



TSG-1000 Family Television Generators

- Supports the major proposed HDTV production standards
- Comprehensive test signal complement including moving patterns
- GBR and Y, P_B, P_R formats
- 30 MHz bandwidth
- 10 bit signal generation



1910 NTSC Digital Generator/Inserter

- Studio, transmitter, and transmission test signals
- 10 bit signal generation
- User friendly RS-232-C control port for added versatility
- Four external VITS input
- Non-volatile memory to maintain selected VITS and full field signal configuration after power interruption

TSG-100 NTSC Television 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 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 (Option 1)

TSG-170D Digital Composite Generator

- Digital and NTSC analog test signal outputs
- Digital and analog audio tone outputs
- RS-170A black burst output for master SPG application

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-370/TSG-371 Component/Composite Television Generators

- Analog component and composite test signals
- Simultaneous and independent component and composite test signal outputs
- High stability, correctly SCH phased internal sync generator
- Black burst (6 outputs), comp sync, and comp blanking outputs
- Full color genlock
- Component/PAL and component/NTSC versions available

TSG-422 Digital Component Generator

- Conforms to CCIR recommendation 601, SMPTE RP 125, and EBU Tech. 3246-E
- 4:2:2: format
- 8 bit signal generation
- Digital test signal outputs
- NTSC or PAL black burst outputs
- Genlock to 525/60 or 625/50

For complete product and ordering information, please complete the business reply card on page 505 for a TV Products Catalog.

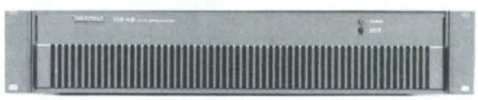
VITS201/110-S/ 118-AS/DP-100/ TPG-625/1450-1, 1450-2,1450-3

VITS201 PAL Insertion Generator

- CCIR, EBU, UK National ITS
- Operates in the presence of sound in syncs
- Five external ITS inputs
- Source identification
- User programs for:
  - Insertion of internal, external, and source identification signals
  - Loss of program input models
  - Text insertion
- All user program settings saved in non-volatile storage

110-S Video Synchronizer

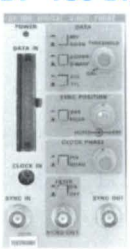
- True 10 bit accuracy and resolution
- Tracks signals into the noise
- Optional four-field memory for the highest picture quality
- Digitally precise RS-170A sync and burst insertion
- Heterodyne color processing
- Auto VTR signal recognition
- Infinite window correction range



118-AS Audio Synchronizer

- Automatic or manual control of audio to video timing
- Simple one-wire interface to 110-S Video Synchronizer
- Expandable to 3 channels for stereo and auxiliary channel
- Compensates for up to ten fields of video delay

DP-100 Digital Video Probe



- Convenient analog display of digital television signals
- Fully buffered ECL/TTL Probe
- Up to 50 MS/s data rates
- Precision 10 bit DAC
- Switchable reconstruction filter
- Adjustable clock phasing
- Adjustable sync timing

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 VM700A Video Measurement Set (Option 01)

1450 Series Demodulators

- Measurement-quality performance resulting in negligible distortion
- Precise Nyquist slope provided by surface acoustic wave filter
- Wide dynamic range with constant bandpass characteristics
- Synchronous detection eliminates quadrature distortion
- Envelope detection for determining differential phase
- Any single VHF or UHF channel operation
- UHF and VHF tunable down converters

1450-1 ONLY

- Wideband audio output for BTSC multi-channel sound applications
- Wideband audio output compatible with Japanese stereo sound with FAX channel

1450-2A AND 1450-3A ONLY

- NICAM intercarrier output compatible with 728D NICAM Decoder input

ORDERING INFORMATION

VITS201 Inserter	**$4,000**
TPG-625 Pattern Generator	**$5,500**
110-S Video Synchronizer	**$14,975**
Opt. 10 – Four-field Memory	**+$1,500**
Opt. 20 – Adds Time Base Correction for Heterodyne Color VTRs	**+$2,000**
118-AS Audio Synchronizer	**$5,500**
118F01 – Audio Channel Kit	**$1,000**
1450-1 Demodulator	**$14,900**
1450-2 Demodulator	**$13,145**
1450-3 Demodulator	**$13,145**
DP-100 Digital Video Probe	**$2,965**
Opt. 01 – Deletes the P6460 Data and P6454 Clock Probes	**–$965**

For complete product and ordering information, please complete the business reply card on page 505 for a TV Products Catalog.

751 BTSC Monitor

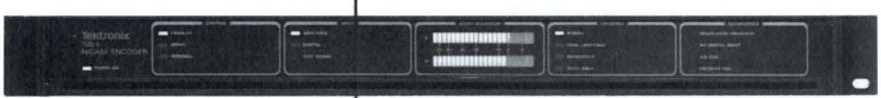
- *Precision Modulation Monitor for Entire BTSC Sound Channel*
- *Simultaneously Displays All Components Necessary to Ensure Modulation Remains within Legal Limits*
- *Bars Feature Peak Indicators with Timed Peak Hold and Easily Set Peak Limits*

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*



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*

ORDERING INFORMATION

751 Audio Monitor	**$12,000**
728E NICAM Decoder	**$8,000**
728D NICAM Decoder	**$3,200**
AVC-20 Audio Vector Conv.	**$495**
760 Series Audio Monitors	**$1,990**

751 BTSC Aural Modulation Monitor/ Decoder

The 751 BTSC Aural Modulation Monitor/Decoder provides accurate modulation monitoring and measurement of the BTSC encoded TV sound channel.

728D NICAM Decoder

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.

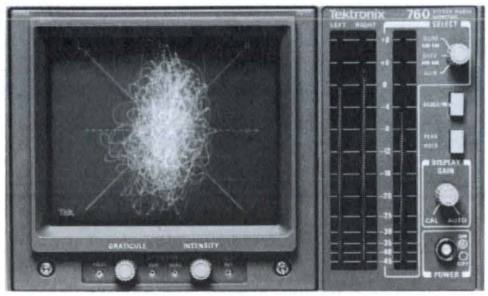
728E NICAM Encoder

The Tektronix 728E NICAM Encoder has been designed as a cost-effective solution to a broadcaster's requirements for NICAM-728 encoding and modulation.

AVC-20 Audio Vector Converter

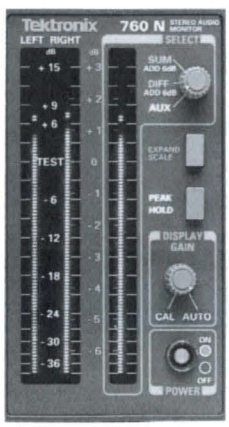
- ***Use with Any NTSC Vectorscope***
- ***Balanced Line Level Inputs***
- ***User Selectable Display Formats; Lissajous Pattern with Calibrated Amplitude; Lissajous Pattern and Sweep Displays of Both Channels***
- ***Time Code or Third Channel Input; Field Locked for Time Code Phase***

The AVC-20 provides stereo audio monitoring capability when installed with an NTSC Vectorscope. Complete audio monitoring can be added to VTR bridges, master control consoles and other locations requiring stereo audio monitoring without modifying the vectorscope and without using front panel space.

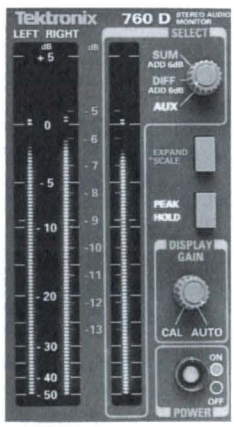


760 Series Stereo Audio Monitors

- 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 SUM
- Suitable for phase and amplitude measurements
- Optional Nordic or DIN scale



760N



760D

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: 760 (standard), 760 N (Nordic), or 760 D (DIN) (see photo).

For complete product and ordering information, please complete the business reply card on page 505 for a TV Products Catalog.

NEW

VISUAL SYSTEMS SOLUTIONS

Tek designs, manufactures, and markets the industry's broadest line of compatible graphics workstations, netstations, terminals and printers, all supporting a wide range of graphics-intensive applications.

Our new XD88 Graphics Superworkstation family sits at the high end of the product line, followed by our 4200 Series Netstations, and Terminals.

INCREASED PERFORMANCE FOR GRAPHICS SOFTWARE TOOLS

The PLOT 10® family delivers an order-of-magnitude increase in the performance of the 20-year PLOT 10 graphics standard. Now you can build even more sophisticated 2D and 3D applications. Port them easily to the newest hardware and you will have compatibility with an installed base of hundreds of PLOT 10 based products.

TRUE GRAPHICS SOLUTIONS

To ensure broad application support for its graphics systems, Tektronix maintains close relations with third-party software suppliers in application areas such as 3D and 2D mechanical CAD, computational fluid dynamics, facilities management, mapping, GIS, CAM/CIM, data analysis,C^3I, graphic design, animation, process control and monitoring, photogrammetry, and image processing, among others. In addition, we have an active *VARsity* program that works with value-added resellers to create total solutions in various design, scientific and engineering fields.

High performance workstations and netstations

XD88 SERIES *GRAPHICS SUPERWORKSTATIONS*

TYPICAL APPLICATIONS

- *Mechanical CAD*
- *Earth Resource Management*
- *Simulation*
- *Architecture*
- *Animation*
- *C³I*
- *Graphics Software Development*

FEATURES

- *17 MIPS Performance*
- *1 Million Vectors per Second*
- *65,000 Shaded Polygons per Second*
- *UTek™ V – Enhanced UNIX® System V*
- *X Window System™, Version 11*

NEW XD88 SERIES GRAPHICS SUPERWORKSTATIONS

With introduction of the XD88 Series Superwork - stations this year, Tek expands its capabilities in the workstation market. As our flagship, the XD88 Series provides outstanding compute speed, brilliant graphics, adherence to industry standards, and competitive prices. The series follows Tek's longstanding approach of upgrading users to new levels of performance while maintaining compatibility with their current graphics products.

The XD88 Series is built around the exceptionally high-speed Motorola 88000 RISC processor, which produces applications throughput at speeds of up to 17 MIPS. As in all Tek workstations, an independent graphics processor produces blazing graphics execution.

CONFIGURATION FLEXIBILITY

With Tek's high-powered 3D graphics engine, the XD88/30 Graphics Superworkstations achieve top performance for compute-intensive graphics applications. These workstations include such features as 64 KB of cache memory, on-chip integer and floating-point support, 1280 x 1024 addressability, and four-way memory interleaving to keep application performance high. An innovative twin-bus architecture provides the technology independence and growth potential of the Futurebus, and the configuration flexibility of the VMEbus™ with 6U Euro card compatibiltiy.

XD88 Superworkstation

SUPERWORKSTATION FOR PRICE-SENSITIVE USERS

Drawing speeds of 90,000 2D vectors per second make the XD88/20 the industry's price/performance leader for high-end 2D graphics applications. Like the XD88/30 group, the XD88/20 is powered by Motorola's 20 MHz 88000 processor and Tek's custom graphics gate arrays. Four-way memory interleaving and the flexible architecture keep the processor pipeline full, and a high-speed SCSI interface minimizes the traditional bottlenecks associated with disk I/O.

For superior color bit-mapped graphics the XD88/10 combines the power of the 88000 RISC processor and the graphics acceleration of Tek's Color≠Cache gate array. The low-cost and high-interactivity make it an ideal choice for price-sensitive users in all graphics applications.

OPTIMIZING PERIPHERALS

Peripherals are easier to justify when all authorized network users can access them. With the XD88/05 Server Node on your network, users share peripherals without affecting individual workstation performance. And, you can upgrade the XD88/05 to an XD88/20 by adding a 16-inch 1280 x 1024 monitor with keyboard and mouse.

MORE POWER FOR YOUR NETWORK

The XD88/01 Compute Server adds compute power and mass storage to your exisiting network of terminals, netstations, workstations, and PCs or upgrades your 4200 Series Netstations to XD88 Series Superworkstations. It's outfitted with a 150 MB streamer tape, 156 MB Winchester disk, 4 GB of virtual address space, and up to 168 MB of RAM.

PLENTIFUL SOFTWARE

Because the 88000 is binary-code compatibile, software packages need to be ported only once. This, combined with the excellent development tools available for the 88000, translates into tremendous software availability in all application areas.

DESIGNED TO GROW WITH YOUR FUTURE

The XD88 Series will keep pace with rapidly changing workstation technology into the 1990s. And to preserve your current investment, you can easily upgrade your Tek Netstations to XD88s, taking advantage of the latest workstation technology even though you made your hardware choice years ago.

GRAPHICS PIPELINE, DIGITAL VIDEO INTERFACE, ONRAMP GRAPHICS LIBRARY

NEW

NEW GRAPHICS PIPELINE

PREMIER GRAPHICS IMPLEMENTATION

When matched with Tek's XD88 Series Superwork station computing engine, Option 4G Graphics Pipeline provides balanced system performance and top interactivity for even the most rigorous graphics, achieving redraw rates of 1 million vectors per second and over 65,000 shaded polygons per second. As an upgrade for a 4230 Series Netstation, the 4G pipeline boosts graphics interactivity and responsiveness by up to 500 percent.

NEW OPTIONAL DIGITAL VIDEO INTERFACE

REAL-TIME, FULL-SCREEN, STUDIO-QUALITY VIDEO

The Optional Digital Video Interface (DVI) makes the XD88 Series an ideal rendering station for computer-generated images and animation loops. The single-board interface converts full-screen high-resolution graphics to broadcast-quality video. The DVI provides both real-time down-conversion and frame-by-frame rendering. A variety of outputs are available for direct feed to records or for use in studio production environments.

NEW ONRAMP GRAPHICS LIBRARY

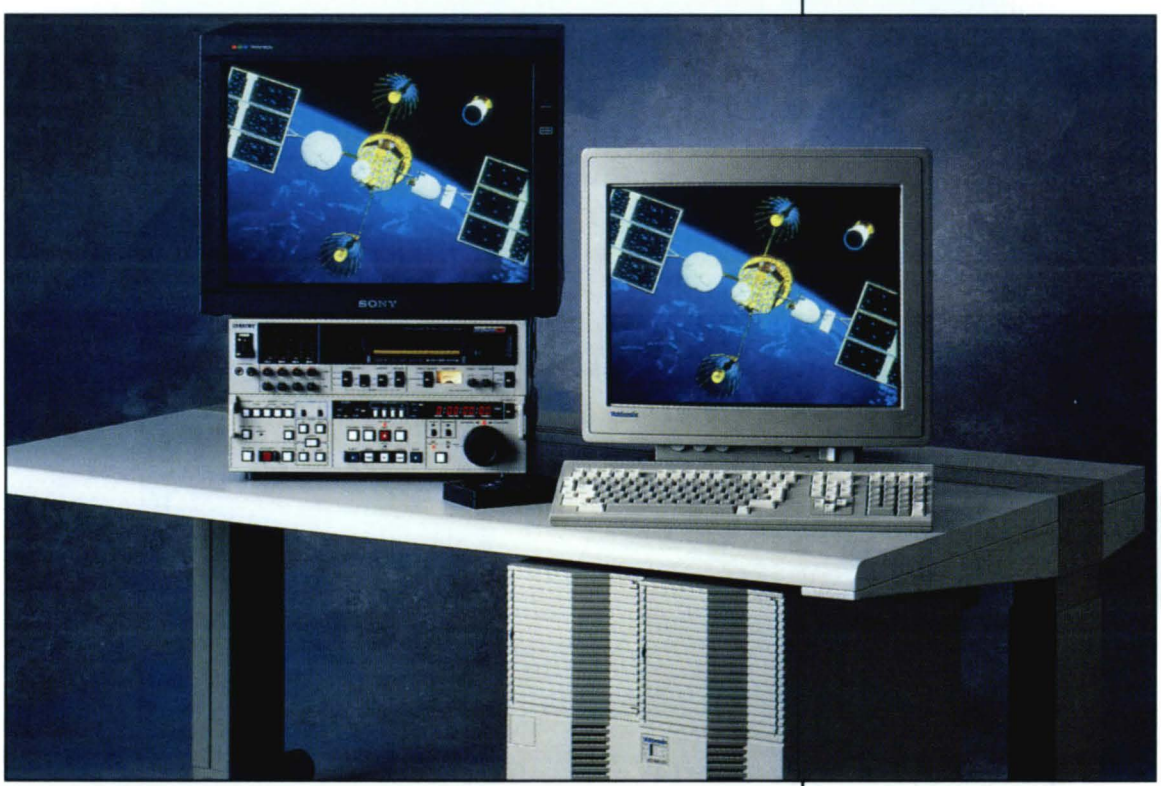
3D GRAPHICS IN MULTIPLE WINDOWS

Tek's OnRamp Graphics Library is the development tool of choice for maximum graphics performance on XD88 3D Graphics Superworkstations. OnRamp's graphics primitives and library routines assist programmers in creating state-of-the-art, workstation-style 3D graphics programs to run within the XD88's X Window System™. Applications can take advantage of the complete XD88 graphics feature set, including multiple light-sources, shading, double-buffering, and 24 bit true color.

Graphics Pipeline

Optional Digital Video Interface

OnRamp Graphics Library



Optional Digital Video Interface

NEW

GRAPHICS NETSTATIONS

TYPICAL APPLICATIONS

- *Mechanical CAD*
- *Molecular Modeling*
- *Kinetics*
- *Stress Analysis*
- *Mapping*

FEATURES

- *Wireframe, Hidden Line, and Shaded Surface*
- *Up to 12 Bit Planes for 4,096 Simultaneous Colors*
- *LAN and RS-232C Connections*
- *Upgradeable to Standalone Workstations*

GRAPHICS NETSTATIONS

For over a decade, Tektronix' graphics displays have set the industry standard for color graphics performance and image quality. Netstations provide high-performance displays in networked environments and can be linked to mainframes, minicomputers, or, for peak performance, Tek workstations. Our complete netstation family offers a range of price/performance alternatives for various computing needs and RS-232C, LAN, and DMA ports allow connection to a wide variety of host environments.

3D GRAPHICS PERFORMANCE

The 4230 Series of 3D Graphics Netstations are fully compatible with Tek's terminals and provide a logical upgrade path to increase the performance of those terminals. Four to 52 MB of display list memory provide quick access to large drawings, and a 24-bit Z buffer gives you extremely fast locally shaded 3D images with hidden surface removal. A high-performance graphics engine, Tek's complete graphics command set, and stunning screen quality make the 4230 Series an excellent choice for all 3D graphics environments.

COST-EFFECTIVE 2D GRAPHICS

Tek's 4220 and 4210 Series of Graphics Netstations provide cost-effective displays for demanding 2D graphics applications. With flexible host connections, they can be networked into a mixed computing environment consisting of host computers, terminals, netstations, and workstations. Through the LAN connection, you can use the netstations as low-cost graphics nodes on exisiting workstations or upgrade them to full workstation capability, thus preserving your hardware and software investment.

NEW HIGH-PERFORMANCE X STATIONS

Tek's new series of X Station products are high-resolution, low-cost network displays with X support. Users in CAD/CAE, mapping and GIS, manufacturing automation, data analysis, CASE and other graphics applications can choose from the full color XN11, which provides all the features of a Tek netstation, or the monochrome XN5.

RACKMOUNT COMPATIBILITY

For environments requiring rackmount capability, the 4211 Netstation and XN11 X Station can be configured for installation in standard 19-inch RETMA racks.

New High-Performance X Stations

4200 SERIES GRAPHICS TERMINALS

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

The 4205 is the entry point of the terminal family. The 4207 adds more advanced features like a two-port peripheral interface and extended memory. For even more memory and RGB-out choose the 4208 or 4209, a 19-inch screen version.

Special options for the 4200 Series include sealed keyboards for harsh environments, bar code readers as a custom input devices, and a mouse for easy interfacing.

SPECIALIZED GRAPHICS TERMINALS

INDUSTRIAL COLOR GRAPHICS TERMINAL

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

GLOBAL SERIES TERMINALS FOR WORLDWIDE EXPORTATION

The GS4207, GS4209 and GS4211 are products designed for export to all destinations without U.S. Goverment Individual licenses. These terminals qualify for General License G-DEST. They are compatible with applications written for standard Tektronix features and functionality.

TYPICAL APPLICATIONS

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

FEATURES

- *Compatible with Thousands of Applications on Host-Based Platforms*
- *Sophisticated Graphics*
- *Excellent Reliability*
- *DEC and IBM Connections*
- *640x480 Addressability*

ORDERING INFORMATION

4200 Terminals	**$2,500-$6,000**
4200 Netstations	**$2,800-$37,500**
XD88 Superworkstations	**$15,500-$125,000**

All Tektronix Superworkstations, Netstations, and Terminals are available with International keyboards and power plug options.

For *Warranty-Plus* Service Plan options, please see Service Support on page 497.

Reconditioned products: Our demo and lease returns are restored to latest specifications and are available with a variety of options. These products carry Tek's full warranty.

Flexible leasing programs available in the continental U.S.

NEW

COLOR PRINTERS

With COLOR you can

- *Give a Competitive Edge to Your Presentation Graphics.*
- *Highlight Important Points and Enhance Details.*
- *Color-Code Different Types of Data.*
- *Add Accuracy and Realism to Your Computer-Generated Designs.*
- *Categorize the Elements in a Picture.*

ORDERING INFORMATION

Phaser™ CPS Color PrintStation. Order 4693PS	**$15,995**
ColorQuick™ Ink-Jet Printer Order 4697	**$2,495**
4693DX Color Image Printer	**$8,995**
Phaser PS PrintStation Order 4590AS	**$9,995**
4693RGB Color Screen Printer (The 4693RGB must be ordered with a video adapter with prices starting at $1,300.)	**$6,400**
Phaser CP Color Printer Order 4693PC	**$12,995**
4696 Color Ink-Jet Printer	**$1,795**

OPTIONS

Contact your local Tektronix Sales Representative or authorized dealer.

***WARRANTY-PLUS* SERVICE OPTIONS**

See Service Support on page 497.

GRAPHIC SUPPLIES DIRECT ORDER DESK

Toll Free 1 800-TEK-6100
6:00 AM to 5:00 PM PST
Outside the U.S., call your local Tektronix office.
VISA/Mastercard accepted
For all your printing supplies: paper, transparencies, inks, ribbons, toners, maintenance cartridges, plotter pens, etc.
Complete Computer Graphics Supplies Catalog available on request.
Orders shipped within 24 hours.
Rush Order delivery service available.

The Tektronix family of advanced color printing solutions for personal computers.

IMAGINE THE WORLD WITHOUT COLOR.

Everything in shades of gray. Of course, we can give you *256 shades of gray* if that's what you want. Now think of COLOR; vibrant shades of blue, red, green, purple, orange, yellow, *and 16 million dithered shades.*

Most computer graphics are information-oriented images. Adding COLOR to graphics makes them a more effective communication tool.

TEKTRONIX OFFERS TWO COLOR PRINTING TECHNOLOGIES.

Thermal wax transfer printing *gives you bright, glossy colors with high resolution and rapid print speed.*

Ink-jet printing *gives you bright, highly saturated colors at a reasonable cost.*

For professional-quality color output, Tektronix offers a family of advanced color printing solutions. Our color solutions range from a low-cost ink-jet printer to a thermal wax, PostScript-compatible printing system that provides AppleTalk network spooling.

NEW PHASER™ CPS COLOR PRINTSTATION

A 300-dpi color thermal wax print engine, plus a PostScript-compatible printer controller. The controller performs local hard disk print spooling and provides an AppleTalk network connection. You can easily expand the Phaser CPS by adding additional printers, memory, and controller cards.

COLORQUICK™ INK-JET PRINTER

A 216-dpi drop-on-demand ink-jet printer. The printer's range of media sizes, types, and handling methods make it a flexible and economic color printing solution for individual users with a broad array of applications.

4693DX COLOR IMAGE PRINTER

A 300-dpi intelligent, high-speed color thermal wax printer. The printer's on-board image processor is compatible with many Tektronix terminals and work stations. It also connects to a Macintosh II with an easy-to-install interface board to produce quick, vibrant QuickDraw™ generated images.

NEW PHASER PS PRINTSTATION

The same printer controller used by the Phaser CPS. Along with its print spooling and AppleTalk network hookup capabilities, the Phaser PS provides users of Tek color printers, including the 4693DX, with an upgrade path to PostScript compatibility while maintaining the printer's Quickdraw capability.

4693RGB COLOR SCREEN PRINTER

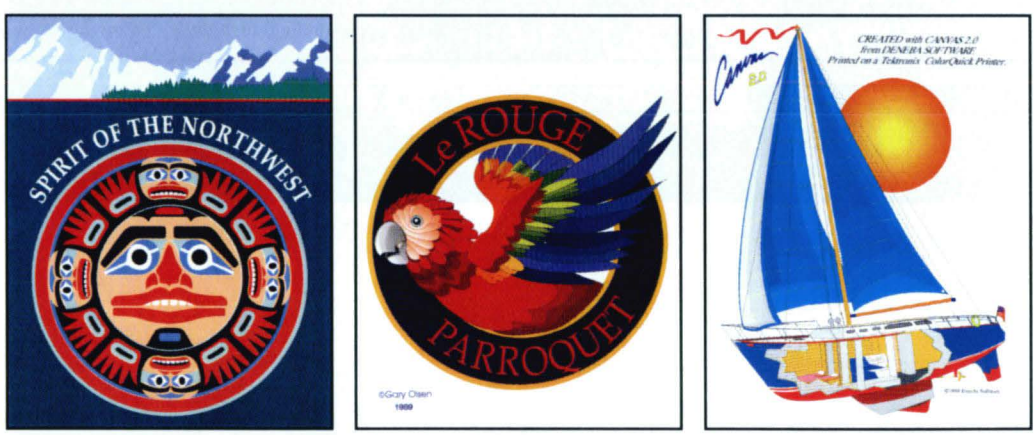
A 300-dpi intelligent color thermal wax printer with a personal control unit to operate the user interface. This video-interfaced printer is compatible with a broad range of color graphics displays, including workstations, terminals, high-resolution PC systems, and specialized monitor systems.

PHASER CP COLOR PRINTER

A 300-dpi thermal wax printer, and a controller card that plugs into a personal computer and emulates HP-GL™ and PostScript.

4696 COLOR INK-JET PRINTER

A 120 x 240-dpi low cost ink-jet printer. The printer produces high quality color prints at the push of a single key. It has three graphics printing modes that offer a variety of print qualities and speeds, and a separate black ink cartridge for printing a true black.



Professional-quality thermal wax and ink-jet color output.

STEREOSCOPIC 3-DIMENSIONAL COLOR DISPLAYS

Tektronix Stereoscopic 3D Color Displays enable users with 3D databases and stereo software to easily add stereoscopic viewing to their systems. The displays offer excellent image quality, high light transmission, and can be used with any graphics system that provides analog R/G/B signals at 1280 x 1024 resolution.

2D AND 3D VIEWING

Designed to be used in both 2D monoscopic and 3D stereoscopic modes, the displays feature an easily-removable stereoscopic modulator assembly using advanced liquid crystal technology. (See description of liquid crystal cell operation, page 469.) Circular polarization offers good extinction plus excellent viewability over the entire visible spectrum.

PASSIVE VIEWING GLASSES/CLIP-ONS

Displays are viewed using passive stereo viewing glasses or clip-ons, providing a wide viewing angle for multiple viewers.

INTEGRATED DISPLAYS

The SGS 421 and SGS 620 single-mode displays are completely packaged units featuring large – area 16-inch and 19-inch diagonal color monitors, removable liquid crystal stereoscopic modulators, and passive 3D viewing glasses and clip-ons. The display monitor automatically switches from 2D @ 60hz to 3D stereo @ 120 hz by sensing the vertical sync.

WORKSTATION COMPATIBILITY

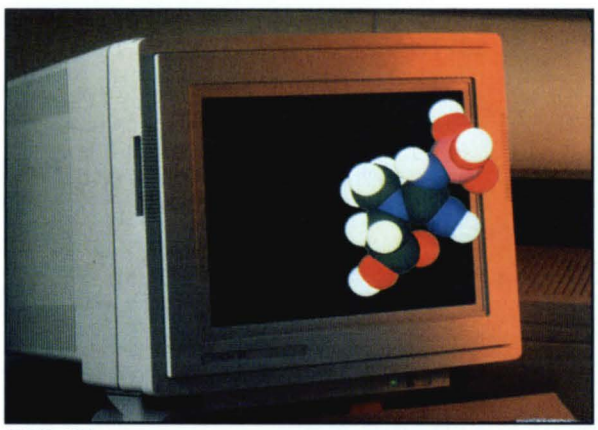
The SGS 625 includes all the features of the SGS 620, and is designed as a multi-mode display for easy adaptability to many common workstations and imaging card sets that support 1280 x 1024 resolution.

All models meet FCC (Class A) and VDE (Class B) EMI limits and are certified for safety by UL, CSA and TUV.

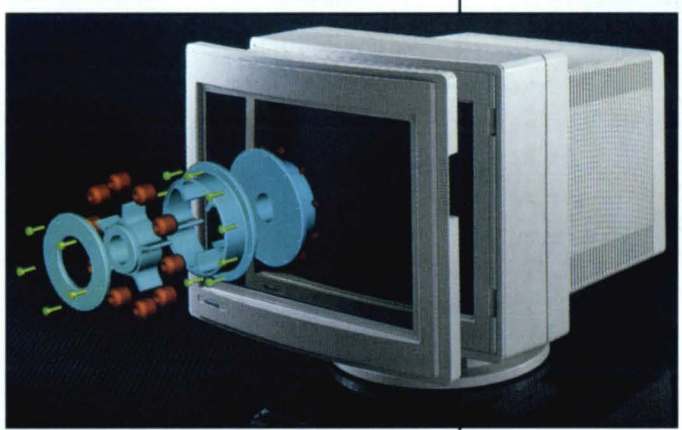
SGS 421
SGS 620
NEW SGS 625

TYPICAL APPLICATIONS

- *Mechanical CAD*
- *AEC (Architectural, Engineering and Construction)*
- *Molecular Modeling/ Computer-Aided Chemistry*
- *Cartography and Photogrammetry*
- *Geographic Information Systems*
- *Remote Sensing*
- *Non-Destructive Testing*
- *Education (Communicating Complex 3D Models)*
- *Medical Imaging*
- *Remote Vision and Robotics*
- *Computational Fluid Dynamics*
- *Defense Mapping and Mission Planning*



SGS 421



SGS/620/625

CHARACTERISTICS/SELECTION GUIDE

Feature	SGS 421	SGS620	SGS625
Display Size (diagonal-measure)	16-in	19-in	19-in
Stereo Display Area	9.76 x13.0 in	10.8 x13.5	10.8 x13.5
Display Resolution (all)	1280 pixels x 512 lines (120 Hz) or 1280 pixels x 1024 lines (60 Hz)		
Aperature grill pitch	0.26 mm	0.31 mm	0.31 mm
Video Input	RGB	RGB	RGB
Video Sync Input	Sync-on-green	Sync-on-green	Same or Separate/Composite
Mode Switch	N/A	N/A	1. Int. vert. sync 2. Int. frame sync. 3. Normal
Modulator Sync (all)	TTL ext. frame sync.	TTL ext. frame sync.	TTL ext. frame sync./internal
Horizontal (all)	63.25 kHz	63.25 kHz	63.25 kHz
Vertical (all)	Automatically switchable to either 60 Hz or 120 Hz vertical input rate		
*Power Requirements (all) Voltage Range	90 VAC to 132 (US) 180 to 264 VAC (Euro)		
Current	2.2/1.3A	2.6/1.6A	2.6/1.6A
Operating Temperature (all)	+10° C to +40° C		
Physical Dimensions	16.0 H x 15.9 W x 17.6 D	18.7 H x 18.9 W x 22.6 D	18.7 H x 18.9 W x 22.6 D
Weight	65 lbs.	90 lbs.	90 lbs.

For further information, please contact:
Liquid Crystal Products, Tektronix, Inc., P.O.Box 500, M.S. 48-300, Beaverton, Oregon 97077, 503-627-5000

ORDERING INFORMATION

SGS 421, 620, 625 Stereoscopic 3D Display systems include: stereo-ready monitor, liquid crystal modulator and bezel assembly, two pairs of glasses, two pairs of clip-ons, users manual, power cords.

SGS 421 (16-in display)	**$7,500**
SGS 620 (19-in display)	**$11,000**
SGS 625 (19-in display, multi-mode)	**$11,500**

OPTIONS

Stereoscopic Graphics Adapter Card for IBM PC/AT. Includes graphics subroutine library	**$2,500**
Storage rack for modulator and glasses	**$145**
Service Manual	**$50**
Additional Glasses or Clip-ons	**$60 ea.**

Additional purchase options are available. Call for details and pricing.

STEREOSCOPIC 3-DIMENSIONAL DISPLAY SYSTEM AND KITS

SGS 431

FEATURES

- *16-inch Diagonal Stereoscopic/Monoscopic RGB Color Monitor*
- *1280 Pixels x 1024 Lines (60 Hz), 512 Lines (120 Hz)*
- *2D Monoscopic or 3D Stereoscopic Viewing*
- *Excellent Image Quality*
- *Stereo Viewing Glasses and Clip-ons*
- *Stereoscopic Graphics Adapter Card*

ORDERING INFORMATION

431 SYSTEMS

Complete 3D Display System including RGB color monitor, Liquid Crystal Modulator, Stereo Modulator driver unit, connecting cable, four pairs stereo viewing glasses/clip-ons Stereoscopic Graphics Adapter (SGA) Card and Graphics Subroutine Library (GSL)
(SGS 430) **$9,800**

SGS 100 OPTIONS

Stereoscopic Graphics Adapter (SGA) card **$2,500**

SGS 9000 OPTIONS

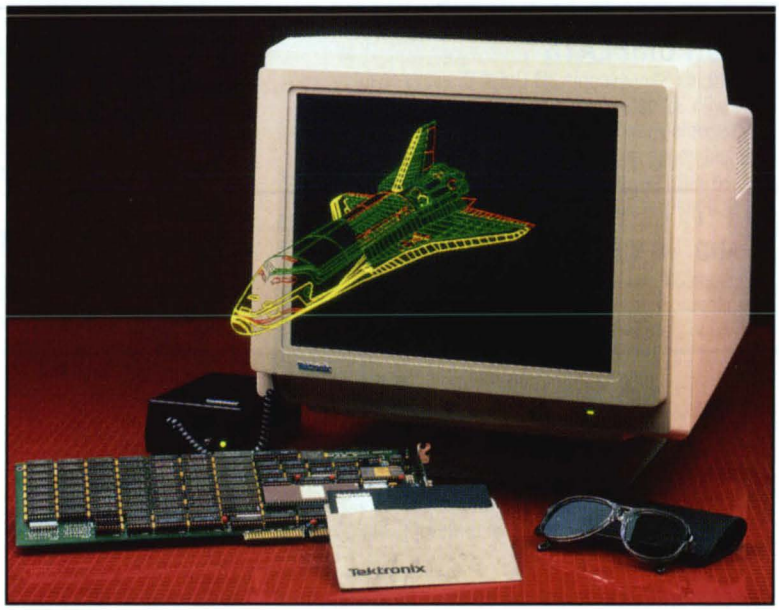
Graphics Subroutine Library (GSL) **$100**

SGS 310, 410, 610 KITS

Kit for 12-in Display (SGS 310) **$3,800**
Kit for 16-in Display (SGS 410) **$5,250**
Kit for 19-in Display (SGS 610) **$6,700**

SGS 431 SYSTEM

Complete stereoscopic 3D graphics display system for IBM PC/AT or compatible personal computers. The system enables users to display high quality stereoscopic 3-dimensional images from the applications software. The Stereoscopic Graphics Adapter Card included supports all common 2D primitives such as Move, Line, Polygon, Circle, Area Fill, etc. The Graphics Subroutine Library supports all 2D primitives, as well as 3D primitives such as Window, View, Viewport, Color Map Operations, and 3D Viewing Transforms. The SGS 431 System includes the following components:



SGS 431

STEREOSCOPIC MONITOR

Stereo-ready monitors feature a Trinitron™ RGB color CRT with 16-inch diagonal screen. The CRT uses a 0.26 mm-pitch shadow-mask, offering a display resolution of 1280 pixels x 512 lines (120 Hz field rate), or 1024 lines (60 Hz field rate).

LIQUID CRYSTAL MODULATOR

Screen-sized liquid crystal modulator features a high extinction ratio for improved viewing, and provides circular polarization for left and right eye images. Controlled by the Stereoscopic Modulator Driver.

STEREOSCOPIC MODULATOR DRIVER

Multifunction device which provides drive signals to the liquid crystal modulator. Accepts the following inputs:

- Raster mode frame sync – 30 Hz or 60 Hz
- Raster mode field sync – 60 Hz or 120 Hz (Stereo frame rate is 30 Hz and 60 Hz respectively.)
- Raster mode field sync plus composite sync – 60 Hz or 120 Hz (Stereo frame rate is 30 Hz and 60 Hz respectively.)
- Vector mode - gated input, latched input, single input.

SOFTWARE

Graphic primitives, including 3D transforms, are available in *Graphics Subroutine Library* (GSL) to ease interfacing of user-supplied 3D information representing the applications model to the SGA card. The GSL is compatible with certain development languages including the Microsoft family. Software supported primitives include:

- All Hardware supported 2D primitives (Move, Line, Rectangle, Polyline, Polygon, Arc, Ellipse Arc, Filled Rectangle, Circle, Ellipse, Area Fill, Point, Pattern, Clipping, Graphic Copy, Logical Screen, Operations)
- Window
- View, Viewport
- Color Map Operations
- 3D Viewing Transforms

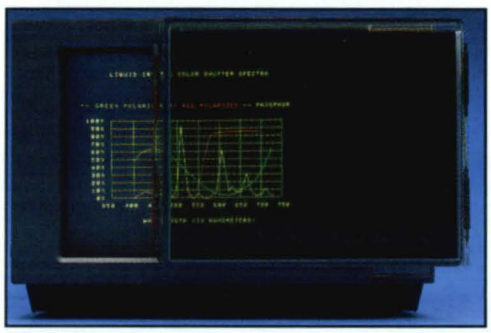
STEREOSCOPIC COMPONENT KITS

Kits are offered for those interested in developing their own stereoscopic displays. Using Tektronix-developed liquid crystal display technology, these kits provide the necessary components and documentation to build a high resolution stereoscopic 3D display. Kit Components include a Liquid Crystal Modulator, Stereoscopic Modulator Driver Unit, Stereo Viewing Glasses and Clip-ons, Velcro Mounting Strips, and Connecting Cable.

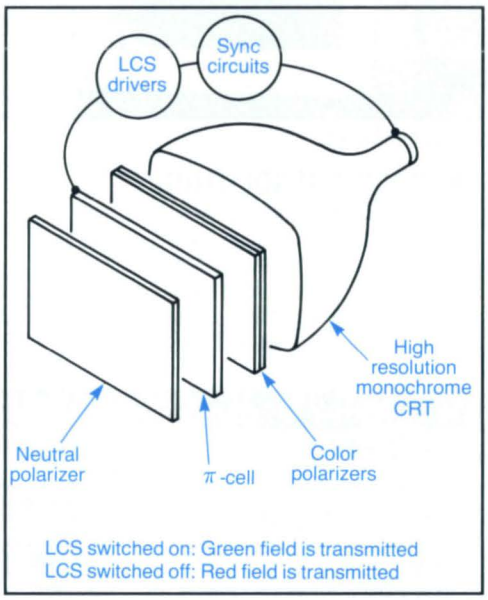
Tektronix Liquid Crystal Shutters are basically fast optical switches, which offer the ability to provide color using selected monochrome CRTs. This is provided without loss of resolution or image quality. Available in sizes ranging from 5 to 19-inch diagonal, applications span the range of raster and vector CRT products. Tektronix Liquid Crystal Shutter technology offers the unique advantages of excellent contrast and high resolution, in addition to being an economical alternative to shadow-mask color CRTs.

DEVICE OPERATION

A typical display system using a Liquid Crystal Shutter (LCS) consists of two basic elements: the LCS and the driver circuitry, plus a high resolution, broad spectrum monochrome CRT. The LCS consists of an electronically-driven, fast liquid crystal cell sandwiched between two dichroic polarizers and a neutral linear polarizer. Color images are viewed on the monochrome CRT by rapidly switching the cell in synchronization with the information displayed on the CRT. This allows polarized light to appear as two primary colors, plus all hues in between.



Liquid Crystal Shutter



CELL SPECIFICATIONS

	LCS 100	LCS 200	LCS 300	LCS 400	LCS 600
Diagonal measure (in.)	5.0	7.0	9.0	12.0	19.0
Overall shutter dimension (in.)	4.9x3.9	6.2x4.9	8.1x6.1	11.2x8.8	15.5x12.2
Usable area (in. 2)	13.3	23.2	40.8	70.7	158.7
Display colors	Continuously variable over the red-green bi-primary spectrum				
Operating temperature	10-50° degrees C				
Drive voltage	60 VDC (typ)				
Drive frequency	2 kHz				
Turn-on time	0.2 ms @ 25°C				
Turn-off time	2.0 ms (typ) @ 25°C				

LCS 100/200/300/400/600

FEATURES

- ***High Resolution***
  Based on Spot Size of Monochrome CRT.
- ***Excellent Contrast***
  Polarizers Enhance Contrast Even in High Ambient Light.
- ***Inherent Convergence***
  All Screen Writing Achieved with Single Electron Gun.
- ***High Brightness***
  High Brightness Can be Achieved Since There is No Shadowmask.
- ***Low Power Requirement***
  Typically One-Half to Two-Thirds That of Shadowmask Display.
- ***Rugged***
  No Shadowmask or Complex Electron Gun.

DISPLAY APPLICATIONS

- ***Test and Measurement Instruments***
- ***Point-of-Sale Terminals***
- ***Process Control Panels***
- ***Avionics Displays***
- ***Medical Displays (ECG, EKG, Ultrasound)***

ORDERING INFORMATION

LCS 100 5-in. Shutter	**$170**
LCS 200 7-in. Shutter	**$175**
LCS 300 9-in. Shutter	**$185**
LCS 400 12-in. Shutter	**$300**
LCS 600 19 in. Shutter	**$6,000**

OPTIONS

Raster Driver	**$200**
Vector Driver	**$200**

Cover glass (Etch, AR and Backglass) and frames are also available. Call for details and pricing.

CONTACT INFORMATION

Liquid Crystal Products
Tektronix, Inc.
P.O. Box 500, M.S. 48-300
Beaverton, Oregon 97077
503-627-5000

606B

FEATURES
- *Very High Resolution*
- *Uniform Brightness*
- *Multi-Imaging Capability*

TYPICAL APPLICATIONS
- *Gamma Camera Recording*
- *Other Photographic Recording*
- *Scan-Conversion Imaging*
- *Scanning Electron Microscopy*

BENEFITS
- *Ultra Sharp Images*
- *Image Stability*
- *High Reliability*
- *Worldwide Tek Service*

NEW 608/609

FEATURES
- *High Brightness*
- *High Resolution*
- *Excellent Gray Scale*
- *Bi-Primary Color (609)*

TYPICAL APPLICATIONS
- *Ultrasound Imaging*
- *Spectrum Analysis*
- *IR Imaging*
- *Mass Spectroscopy*
- *Test and Measurement*
- *Simulation (609)*

BENEFITS
- *Optimum Viewing Capability*
- *High Ambient Viewing*
- *Photographic Quality Images*
- *Worldwide Tek Service*
- *Color Enhances Viewability of Images (609)*

ORDERING INFORMATION

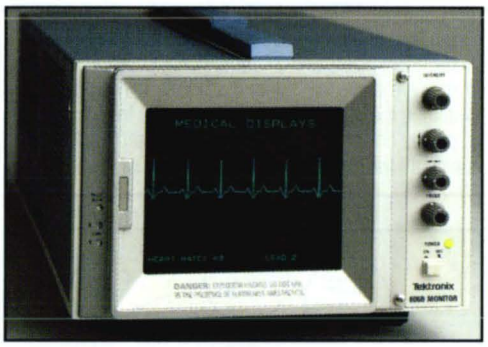
606B Monitor	**$4,995**
608 Monitor	**$3,190**
609 Monitor	**$5,900**

RECOMMENDED CAMERAS

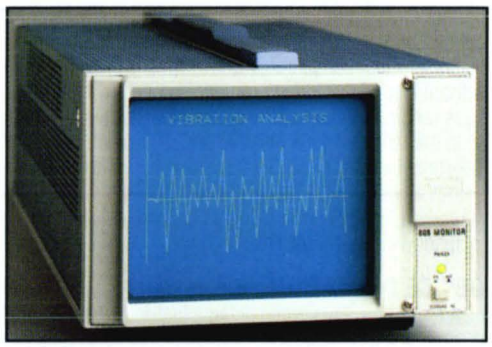
See Instrumentation Documentation Devices pages 387-397.

C-5C Opt. 01 – Camera	**$500**
C-7 Opt. 01 – Camera	**$600**
C-59A – Camera	**$1,375**

For further information, contact:
Tektronix, Inc.
P.O. Box 500, MS 46-943,
Beaverton, Oregon 97077
or call: (800) 835-9433, ext. 2002;
TWX: 910-467-8708;
TLX: 151754;
FAX: 503-627-2670



606B Option 06



608 Option 23

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.

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. The 609 incorporates a liquid crystal shutter to produce a bi-primary color palette.

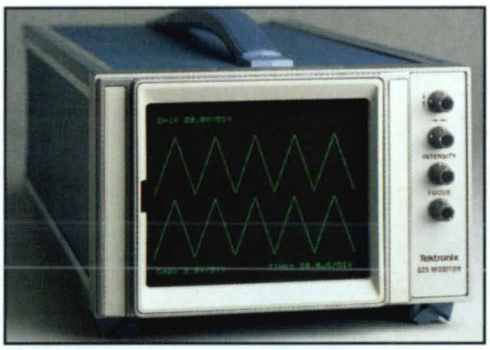
SELECTION GUIDE

Key Specifications	606B	608/609	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 50Ω "<" ≤ 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	26W
Included Accessories	Lined external Implosion shield (graticule) for adjustment purposes.		
Recommended Cameras	C-30BP, C-5C Opt. 01, C-7 Opt. 01	C-5C Opt. 01, C-7 Opt. 01, C-59A	C-5C, C5-C Opt 01, C-7 Opt. 01

*1 *Measured at 0.5 μA*
*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.*

Key Specifications	634*1
Display size (flat screen)	9.8 cm x 12.2 cm
Resolution*1 At least	1100 line
Position Accuracy/Nonlinearity	≤ 0.5% within 9 cm circle. ≤ 1% in corners. For Option 01: 1% within 4 cm circles ≤ 2% at corners.
Brightness	515 cd/m² (150 fL) max.
Brightness, Nonuniformity	Less than ± 10%
Bandwidth	1-10 MHz std. (20 MHz vidoe bandwidth available as Option 14.)

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



620 Option 23

634

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.

HIGH RESOLUTION

The 634 High Resolution Video Display delivers extremely high quality video images for either direct viewing or film recording (photography). Its excellent gray scale and uniform, full-screen brightness make it the ideal display for military infrared imaging and automated testing applications.

OPTIONS AND ACCESSORIES

Feature	606B	608/609	620	634	Option	Price
Internal Graticule		•	•		Option 01	+$15
Resolution of 800 Line Nominal, 650 Worst Case				•	Option 01	–$100
UL 544 (Includes Handles, Feet and Covers)			•		Option 06	+$140
UL 544 (Includes Handles, Feet and Covers)	•			•	Option 06	+$135
Screwdriver Front Panel Controls	•				Option 07	+$45
UL 544 Component Recognized	•	•	•	•	Option 09	NC
25-Pin Remote Program Connector		•	•		Option 10	+$55
Reverse Video				•	Option 13	+$85
20 MHz Video Amplifier				•	Option 14	+$145
Variable Line Rates				•	Option 15	+$280
25-Pin Remote Program Connector				•	Option 16	+$55
AC Delete			• (6,31)*1		Option 20	–$20
Full Differential Inputs		•			Option 21	+$70
Extended Gain Range		•			Option 22	+$45
Handle, Feet, and Covers			• (6,28,31)*1		Option 23	+$120
Handle, Feet, and Covers		• (28)*1			Option 23	+$130
Linearized Z-axis		•			Option 24	+$75
TTL Blanking		•			Option 25	+$75
TTL Blanking			•		Option 25	+$50
Covers only	• (6)*1	• (23)*1	• (6,23,31)*1		Option 28	+$90
Metal Bezel		•			Option 29	+$75
Delete all Rear BNCs, DC Power Connector and AC Power Supply and Switch			•		Option 31	–$25
GM (P7) Phosphor		•	•		Option 76	+$65

**1 Not available with these options*

620

FEATURES

- *Mechanically Rugged*
- *Versatile Modular Packaging*
- *Low Power Consumption*

TYPICAL APPLICATIONS

- *Ultrasound Analysis*
- *Electronic Equipment Testing*
- *Network Analysis*
- *Non-Destructive Testing*

BENEFITS

- *Economical Display*
- *High Reliability*
- *Worldwide Tek Service*

634

FEATURES

- *Superior Resolution*
- *Gray Scale Fidelity*
- *Uniform Full-Screen Brightness*

TYPICAL APPLICATIONS

- *Film Recording*
- *Reconnaissance and Surveillance*
- *Scanning Electron Microscopy*
- *Automated Testing*

BENEFITS

- *Picture Perfect Images*
- *Low Distortion Images*
- *High Stability*
- *Worldwide Tek Service*

ORDERING INFORMATION

620 Monitor **$1,875**
634 Monitor **$3,750**

RECOMMENDED CAMERAS
See Instrumentation Documentation Devices pages 387-397.
C-5C Opt. 01 – Camera **$500**
C-7 Opt. 01 – Camera **$600**
C-59A – Camera **$1,375**

For further information, contact:
Tektronix, Inc.
P.O. Box 500, MS 46-943,
Beaverton, Oregon 97077
or call: (800) 835-9433, ext. 2002;
TWX: 910-467-8708;
TLX: 151754;
FAX: 503-627-2670

ULTRA HIGH RESOLUTION DISPLAYS

GMA201/202/251

FEATURES

- *1 to 3.5 million-Pixel Displays*
- *256 Levels of Gray Scale*
- *Resolution Matched to Addressability*
- *Digital Dynamic Focus and Astigmatism*
- *Landscape or Portrait Formats*
- *14 x 10.5-in Quality Area (356 x 267 mm)*
- *Digital Input (GMA251), Analog Input (GMA201,GMA202)*

BENEFITS

- *Image Uniformity*
- *Highly Stable Display*
- *High Reliability*
- *Rugged Construction*
- *Low Power Consumption*

NEW GMA213S/263S

FEATURES

- *Wide-Angle Viewing*
- *Liquid Crystal Shutter with Circular Polarization*
- *High Brightness (40 fL to Each Eye)*
- *High Extinction Ratio*
- *Passive Viewing Glasses and Clip-ons*
- *1024 x 1024 Pixel Display at 120 Hz*
- *Resolution Matched to Addressability*
- *256 Levels of Gray Scale*
- *Digital Dynamic Focus and Astigmatism*
- *Digital Input (GMA263S), Analog Input (GMA213S)*

BENEFITS

- *Multiple User Viewing*
- *No High Voltage Hazard*
- *Image Uniformity*
- *Clear Stereo Images with Minimal Ghosting*
- *Easily Viewed in Normal Office Environments*

GMA201 (Option 23)

GMA251

The GMA 200 Series displays are designed for applications where very high image quality and fidelity are required. Each model has unique characteristics aimed at meeting your specific applications, whether it be an easy interface, small installation 'footprint', or stereo viewing.

APPLICATION GUIDE

Application	GMA 201/251	GMA 202	GMA 213S/263S
Document Retrieval	•	•	
Electronic Publishing	•	•	
Medical Imaging	•	•	•
Architectural CAD	•		
Remote Sensing			•
Non-Destructive Testing	•		•
Photogrammetry	•		•
Picture Archiving	•		
Reconnaissance	•		

GMA202

NEW GMA213S/GMA263S

Choosing a GMA 200 Series Display can minimize costly custom modifications to existing systems, and give you the exact performance features you need for a particular application. All GMA 200 Series feature bright, stable, flicker-free images that are distortion-free. The GMA213S and GMA263S, in addition, offer clear stereo viewing using passive glasses. Displays are complete with all necessary internal shielding, and meet all regulatory requirements.

SELECTION GUIDE/PERFORMANCE CHARACTERISTICS

		GMA201	GMA202	GMA251	GMA213S	GMA263S
Addressable Pixels (Merged Raster)		2048 H x 1536 V	1536 H x 2048 V	2048 H x 1536 V	1024 H x 1024 V	1024 H x 1024
Spot Size	Typical	6 mils center	6 mils center	6 mils center	10 mils center	10 mils center
	Maximum	7.5 mils center	7.5 mils center	7.5 mils center	12 mils center	12 mils center
Frame Buffer Size		NA	NA	2048 x 2048 x 8	NA	2048 x 2048 x 8
Gray Scale Levels		Infinite	Infinite	256	Infinite	256
Brightness with:	Phosphor type	30 fL (100cd/m) WW (P4)	30 fL (100cd/m) WW (P4)	30 fL (100cd/m) WW (P4)	40 fL each eye WB (P45)	40 fL each eye WB (P45)
	Filter	62% Transmissive	62% Transmissive	62% Transmissive	Stereo Modulator & Glasses	Stereo Modulator & Glasses
Optional Phosphor/Filters	WB (P45)/62%	WB (P45)/62%	WB (P45)/62%	None	None	None
Interface	Standard	Separate Video and Sync	Separate Video and Sync	T-16 Bus	Separate Video and Sync	T-16 Bus
	Optional	Composite Video and Sync	Composite Video and Sync	None	None	None
Horizontal Sync:	Type	TTL Falling Edge	TTL Falling Edge	Internal	TTL Falling Edge	Internal
	Standard Sweep Rate	93 kHz	126 kHz	Internal	126k Hz	Internal
	Avaliable Sweep Rates	64 and 78 kHz	80 and 93 kHz	None	None	Internal
Vertical Sync:	Type	TTL Falling Edge	TTL Falling Edge	Internal	TTL Falling Edge	Internal
	Standard Refresh Rate	60 Hz	60 Hz	Internal	120 Hz Frame Seq	Internal
	Available Refresh Rates	75 Hz Only with 64-78 kHz Sweep	120 Hz Interlance only with 80 kHz Sweep	Internal	None	Internal
Video:	Type	Linear, AC Coupled	Linear, AC Coupled	Internal	Linear, AC Coupled	Internal
		DC Restored	DC Restored		DC Restored	Internal
						Internal
	Impedance	50 Ω Std, 75 Ω Opt	75 Ω Std, 50 Ω Opt	Internal	50 Ω	Internal
	Level	0.7 V = Full On	0.7 V	Internal	0.7 V = Full On	Internal
	Bandwidth	200 MHz	200 MHz	Internal	200 Mhz	Internal
	Rise and Fall Time	<1.8 ns	<1.8 ns	Internal	<1.8 ns	Internal
	DAC Type	NA	NA	8-Bit GaAs	NA	8-Bit GaAs
Dimensions without Cabinet	Height	15.3 in (389 mm)	19.6 in (499 mm)	NA	NA	NA
	Width	17.6 in (447 mm)	14.0 in (356 mm)	NA	NA	NA
	Depth	19.1 in (485 mm)	19.8 in (503 mm)	NA	NA	NA
	Weight	55 lbs (25 kg)	57 lbs (26 kg)	NA	NA	NA
Dimensions with Cabinet	Height	16.9 in (429 mm)	NA	16.9 in (429 mm)	16.9 in (429 mm)	16.9 in (429 mm)
	Width	21.8 in (553 mm)	NA	21.8 in (553 mm)	21.8 in (553 mm)	21.8 in (553 mm)
	Depth	22.3 in (567 mm)	NA	22.3 in (567 mm)	22.3 in (567 mm)	22.3 in (567 mm)
	Weight	80 lbs (36.4 kg)	NA	88 lbs (40 kg)	83 lbs (37.7 kg)	93 lbs (42.2 kg)

ORDERING INFORMATION

GMA201 Monochrome Raster Display Monitor **$4,505**

OPTIONS

Opt. 23[*1] – Cabinetry and CRT Bezel **+$970**
Opt. 30 – 64 kHz Horizontal Sync **NC**
Opt. 32 – 78 kHz Horizontal Sync **NC**
Opt. 38 – 75 Hz Vertical Sync **NC**

GMA 202 Monochrome Raster Display Monitor **$5,175**

OPTIONS

Opt. 02 – WB (P45) Phosphor with 62% contrast enhancement filter **+$150**
Opt. 10 – Composite Video **+$85**
Opt. 41 – 80 kHz-120 Hz interlace **NC**
Opt B1 – Service Manual **$75**

GMA251 Monochrome Digital Image Display **$16,250**
GMA213S Analog Stereo Image Display **$19,500**
GMA263S Digital Stereo Image Display **$29,500**

COMMON OPTIONS

Opt. B1 – Service Manual **+$150**

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**

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

For further information, contact:
Tektronix, Inc.
P.O. Box 500, MS 46-943
Beaverton, Oregon 97077
or call: (800) 835-9433, ext. 2002;
TWX: 910-467-8708;
TLX: 15174;
FAX: 503-627-2670

NEW

CAChe/ RP88

COMPUTER-AIDED CHEMISTRY WORKSYSTEM/ 17 MIPS COPROCESSOR FOR MACINTOSH® II

CAChe Worksystem

FEATURES

- *Apple® Macintosh® IIx– Based*
- *Interactive Software Featuring Molecule Editing, Mechanics, Visualization*
- *16 inch Color Monitor, 640 x 480 Resolution*
- *Stereo 3-D Viewing*
- *Mouse and 3-D Trackball*
- *17 MIPS Computing Power*
- *256 Displayable Colors*
- *Optional Color and B&W Printers*

TYPICAL APPLICATION

- *Synthetic Organic Chemistry in Pharmaceuticals, Agrichemicals, Plastics, Petrochemicals.*

ADDITIONAL INFORMATION

Contact Tektronix CAChe Group at (800) 872-7924

RP88 Coprocessor

FEATURES

- *17 MIPS and 7 MFLOPS Performance*
- *20 MHz Operation*
- *Motorola 88100 RISC CPU*
- *Up to 3 Motorola 88200 CMMUs*
- *Up to 8 MBytes of DRAM with Burst Mode Cache Line Fill*
- *Up to 32 kBytes Instruction Cache*
- *16 kBytes Data Cache*
- *Full Master/Slave NuBus Interface*

TYPICAL APPLICATIONS

- *Engineering CAD*
- *Photorealistic Imaging*
- *Manufacturing Robotics and Machine Vision*
- *Scientific Visualization*

ADDITIONAL INFORMATION

Contact Tektronix Advance Technologies at (800) TEK-WIDE. ext. 8800

CAChe Worksystem. Designed by chemists, for chemists.

The *CAChe™ Worksystem* is a personal chemical modeling system designed by chemists, for chemists. User-friendly, it provides synthetic organic chemists with timely solutions using computational chemistry and computer graphics. The Worksystem is based on an accelerated Apple® Macintosh® IIx platform, offering local computing resources equal to a mainframe.

POWERFUL, INTERACTIVE TOOLS

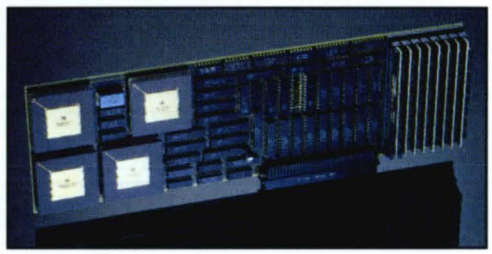
3-D interactive color graphics, plus chemistry application software developed at Tektronix by chemists, provides an integrated set of interactive tools for chemical modeling and calculations. Tools are in the familiar, graphically-oriented Macintosh® style, enabling chemists to examine graphical representations of complex chemical information and to manipulate, via 3-D trackball, geometric models of molecules in real time.

MACINTOSH®–BASED

Since the CAChe Worksystem is based on a Macintosh® II computer, the user also has access to a wide variety of personal software applications. Output can include a wide variety of color and B&W printers, and other add-on products.

COMPLETE DOCUMENTATION

Each system also includes a full complement of user documentation including a *User's Guide, Reference Manual and Card, and Chemistry Tutorial.* Systems are factory-installed; and installation, maintenance, and support services are available.



RP88 Coprocessor

INCREASED MAC II PROCESSING POWER

The Tektronix RP88 Coprocessor is a single Macintosh® II Series-compatible board that offers a significant performance advantage for applications configured for the board. Based on Motorola's 88000 RISC chip set, the coprocessor increases the processing power of the Mac® II by up to 30 times, delivering up to 17 MIPS and 7 MFLOPS performance.

PROGRAMMER'S TOOL KIT FOR FAST APPLICATIONS DEVELOPMENT

To assist software developers in developing and running applications, a complete Programmer's Tool Kit is available in either "C" or Fortran versions. Development tools include an 88000 assembler and linker (MPW-compatible), a symbolic debugger (Debug88™), and an 88000 library manager. The Tool Kit also enables porting of applications written for the UNIX operating system.

FULL ACCESS TO MAC II TOOLBOX

Software support libraries included with the Programmer's Tool Kit permit applications written for the RP88 Coprocessor to take full advantage of the Mac II, enabling use of the popular Macintosh graphical user interface, as well as, Macintosh system access and Macintosh memory management.

EASY INSTALLATION, SERVICE

The RP88 Coprocessor is easily installed into any Mac II series expansion slot, and complete user documentation is provided. The RP88 is fully serviced and supported by Tektronix.

ORDERING INFORMATION

CAChe Worksystem (includes complete molecular modeling software, installation and training)	$39,990
CAChe Add-on Worksystem (Hardware upgrade to existing Macintosh IIx or Cx)	$19,990
4693DX Color Image Printer (with Macintosh interface card)	$9,490
RP88 Coprocessor Includes: 2 MBytes DRAM; 32 K cache memory; Sample programs; User documentation.	$9,575
RP88 OPTIONS	
Opt. 01 – Adds 6 MBytes DRAM	$1,500
Opt. 02 – Adds 16 K of cache memory	$420
RP88 PROGRAMMER'S TOOL KIT	
Base Kit Includes: C compiler; Assembler, Debugger; Libraries.	$995
Fortran Kit (requires Base Kit) Includes Fortran compiler	$1,995
RP88 COMPLETE DEVELOPMENT PACKAGE	
Includes Coprocessor Board, Options 01 and 02, and Base Programmer's Tool Kit	$11,995

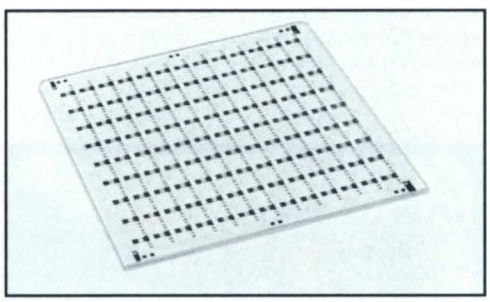
TEK'S WORLD CLASS FACILITIES AND KNOW-HOW AT YOUR DISPOSAL

We know that your systems can only be as reliable as the components that go into them. For that reason we place a premium on dependability. We produce products that will keep you and your customers satisfied and your service costs down.

We take your design (or assist you with design) and take the entire process through manufacturing and shipment. Quality control is assured, along with on-time delivery and customer satisfaction. We want to work with you and value you as our customer.

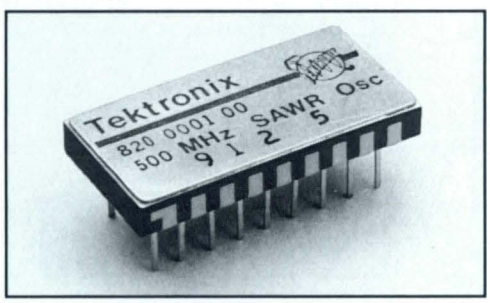
Contents

SAW Products 475
Avionics /CRTs 476
Ceramic Products 478
Applied Chemical Components 479
Integrated Circuits 480
ComTek 482



SAW RESONATORS (SAWRs)

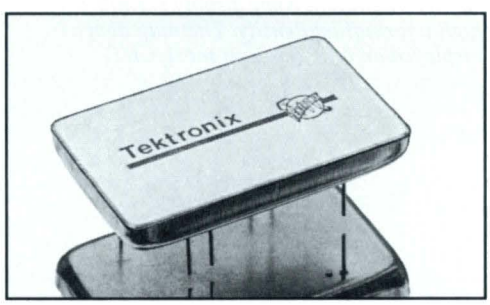
- 1 GHz SAWR
- 500 MHz SAWR
- 400 MHz SAWR
- 315.525 MHz SAWR
- Any Custom SAWR from 100 MHz to 1 GHz*1



SAWR OSCILLATORS (SAWROs)

- 1 GHz SAWRO
- 500 MHz SAWRO
- 400 MHz SAWRO
- Any Custom SAWRO and SAWR Voltage Controlled Oscillator from 100 MHz to 1 GHz*1

All the above SAW products use SAW Grooved Resonators on quartz. We can also supply (Custom) SAW Metal Resonators.



SAW FILTERS

- Existing Products:
  Several filters in the 30 MHz to 50 MHz range.
- Custom Design Capabilities:
  Wide range of center frequencies: 10 MHz to 1 GHz*1
  Wide range of bandwidths: 500 kHz to 250 MHz*2
  Small bandpass ripple: < 0.2 dB p-p
  Small shape factors: <1.1
  Good out-of-band rejection: 70 dB (maximum)
  Good phase group-delay control: ±2° / ±10 ns

*1 *Negotiable to 2 GHz*
*2 *Negotiable depending on center frequency*

SAW Products

- ***Trade-offs Exist Between Parameters***
- ***Tek can Tailor Filter Characteristics to Your Needs***
- ***Any Subsystems Including Various Combinations Shown on the Left:*** *SAW Products with Hybrids, Switches and Multiple Type Packages.*

ORDERING INFORMATION

Tektronix, Inc.
SAW Technology
P.O. Box 500 – M.S. 50-240
Beaverton, OR 97077
Phone: (503) 627-6171
FAX: (503) 627-5502

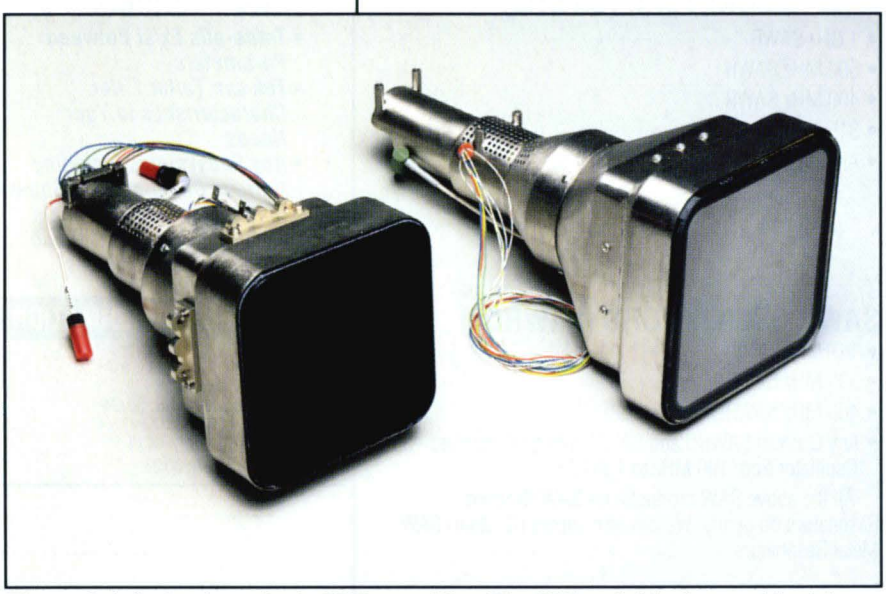
When Your Requirements Push You to the State-of-the-Art and Beyond, Tektronix Stands Ready to Help You – with CRTs and Electron Beam Devices to Meet Your Challenge.

MIL SPEC ELECTRON BEAM DEVICES

AVIONIC TAUT SHADOW MASK COLOR CRTs

MILITARY APPLICATIONS

Tektronix' patented taut shadow mask color CRTs are unsurpassed for displaying high quality images in a full sunlight environment. Designed to support both stroke and raster deflection, avionic CRTs are provided with yoke, neck magnetics, shield, and flying leads. Your specific design requirements will be quoted on request.



Five and six inch color avionic CRT assemblies. The CRT on left is shown with night vision compatible contrast enhancement filter.

- High Brightness
- High Resolution
- Static or Dynamic Convergence
- Ruggedized
- Night Vision Goggle Compatibility Option
- Anti-Reflection Contrast Enhancement Filter Options
- 5" x 5" and 6" x 6" Square Displays

Applications

- Military and Commercial Aircraft
- Fixed Wing and Helicopter Installations
- Moving Map Displays
- Multifunction Displays
- Ground-based Displays

SIMULATOR APPLICATIONS

High value simulator CRTs are based on mil-spec designs but are derated for luminance, linewidth, and environmental conditions. Common-parts design and concurrent production with full military versions result in simulator CRTs with superior performance and enhanced value for your display dollar.

- Stroke and/or Raster Deflection
- Integrated Shield Assembly
- Flying Leads
- AR, Contrast Enhancement, and NVG Filter Options
- 5" x 5" and 6" x 6" Square Displays

Applications

- Flight Simulator Training
- Cockpit Design and Testing
- Multi-Purpose Displays

A High resolution color display permits very high information density. The map above is displayed on a 6" x 6" taut mask CRT.

ORDERING INFORMATION

Marketing Dept.
Avionic Displays & Mil Spec Components
Tektronix Inc.
P.O. Box 500 M.S. 48-121
Beaverton, OR 97077
Phone: (503) 627-6888
or 1-800-TEK-WIDE
Fax: (503) 627-2670
Telex: 62905448

COMMERCIAL CRTs

With a modern high-volume manufacturing facility and decades of display design and manufacturing experience, Tektronix offers a full spectrum of commercial and custom CRTs to satisfy your demand.

Our ceramic envelope technology frees you from the restraints of costly and time-consuming glass envelope tooling on new designs.

SIGNAL ACQUISITION CRTs

Tektronix' ability to produce a wide range of Test and Measurement CRTs is unsurpassed. All feature high quality, reliability, and performance – with low power requirements.

- Displays to 7" diagonal
- Oscilloscope CRTs to 100 MHz
- High Deflection Sensitivity
- E-beam Digitizers

Applications

- Mini-scopes
- Monitors
- Scan Converters

DATA DISPLAY CRTs

High beam current and high resolution electron guns allow 2048 x 2048 resolution for demanding display applications.

- Monochrome CRTs to 23" viewable diagonal
- Brightness to 400 fl
- High Bandwidth Z-axis, Low Capacitance Grid Structures

Applications

- High Resolution Monitors
- Medical Imaging
- 3D Stereo

LINE SCAN HARDCOPY CRTs

The line scan fiber optic CRT is the high intensity, high resolution choice for exposing a wide variety of monochrome and full color media.

- Magnetic Deflection With Electrostatic Focus
- Resolution to 300 Dpi
- Continuous Tone Gray Scale
- Color Version With 3 Phosphor Stripes
- Compact Ceramic Envelope Construction

Applications

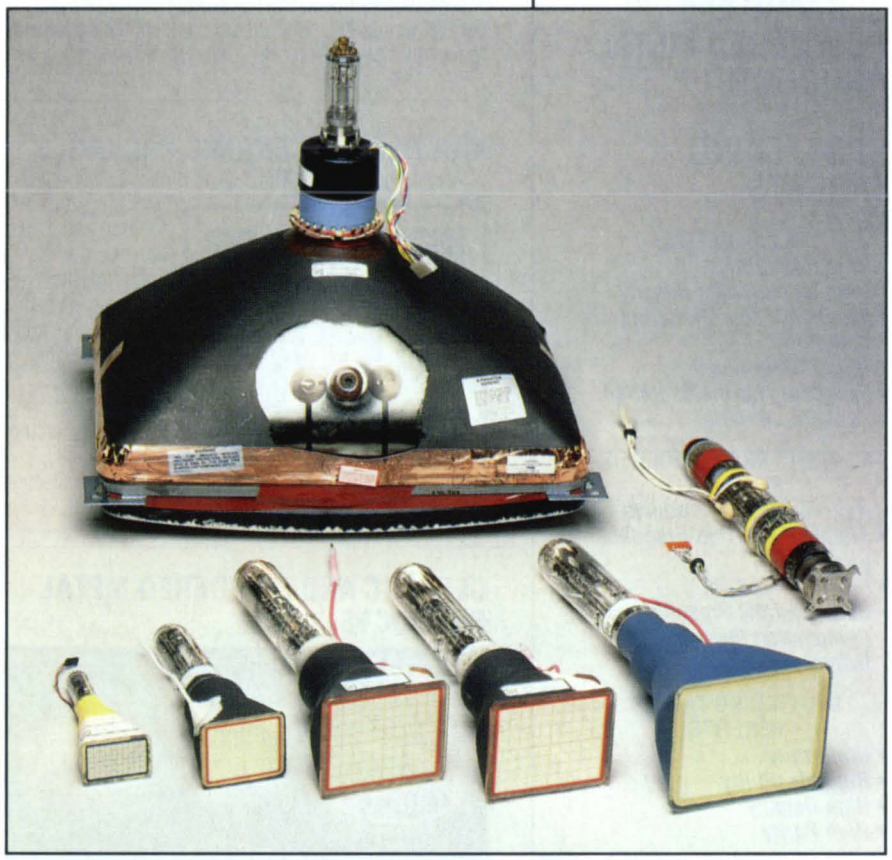
- Printers
- Medical Image Recorders
- Data And Well Loggers

CUSTOM ELECTRON BEAM PRODUCT DESIGN

Electron beam data displays and signal acquisition displays designed and developed for your specific application.

- Technology Development Contracts
- Prototype Fabrication

Tektronix has the Fast Turnaround, Cost Effective Solution for CRTs with Special Requirements or Shapes



Tektronix CRTs and solutions are designed to fit your needs.

Compact Fiber Optic Line Scan CRT

ORDERING INFORMATION

Marketing Dept.
Commercial & Custom CRTs
Tektronix Inc.
P.O. Box 500 M.S. 48-121
Beaverton, OR 97077
Phone: (503) 627-6888
or 1-800-TEK-WIDE
Fax: (503) 627-2670
Telex: 62905448

MULTILAYER CERAMIC PACKAGES

CERAMIC and POWDERED METAL PRODUCTS

SPUTTERING TARGETS

MLC BENEFITS

- *High Reliability*
- *High Interconnect Density*
- *Excellent Power Handling Capability*
- *High I/O Pin Count*
- *Excellent Thermal Isolation*
- *Low-Fire Material*

CERAMIC AND POWDERED BENEFITS

- *Near-Net Shape Products*
- *Standard and Non-Standard Shapes*
- *Low Tooling Cost*
- *Cold Isostatic Pressing, Compaction Pressing, Extrusion*

SPUTTERING TARGET BENEFITS

- *Uniformity*
- *Reproducibility*
- *High Density*
- *High Purity*

ORDERING INFORMATION

Ceramics Division's wide range of products and services enables us to offer the right solution to meet your needs. For further information on any of the above products or services, call or write to discuss your particular application.

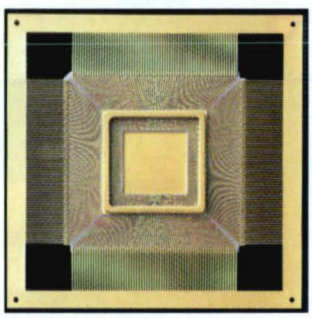
Tektronix Ceramics Division
P.O. Box 500, M.S. 13-835
Beaverton, Oregon 97007
Phone: (503) 627-3993
Fax: (503) 627-5688

For over 30 years, Tektronix has produced high performance near-net shape ceramic CRT funnels and ceramic/powdered metal components for use in our test and measurement equipment. In addition, for nearly a decade, we have manufactured custom sputtering targets required for production of precision thin-films.

Recently, we have also developed multilayer ceramic packages for a variety of applications, including packaging of our own custom integrated circuits. We now provide this capability and expertise to customers outside of Tektronix in a wide range of products and services.

MULTILAYER CERAMIC PACKAGES

Multilayer Ceramic (MLC) devices offer an alternative packaging method for thin- and thick-film hybrids, leaded plastic packages, etched circuit boards and other packaging methods. MLC offers distinct advantages including high reliability, high inteconnect density, excellent power handling capability, high I/O pin counts, excellent thermal isolation and good control of transmission line parameters. A new low-fire process utilizing noble metal conductors offers significant package cost savings. The process uses our patented low dielectric constant material. An added benefit is lower resistance, enabling better electrical performance. Multilayer ceramic packages can be produced with the following specifications:



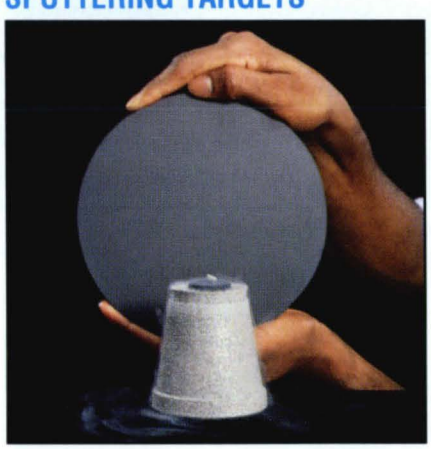
- Dielectric constant of 5.8 at 1 MHz using new low-fire material; 9.6 at 1 MHz using high-fire process.
- 4-mil line and 3-mil space layouts
- 5-mil vias
- Single and multiple chip carriers
- Leaded, leadless, pin-grid and pad-grid array packages

CERAMIC AND POWDERED METAL PRODUCTS

A world-class cold isostatic pressing facility enables us to produce a variety of near-net shape products, such as the famous Tektronix ceramic forsterite funnels for CRTs. Computer-aided design and state-of-the-art processes provide us with an edge to quickly design and produce standard and non-standard shapes in various volumes, without high tooling costs.

Ceramics Division also produces ceramic and powdered metal component parts using a variety of manufacturing processes, including compaction (dry) pressing and extrusion. We prototype and manufacture ceramic components such as ceramic lids, substrates and insulators, using forsterite and aluminum oxide. Our powdered metal products include cams, relays, heat sinks, and a large variety of custom components, Materials include stainless steel, nickel silver, iron, copper tungsten, titanium tungsten and nickel chrome.

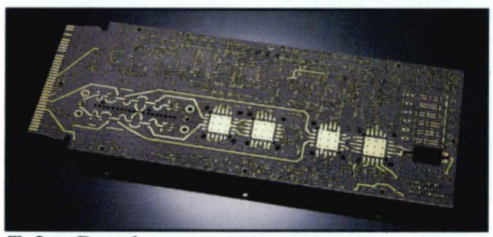
SPUTTERING TARGETS



Ceramics Division has developed uniform, reproducible sputtering targets that provide densities over 90% and purity up to 99.999%. We can provide round targets in sizes up to 8 inch dia. x 0.25 inches, and one-piece retangular targets up to 5 x 15 x 0.25 inches. Materials include titanium tungsten (TiW), indium-tin-oxide (ITO), doped and undoped nickel chrome (NiCr), aluminum oxide (Al_2O_3), lead zirconate titanate (PZT) and superconductor ($YBa_2Cu_3O_{7-x}$). Other sizes and materials are available upon request. We will also bond targets to user-supplied or Tektronix-supplied backing plates.

FLEXIBLE CIRCUITS

Flexible Circuits made on polyimide or fluoropolymer dielectric base material meet critical analog and digital electrical performance in high speed test, emulator and logic analyzer probing situations, or when dense 3D packaging is required for small light weight or portable electronic equipment. A replacement for a complex wire harness when assembly speed and reliability are required. Fluoropolymer materials also satisfy high temperature requirements in harsh environments. UL recognized products available.



Teflon Board

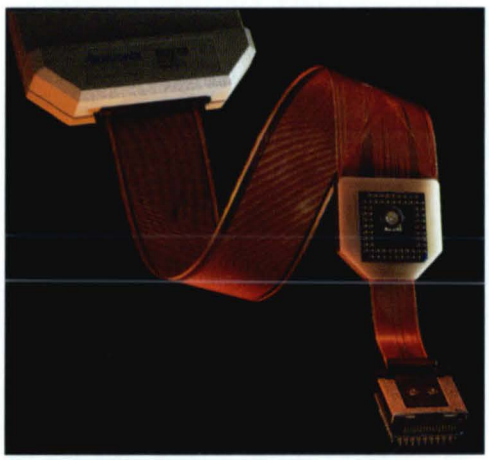
HYBRID TO CIRCUIT BOARD ELASTOMER CONNECTOR

Hybrid to Circuit Board Elastomer Connector is used for analog or digital applications where a reliable and/or easily assemblable connector is needed. The patented Hypcon™ connector is unique for second level interconnections. The gold-on-gold pressure contact is virtually transparent at frequencies > 0.5 GHz.

Plating

PHOTOCHEMICAL MACHINED PARTS

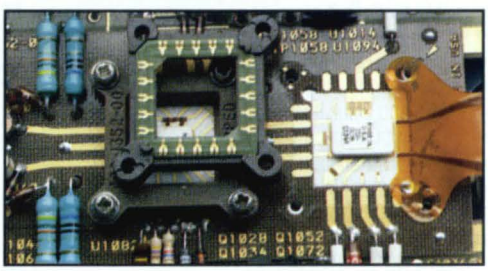
Photochemical Machined Parts provide a cost effective alternative to die blanking for tight tolerance, low volume applications. Simple, low cost phototooling means quick turn time for prototype and easy tooling modification for redesign. Burr free parts can be produced on most white and yellow metals like stainless steel, beryllium copper, brass and copper.



Flex Circuit

PTFE AND COMPOSITE MATERIAL CIRCUIT BOARDS

PTFE and Composite Material Circuit Boards for high frequency circuits with glass or ceramic filled fluoropolymer, polysulfone or polyetherimide base materials. The fluoropolymer material can be selected within the permitted range of 2.2 to 10.6 for low-loss applications at gigahertz-plus frequencies in communications and data transmission applications.



Hypcon

PLATED PARTS

Plated Parts using electronic-grade electroplating capabilities to provide corrosion resistance, conductivity, solderability, wear resistance, wire bonding, appearance or shielding on metal and plastic substrates. UL recognized process for plating on plastics for EMI shielding. Finishing by electroplating is used where surface requirements differ from substrate material properties. Finishes provided include:

- Soft and hard gold
- Copper-tin-zinc alloy
- Bright and matte silver
- Black chrome
- Bright chrome
- Tin
- Electroless copper and nickel
- Zinc
- Nickel
- Electroless palladium

Applied Chemical Components

Supplier of Custom State-of-the-Art Electronic Interconnect Components and Electronic-Grade Plating. Engineering design, prototype and production manufacturing for:

- *Flexible Circuits*
- *PTFE and Composite Material Circuit Boards*
- *Hybrid to Circuit Board Elastomer Connectors*
- *Plated Parts*
- *Photochemical Machined Parts*

CONTACT INFORMATION

Applied Chemical Components
Customer Services, M. S. 38-330
Phone: (503) 627-2000
Fax: (503) 627-2310

ICO

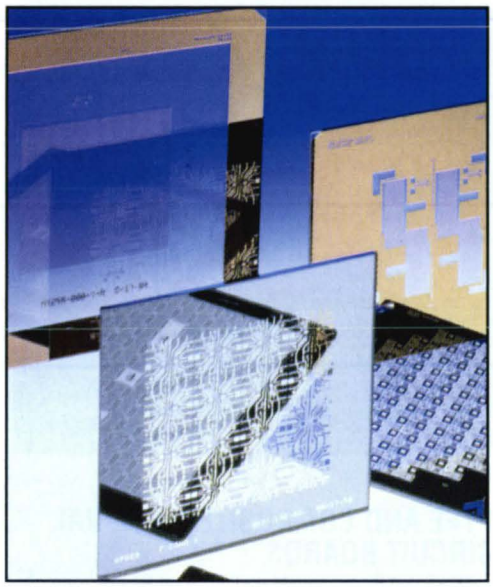
Integrated Circuits Operation

Superior Micro-Lithography Capabilities and Leading Edge Charge Coupled Device Imagers.

- *Design Layout and Photomask Tooling Capability*
- *Sub Micron Critical Feature Sizes*
- *Wafer Scale Integration*
- *Scientific Imagers in a Large Area Format*
- *High Frame Rate Imagers for Fast Read Out*
- *Custom and Semi-Custom CCD Prototype Services*

CONTACT INFORMATION

Integrated Circuits Operation
P.O. Box 500, Mail Sta. 59-420
Beaverton, OR 97077
Phone: (503)-627-2149
FAX: (503)-627-5560



MASK DESIGN AND FABRICATION

MASK DESIGN

Working from menu-based design layout technology and grid based layouts, we provide layout support for:

- QuickChip™ and Gate Array Designs
- Full Custom Designs
- Analog and Digital ASIC
- Thick and Thin Film Hybrid Circuits
- MLCs
- SAW's and Optical Waveguides
- Mesh and Chemically Milled Parts
- ELC's and Graticules
- Non Standard Layout Requirements

ICO supports a variety of design formats, including:

- Calma GDSII, STREAM
- GCA DW Mann, 3000 or 3600F
- CIF
- QuicKic
- Gerber
- ECAD

MASK FABRICATION

Our facility includes both Optical GCA DW Mann and MEBES III Perkin-Elmer Electron Beam Technologies. ICO Microlithography is a full service facility; capable of suppling a wide variety of photomask tooling. Such as:

- 1X, 5X, 10X Reticles
- 1X Perkin-Elmer Projection Masks
- 1X Masters and Contact Prints

Our manufacturing capability provides critical features size to less than 0.5 micron, ±0.05 micron tolerances. To insure high quality products, we have the latest in quality control verification tools and an SPC program in place.

CHARGE COUPLED DEVICES

CCD's are MOS integrated circuits that are essentially sampled data, analog delay lines that can be used in a variety of diverse applications; optimized either for high speed or wide dynamic range, imaging or non-imaging. High speed signal processing applications are:

- Transversal Filters
- Tapped Analog Delay Lines
- High Speed Samplers
- Memory Buffers

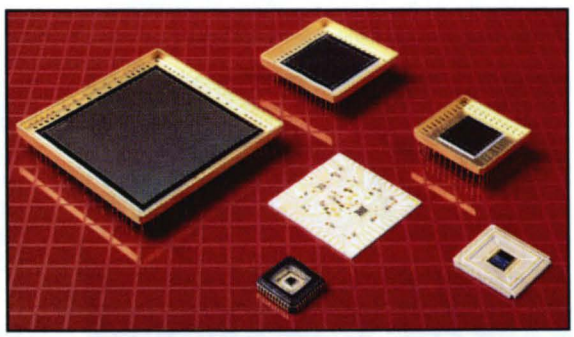
Ultra sensitive imaging detectors for:

- Spectroscopic Imaging
- Medical Imaging
- Astronomical Imagin
- High Definition TV Imaging

ICO offers two families of large area array imagers. Our scientific imager family offers low noise, wide dynamic range, high QE (quantum efficiency), and high sensitivity. This family consists of the TK512C, TK1024A, and TK2048B.

Our high frame rate imager family offers smaller area arrays that run from 100 to 5000 frames per second image rate; while maintaining comparatively low noise and wide dynamic range. This family consists of TK064A, with serial output and TK064B, with 64 parallel outputs.

All imagers are available in front illuminated and back illuminated versions, with backside enhancement for higher QE through the visible spectrum and extending into the near UV.



A development board (TK1DEV) is also available, which will operate imagers up to 3072 x 3072 pixel array size. TK1DEV provides the necessary electronics to begin imaging immediately, with only the addition of power supplies and an XYZ monitor. ICO also offers prototype services using our 2, 3, or 4 phase processes and your custom design.

SELECTION GUIDE

Type	Array Size
High Frame Rate Imager	
TK064A	64 x 64
TK064B	64 x 128
Scientific Imagers	
TK512C	512 x 512
TK1024A	1024 x 1024
TK2048B	2048 x 2048

BIPOLAR ANALOG ICs

Our integrated circuits can provide important technological and market advantages for your state-of-the-art products. Foundry services for analog application specific designs are available. In addition, a number of specialty components for high performance applications are being offered. Two design methods are used to design custom analog ICs: QuickCustom™ and full custom.

QUICKCUSTOM™

A semi-custom design approach, QuickCustom™, helps reduce your development time and cost. It consists of a series of QuickChip™ design formats (cores) and easy to understand, time saving design tools for design simulation, layout, and layout verification.

QuickChips™ begin with a prefabricated chip that consists of the basic "core" array of transistors, capacitors, and resistors configured for interconnection. The engineer simply determines the custom single or dual layer metal interconnections for those circuit elements required. In addition to implanted resistors, laser trimmable Nichrome resistors for precise analog applications are available on all core families.

Once final designs are determined and approved, finished wafers can be delivered (typically) within three weeks or less.

This "designer-friendly" approach was developed by Tektronix engineers who have many years of analog expertise in IC design. ICO design engineers and product engineers are ready to provide you with as much assistance as you require.

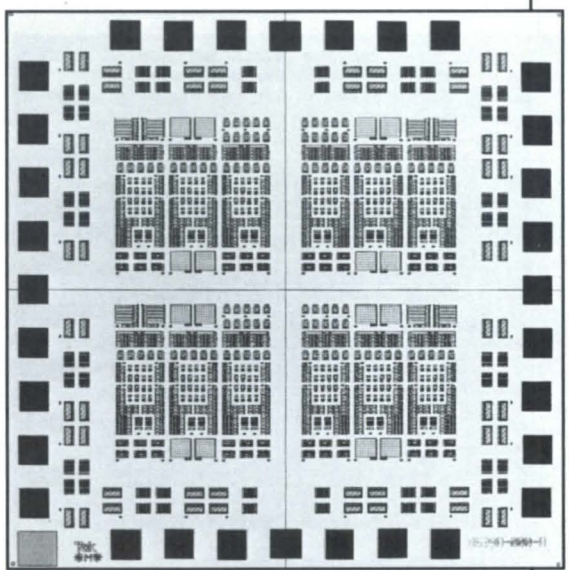
The "tools" include a complete quide to enabling the first time user to complete a design with minimal one-to-one coaching. We provide you with a library of macro cell (QuickChip™ 4), and SPICE models for the "core" IC, that will predict the performance of your design and ensure that your QuickCustom™ circuit works the first time.

We also include a grid-based layout system that specifies where the custom interconnects can be routed, and QuicKic™, a graphic layout editor that makes it easy for even the first time designer to digitize the layout.

FULL CUSTOM

If higher performance or optimization for lower cost per chip are your requirements, ICO also offers a total custom design approach. One of our experienced applications engineers will be assigned to work with you throughout the entire project. Tektronix developed CAD/CAE software will be used to assist you through circuit analysis, simulation, and layout, greatly improving your confidence in meeting design specifications the first time. Typical delivery of finished wafers is less than eight weeks from approval of design layout

SELECTION GUIDE			
QuickChip™ 2 Family (6.5 GHz, Analog Cells)			
	2S	**2**	**2L**
NPNs	150	214	524
PNPs	82	110	240
Resistors (Implant)	602	946	2064
Capacitors	24	20	72
Bond Pads	24	36	70
QuickChip™ 4 Family (6.5 GHz, Digital/Analog Cells)			
Equiv. Gates	300		
NPNs	294		
PNP	174		
Resistors (Implant)	1290		
Capacitors	16		
Bond Pads	30		
QuickChip 6 Family (8.5 GHz, Analog Cells, 4X Density, J-FETs)			
	6-10	**6-40**	**6-120**
NPNs	74	224	600
PNPs	25	100	300
JFETs	12	48	144
Schottky Diodes	44	104	240
Resistors (Implant)	340	1360	4080
Capacitors	4	16	48
Bond Pads	18	32	54



This QuickChip™ 6-40 semi-custom array is one of three members of a new family of high-speed analog IC arrays. Measuring 83.5 x 83.5 mils, the array is ideal for ASIC designers requiring high-speed circuits (F_t approximately 8.5-GHz). The array contains four symmetrical macro-tiles, each containing a variety of circuit components – including transistors, Schottky diodes, and P-channel JFETs – that can be easily interconnected for a wide range of circuit applications. Thirty-two bonding pads are provided for external lead connections.

ICO

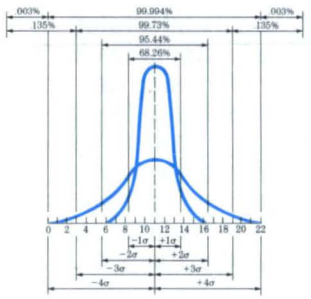
Tektronix Integrated Circuits Operation is Now Marketing its Formidable IC Design and Fabrication Capabilities to Those Who Have High Performance IC Requirements but Limited Resources.

BIPOLAR FOUNDRY SERVICES

- *QuickCustom™ ICs*
- *Full Custom ICs*
- *Specialty Components*
- *Design Services*
- *State-of-the-Art Design Tools*
- *6.5 GHz and 8.5 GHz Analog Processes*
- *Proven High Reliability*
- *Processes Featuring Gold Metalization*

CONTACT INFORMATION

Integrated Circuits Operation
P.O. Box 500, Mail Sta. 59-420
Beaverton, OR 97077
Phone: (503) 627-2149
FAX: (503) 627-5560



All parts are not created equal. They vary. Ever so slightly, but they do vary. Consider the Bell Curve. The closer each part is to perfect, the steeper the curve, the higher the peak. Our customers want the curve squeezed tighter, pushed higher. That's how it was when we were part of Tektronix. And that's how it is now that we are ComTek.

TAKING COMPONENT TECHNOLOGY TO THE LIMITS

Time-to-market. Just-in-time. Turn-around time. Compressing time while maintaining product integrity is the goal of a team effort we bring to each project.

Our design and manufacturing engineers will share their years of experience and knowledge to "value engineer" your design for maximum manufacturability. This is not an added service. We do it for every product, at no additional cost.

Our CAD department will take your product geometry any way we can get it. Transmit your computer geometry via modem, send a disk or tape, or forward blueprints and we'll encode them for you. Once your design is on our computers, we can swap your model back and forth until, together, we've achieved the most manufacturable product. As you know, the earlier design wrinkles are ironed out, the more costs are reduced later on.

When you've approved a refined model we'll separate it, unfold it, flatten it, pattern your product and prototype it on screen. Our CAD/CAM databases know our materials through and through; and our modeling software knows our punches, presses and milling machines inside and out. So if you need a hands-on prototype, we can often prepare a quick NC tape, disk, or even download the computer data directly to our DNC presses or machining centers to fab a quick sample.

Sheet Metal Fabrication:
Pressing For Perfection

Our CNC turret presses bring 45 tons to bear on short runs. They can also generate precise engineering samples before you invest in hard tooling. For high volume, close tolerance work, our 45- to 300-ton punch presses will maintain accuracies down to 0.001".

Hard tools are the heart of your volume sheet metal components. We design them. We build them. We maintain them. We protect them. We guarantee them. We fix them if they wear.

Precision Machining:
Zero Defects, Wide Variety

Our people and machines are organized into manufacturing "cells". Expect to find a cell already equipped, staffed and practiced at machining the product you need. Within the appropriate cells, you'll find precision saws which can cut most pieces to within 0.005". State-of-the-art CNC machines can hold tolerances of 0.0002". Three-axis CNC milling centers control dimensions down to 0.001". Computerized coordinate measurement machines can confirm that precision to accuracies of 0.0001"!

Custom Completion:
Coated, Assembled, Delivered

From etching to painting, you can have the optimum surfaces on your components, metal or plastic, inside or out. Electrostatic spray and powder coating, clean-room hand-spray, and a wide variety of textured finishes are all available. Our Coating Analysis Lab measures color, gloss, thickness, texture and other important parameters – scientifically.

Ordering complete assemblies transfers the overall burden to ComTek, to deliver entire assemblies which are Defect-Free.

Receive them Just-in-time, every time. Getting assemblies or parts to your loading dock or to a specific point on your assembly line is a proven ComTek service.

Reaching The Peak:
Our Past, Present And Future

When Tektronix needed top-of-the-line chassis and precision machined parts they couldn't find anywhere else, they created us. That's right, the customer designed the supplier! We were built to serve.

No longer restricted to Tek, ComTek component technologies are now available to a much broader array of customers. If you believe your product would benefit from the fabrication, finishing, assembly and delivery that ComTek customers have come to depend on, call us. We'll help you push your components to the peak.

COMTEK

ComTek Manufacturing of Oregon, Inc.
13630 Southwest Terman Road
Post Office Box 4200
Beaverton, Oregon 97076-4200
Phones: 503-526-6500
800-582-4444

ANTHROARM® PC

HOLDS UP TO 60 LBS.

AnthroArm® PC...strong, adjustable, well-designed. Put your monitor exactly where you want it. Have room to spread out and be comfortable.

The AnthroArm® PC easily holds your monitor weight up to 60 lbs.*[1] Select either the 13" x 13" platform or the 17" x 17" platform for bigger monitors. Both platforms have a non-skid, cushioned skin. They hold your monitor straight and steady.

The AnthroArm® PC moves with your comfort in mind. Raise your screen 7 3/4" to 12" above your desk with the easy-to-turn crank. Tilt your monitor ±10° by applying pressure to the platform. Swivel both the platform and arms 360° so your screen is at the best viewing angle. Extend your PC Arm 16 1/2" to bring it near you, or retract it to move it out of the way. Let the PC Arm do your lifting for you.

Choose between three different mounts. The Edge Clamp grips onto any edge from 1" to 2" thick. The Desk Clamp is designed for desks with no overhang. And the Cart Mount puts the PC Arm into the leg of any AnthroCart (see next page).

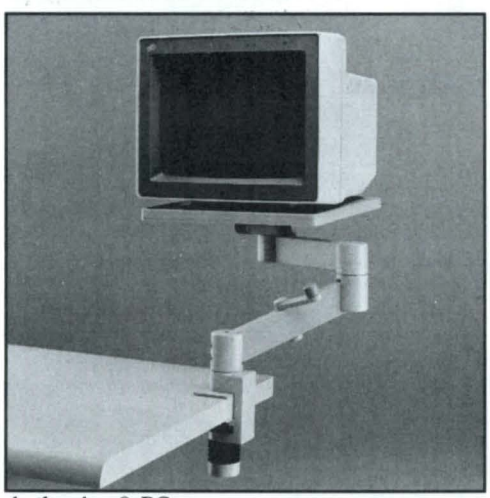
The Keyboard Holder is the option to hold your keyboard up off your work surface. The holder attaches under the platform in a fixed position.

AnthroArm® PC. Quality armature for monitors. Look for our name.

*[1] *For more weight capacity, see the AnthroArm® GT.*

CHARACTERISTICS

- Arms made of 16 gauge steel and cast aluminum.
- Hand crank and knobs made of fiberglass reinforced polycarbonate plastic.
- The platforms are made of laminated high density fiberboard with molded non-skid polyurethane foam skin.
- Arm has durable baked on liquid platinum gray finish.



AnthroArm® PC

ANTHROARM® GT

HOLDS UP TO 200 LBS.

AnthroArm® GT... space saving, heavy duty, solid. Designed to hold 200 lbs. Now you can easily move your heavy equipment around.

Float your hardware above your work surface and have plenty of room to spread out underneath. Swivel both the platform and the arm 360° to move your equipment to the right spot. Pull it toward you. Push it away.

Choose between three different models, depending on the reach you want (how much depth you have on your work surface) and how much maneuverability you want the GT Arm to have. Choose between the 12" Arm, 18" Arm or a Compound Arm. You can also decide on either a 13" x 13" or 17" x 17" platform.

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

Install the GT Arm by drilling through the work surface and mount using the six supplied bolts.

AnthroArm® GT: the Arm strong enough to hold your heaviest equipment. Look for our name.

AnthroArm® GT

CHARACTERISTICS

- Arm, base plate and mounting plate are thick-wall GT Arm aviation grade cast aluminum, hardened to T6. The parts have a smoke tan finish.
- The pivots are lined with 1" 1D bronze bushings.
- The platforms are made of laminated high density fiberboard with molded non-skid polyurethane foam skin.
- Two stacking lugs (3/4" each) are included for height adjustment.

AnthroArm® PC

BENEFITS

- *Holds up to 60 lbs.*
- *Easily Adjusts Up and Down*
- *Safely Tilts and Swivels*
- *Easy to Attach*
- *Made in the U.S.A.*

AnthroArm® GT

BENEFITS

- *Holds up to 200 lbs.*
- *Rotates 360°*
- *5 Year Warranty*
- *Made in the U.S.A.*

ORDERING INFORMATION

FOR A FREE CATALOG, CALL OUR TOLL FREE NUMBER: 800-325-3841

Anthro® Co.
Technology Furniture®
3221 NW Yeon St.
Portland, OR 97210
Phone: 503-241-7113
Fax #: 503-241-1619

AnthroArm® and Technology Furniture® are registered trademarks of Anthro.

ANTHRO™

AnthroCart®

APPLICATIONS

- *Technology Furniture for Use with any Type of Hardware, from Scopes to Personal Computers to Graphic Terminals.*

BENEFITS

- *5 Year Unconditional Warranty*
- *Rugged Construction, Holds up to 150 lbs.*
- *Made in U.S.A.*
- *Over 20 Options to Customize Your Workstation*
- *Mobile*
- *Space Saving*

ORDERING INFORMATION

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Portland, OR 97210
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Fax # : 503-241-1619

AnthroCart® and Technology Furniture® are registered trademarks of Anthro.

ANTHRO™

ANTHROCART®

Three words constantly come up whenever anyone talks about what they like about the AnthroCart®: mobile, compact and incredibly strong. No one seems to have enough space. A lot of people need to move their equipment around. That's why the AnthroCart® was originally designed within Tektronix. It was such a great idea that in 1984, Tektronix spun Anthro out to meet your Technology Furniture needs.

You're familiar with building blocks. First you start with one, then you add more. You can rearrange them and shape them until you have a design that pleases you and meets your needs.

You can do the same thing with our carts. You choose a standard cart to start with. You can use it on its own, or combine it with others. And you can build onto it with our wide range of options to get the shape you want.

You can decide on height, depth, width and all kinds of options to add. And like all building blocks, you can always take the AnthroCart® apart and reconfigure it if your needs change.

PC Compact Cart (Bone Color) shown with Extension Shelf Kit, Paper Feed and Catch, Document Holder, Slide Out Shelf, Wire Base Shelf and Bookends.

FREE CATALOG

Call us on our toll free number to receive your free catalog. The catalog shows you all of our different size carts, how you can configure them, what options you can choose from, and all the product specs you may need. We'll also include a price list and ordering information.

There are three members of the AnthroCart® family: the AnthroCart® Original, the MidSize and the KingSize. The AnthroCart® Original is 25" wide. You can configure it in a sit-down or stand-up application, add additional shelves for extra hardware or storage and fit it into a very small space.

PC Cart with Document Holder, Slide Out Shelf and Scooter.

THE MIDSIZE

The MidSize is 36" wide, a foot wider than the Original. Like all AnthroCarts®, it's strong, compact and mobile. The AnthroCart® MidSize is the right size for in-between spaces.

THE KINGSIZE

The AnthroCart® KingSize is 48" wide – plenty of room if you need to spread out. Wider than the Original and MidSize, the KingSize is still as mobile and heavy duty. Make the AnthroCart® KingSize work for you. Move your equipment around. Stack it all on the KingSize – it's designed for more room.

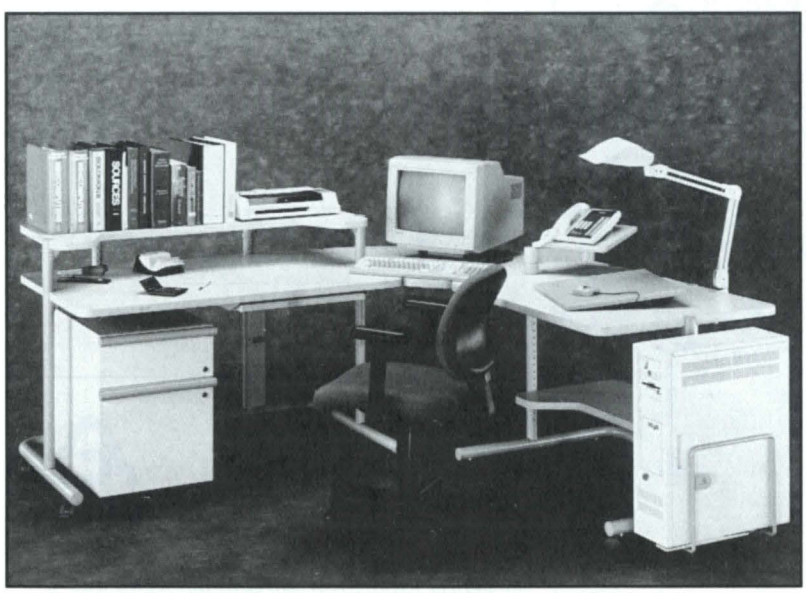
Now that you have all the "blocks", you can build a workstation. Connect any two AnthroCarts® together to create a workstation to meet any of your space needs. Plus, you can move it around.

CHARACTERISTICS

- Made in the U.S.A.
- Legs and base tubes are 16 gauge, seam-welded, cold rolled steel with a baked-on powder coated finish.
- The shelves are 1" thick, 45 lb. density particle board with vinyl t-molding edges.
- All plastic pieces are glass filled injection molded.
- The castors are soft rubber.
- The tops are high pressure laminate.
- Products are shipped knocked down.

PC, MidSize Cart shown with Document Holder, Drawer, Cable Alley, Side Rack and Scooter.

GT KingSize AnthroCart® shown with Extension Shelf Kit and Side Rack.



Decide which carts will work best in your work space. An AnthroCart® KingSize is shown connected with an AnthroCart® MidSize.

ORDERING INFORMATION

FOR A FREE CATALOG, CALL OUR TOLL FREE NUMBER: 800-325-3841

Anthro® Co
Technology Furniture®
3221 NW Yeon St.
Portland, OR 97210
Phone: 503-241-7113
Fax # : 503-241-1619

AnthroCart® and Technology Furniture® are registered trademarks of Anthro.

ANTHRO™

AnthroBench®

- *Space Saving Arm*
- *Generous Cord Management*
- *Spacious 60" x 36" Surface*
- *Adjusts in Height from 25 to 30 inches*

ORDERING INFORMATION

FOR A FREE CATALOG, CALL OUR TOLL FREE NUMBER: 800-325-3841

Anthro® Co.
Technology Furniture®
3221 NW Yeon St.
Portland, OR 97210
Phone: 503-241-7113
Fax # : 503-241-1619

AnthroBench® and Technology Furniture® are registered trademarks of Anthro.

ANTHROBENCH®

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

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

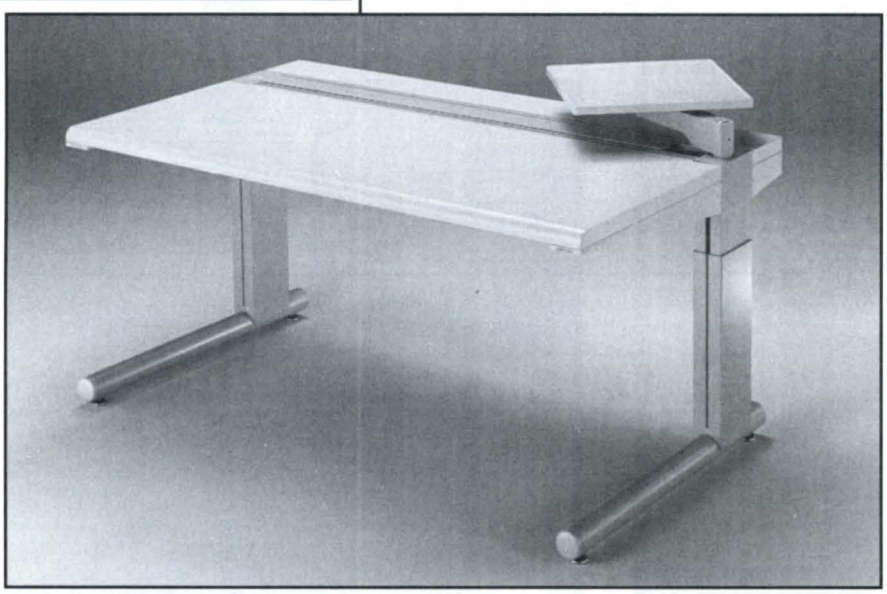
Running the length of the surface is a cord management track with a generous capacity for cables, cords, and power strips. You can run your cords in anywhere along the track, and keep them out of your way in the 2'.5" w. x 3'.75" d. channel.

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

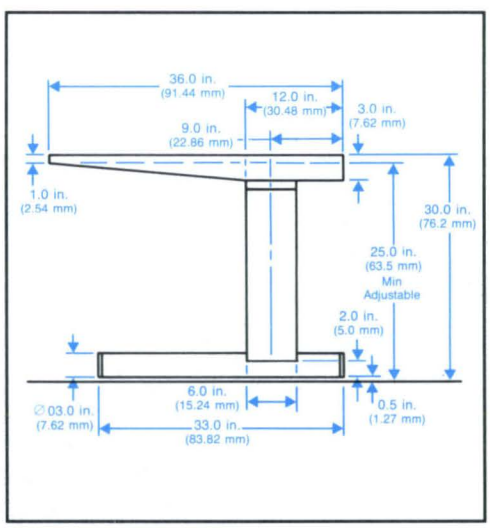
The AnthroBench®: make your space fit your work style.

CHARACTERISTICS

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



AnthroBench® with 12" Arm



ANTHRO™

The perfect CAD/CAM workstation: Anthrobench® with Arm, Task light, HarterAnthro Chair and Printer Stand.

GENERAL TERMS OF SALE

CREDIT AND PAYMENT TERMS

Tektronix, Inc. offers many different terms of sale in order to meet varied purchasing objectives and to assist in financial planning. Credit accommodations must be arranged with Tek's credit department. Orders and requests for credit accommodations should be placed with your local Tek sales office.

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:

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, and air shipments will be insured at full value unless your order instructs otherwise.

LEASING

VISUAL SYSTEMS GROUP PRODUCTS

Products are available under three expanded Leasing programs. Terms vary from 90 days to four years.

Comprehensive Lease – This full service lease provides seven features ensuring customer flexibility. Key features include maintenance, product upgrade, and purchase credits.

Basic lease – Customers can use this program to acquire products at our lowest monthly rates.

Ownership Lease – This even payment plan ensures title transfer at the lease end. No down payment or ending balloon payment is required.

In addition to these standard programs, specialized leasing programs answer customer needs in the areas of new product evaluation, short-term rental, supplying interim products for delayed items, credit acceptance, and others. Custom leases can also be structured, providing a tailored solution for individual customer requirements.

TEST AND MEASUREMENT GROUP

Purchases of Tektronix T&M (Test and Measurement) equipment may be financed through a lease with *Citicorp North America*. Both capital and operating leases are available with standard terms of one to five years. Ownership of the product at the end of the lease is an option.

Arrangements for leases may be made through your local Tektronix field office. For additional assistance or for further information regarding the program, please contact the National Marketing Center at 1 (800) 426-2200. Customized leases to satisfy particular customer requirements may be arranged.

RENTAL PROGRAM

There's no need to look around if you need to rent the best from Tektronix. Authorized Tektronix rental companies can assure you a wide selection of well-maintained instruments and flexible rental terms. You can have confidence you are getting the best of Tektronix, in the best condition, supported by all the right options and accessories for your application, for just the length of time you need.

If you need to demo new equipment on a rental basis before you decide to buy or if you need any of our products the next day, any of our authorized rental companies can have the products you need in the shortest time possible. That's another advantage of calling one of Tektronix' authorized rental companies, who are committed to making the newest Tek instruments available to you right from the outset, so you won't have to delay before you put Tektronix' latest product to the test.

Renting test and measurement equipment can be very convenient, so keep the alphabetical list of Tektronix authorized rental companies nearby. When you are ready to rent the best from the best, just call:

Continental Resources, Inc.	800-343-4688
Electro Rent Corporation	818-787-2100
General Electric Computer Service	800-GE-RENTS
Genstar Rental Electronics, Inc.	800-225-2422
Leasametric, Inc.	800-553-2255
McGrath RentCorp	800-352-2900
Telogy, Inc.	800-835-6494
U.S. Instrumental Rentals, Inc.	800-824-2873

Check the Specifications. You will Find Long Product Life Designed-in.

- ***Reliability Standards Second to None***
- ***Product Specifications to Meet Your Environment***

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OEM COMPONENTS AND POWER SOURCES

ORDERING INFORMATION

POWER SOURCES

Many Tektronix instruments can be fitted with one of the power cord/plug options listed below and wired for the voltage as indicated, if specified on the purchase order.

Standard	North American	120 V
Option A1	Universal Euro	220 V
Option A2	United Kingdom	240 V
Option A3	Australian	240 V
Option A4	North American	240 V
Option A5	Switzerland	220 V

OEM COMPONENTS

SPECIAL INFORMATION FOR OEMs

At Tektronix, we offer many products with terms, conditions, and pricing for OEMs. Computer graphics components, small screen displays, certain cameras, TV signal test and measurement instrumentation – we offer these and other products on a special basis to the original equipment manufacturer.

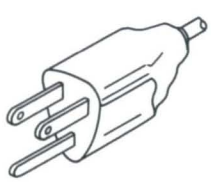
CHOOSE THE PERFORMANCE LEVEL TO MATCH YOUR SYSTEM

In many product areas, our wide range of OEM components allows you to select just the optimal performance you need for the system you are building. When your systems demand highest performance, Tektronix will provide the quality products to meet your standards.

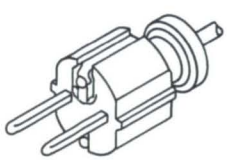
In price-sensitive situations, the wide Tektronix selection usually allows you to select exactly the performance level you need – no more, no less.

SPECIAL OEM TERMS AND PRICING HELP KEEP YOU COMPETITIVE

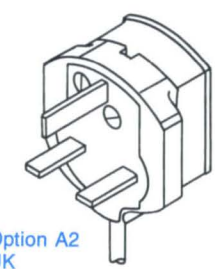
Ask your local Tektronix representative about the special OEM terms and pricing available to you.



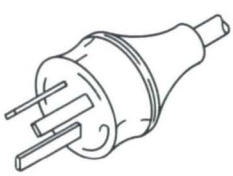
Standard
North American
120 V Plug



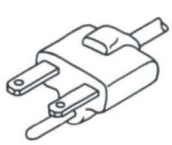
Option A1
Universal Euro
220 V Plug



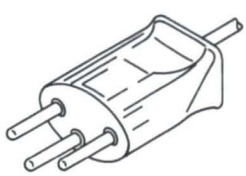
Option A2
UK
240 V Plug



Option A3
Australian
240 V Plug



Option A4
North American
240 V Plug



Option A5
Switzerland
220 V Plug

SERVICE AND SUPPORT – WHEN AND WHERE YOU NEED IT.

Tektronix has service centers throughout the U.S. and in many countries around the world. We offer long term parts support to protect your investment.

If you need applications assistance, we 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 SOURCE CONSIDERATIONS

Most Tektronix instruments provide wide-range regulated supplies, or quick change line-voltage selectors for convenient selection on line-voltage operating ranges. Transformer taps in other instruments can be changed to accommodate specific line-voltage operating ranges or can be factory wired for a specific range if specified on the purchase order.

Many Tektronix instruments are designed to operate from a power source that will not apply more than 250 Volts RMS between the supply conductors or between either supply conductor and ground.

The power cord/plug options may become available on instruments not specified in this catalog. Refer to the individual product ordering information for those products offering these options as of publication date.

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

RECONDITIONED PRODUCTS

If budget restrictions are in the way of getting the Tektronix product that you would like to have – Tektronix Reconditioned Products, with the same warranty as a new product, may be an ideal solution for stretching the tight budget dollar.

THE ORIGINS

Tektronix Reconditioned Products are usually field demo units, marketing demo units or lease returns. Products meet Tektronix standards for quality and performance, both technically and aesthetically. Both current and out-of-production products may be available for sale.

Reconditioned Products are calibrated and tested to meet the same high standards as new products.

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 sold at reduced prices - below new product prices. All standard and contract discounts normally apply.

Your Tektronix sales engineer or local Tektronix field office will be glad to see if there is a Reconditioned Product available and to provide you with a current price quote.

WARRANTY

We are confident in the reconditioning process. *The warranty on current Tektronix Reconditioned Products is the same as on new instruments.* Extended service options are also available on most products.

Reconditioned Products meet Tek standards for quality and performance.

APPEARANCE

We like our products to look as good as they run. Instruments are inspected and cleaned so they visually are near new. If necessary, we refurbish or replace cabinet parts that do not meet our high standards.

Reconditioned Products look as good as they run.

AVAILABILITY/DELIVERY

Reconditioned Products are offered on an "as-available" basis. *Many products are in stock and are immediately available.*

Visual Systems Group and Logic Analyzer products that have multiple configurations available can be provided to your specific requirements usually within several days.

An Ideal Solution for Stretching the Tight Budget Dollar

- ***New Product Warranty***
  Products Meet Tektronix High Standards for Performance, Quality and Reliability.
- ***Reduced Prices***
- ***Quick Delivery***
  Many Products are in Stock and are Immediately Available
- ***Current and Out-of-Production Products May be Available.***

ORDERING INFORMATION

Check with your local Tektronix Field Office to take advantage of Tek's Reconditioned Product bargains.

Or you may call
the National Marketing Center
Toll free line:
1-800-426-2200
(Test & Measurement Products)

1-800-TEK-6100
(Visual Systems Products)

Your Tektronix Sales Engineer will be pleased to discuss your instrument needs.

CUSTOMER SUPPORT

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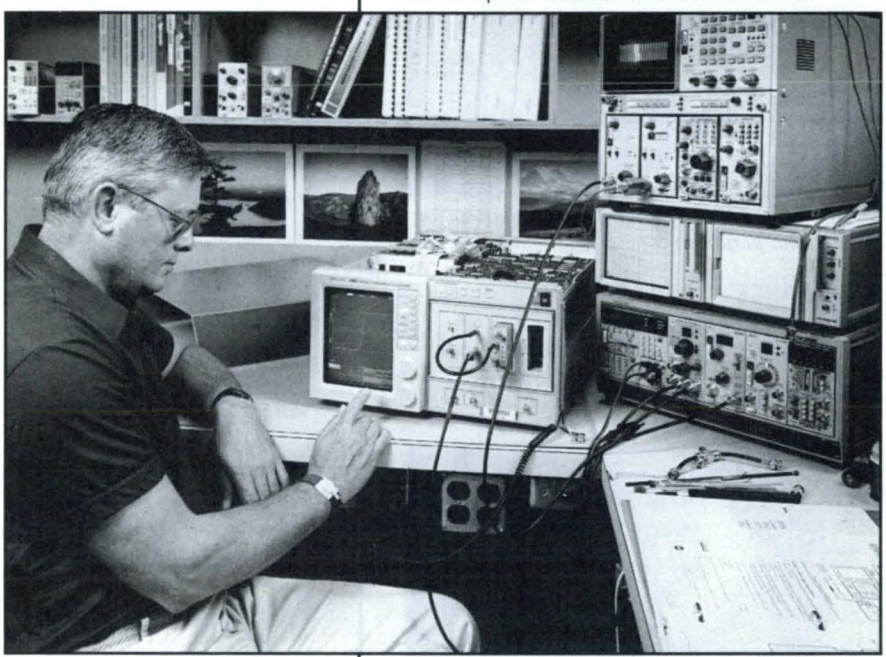
Visual Systems Products 497
Customer Training 498
Warranty Statements 499

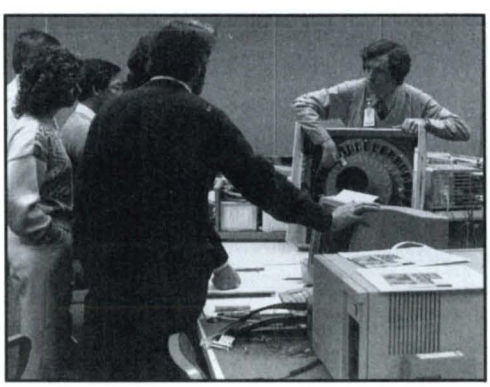
TEKTRONIX WORLDWIDE SUPPORT TOTAL-SOLUTIONS FOR YOUR SUCCESS

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 field office. See office listing on pages 500 through 503. The CSR will give you information on products and the names of sales engineers assigned to serve your product interests.



BUSINESS SECTORS

To provide more focus for our customers, Tektronix is divided into three business sectors:

- Test and Measurement Products
- Communications Products
- Visual Systems Products

Each sector is supported by personnel dedicated to its product types. This provides applications and service expertise for three distinctly different industries and their product requirements.

CUSTOMER SUPPORT PROGRAMS

Various customer support programs are offered:

- Service Offerings
- Warranty Coverage
- *Warranty-Plus* Service Plans
- Per-Incident Service
- Maintenance Agreement Programs
- Customer-Site Installations
- Technical Assistance Service
- Training and Assistance
- Operational and Applications Workshops
- Service Training Workshops
- Module Repair Services
- Replacement Parts
- Long-Term Product Support

Providing You With Worldwide Service and Support to Complement Your New Product Purchase

ORDERING INFORMATION

Contact your local Field Office or Tektronix subsidiary.
Or call our toll-free numbers:
Test and Measurement: 1-800-547-5000
Visual Systems: 1-800-835-6100

WARRANTY COVERAGE

All Tektronix products are warranted to be free from defects in materials and workmanship during the applicable warranty period. See page 499.

BUSINESS SECTOR SERVICE OFFERINGS

Unique service programs are developed for Test and Measurement, Communications, and Visual Systems products. See pages 492 through 497 for details. Service programs include: *Warranty-Plus*, Per-Incident, and Maintenance Agreement plans.

CUSTOMER-SITE INSTALLATIONS

Tektronix provides on-site installations for most visual systems and Tek-configured systems for computer graphics, semiconductor test, microprocessor development, and acquisition/processing products. Your Tektronix specialist will set up your product to meet operating specifications for all functions and will provide basic operating training so that your new purchase is put to immediate use.

TECHNICAL ASSISTANCE SERVICE

When you need technical assistance to supplement your own resources, Tektronix can arrange the services of an application engineer skilled in meeting your needs. Contact your local Tektronix field office for more 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 engineer for details about customer training.

OPERATION AND APPLICATION 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.

MODULE REPAIR SERVICES

If you are able to service and isolate faults to the module level, Tektronix Module Services will repair your modules and return them to you fully operational. Prices for this service include module repair, adjustment and performance verification. For an additional charge, the latest design modifications and enhancements can be incorporated into your repaired module.

REPLACEMENT PARTS

Components of equal or improved quality can be supplied for over 5,000 Tektronix products. Our computerized warehouse and adjoining distribution center is one of the most sophisticated delivery systems in the world. No one can match our inventory of spare modules, assemblies, circuit boards, and other essential components for Tektronix products.

LONG-TERM PRODUCT SUPPORT

Tektronix has a long-standing policy to provide continuous service coverage after a product has been removed from the catalog. Most products have Per-Incident service coverage for up to nine years after a product ceases production. Obsolete products can be serviced pending part availability. Contact your local office for availability.

Remember, when you purchase your Tektronix product, there is more in the box than a new piece of equipment: total-solution support is just a phone call away!

TEST & MEASUREMENT PRODUCTS AND COMMUNICATIONS PRODUCTS

DEPOT SERVICE

TEKTRONIX *WARRANTY-PLUS* M-OPTIONS

For products with a **ONE-YEAR** product warranty

M-OPTIONS AND PRODUCT WARRANTY	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	*WARRANTY-PLUS* M-OPTION DESCRIPTIONS
M1 plus ONE YEAR PRODUCT WARRANTY =	ONE YEAR PRODUCT WARRANTY	DEPOT REPAIRS, CAL	DEPOT REPAIRS, CAL			Extends remedial coverage through the third year of product ownership and provides two calibrations: one each in years two and three.
M2 plus ONE YEAR PRODUCT WARRANTY =	ONE YEAR PRODUCT WARRANTY	DEPOT REPAIRS	DEPOT REPAIRS	DEPOT REPAIRS	DEPOT REPAIRS	Extends remedial coverage through the first five years of product ownership.
M3 plus ONE YEAR PRODUCT WARRANTY =	ONE YEAR PRODUCT WARRANTY	DEPOT REPAIRS, CAL	DEPOT REPAIRS, CAL	DEPOT REPAIRS, CAL	DEPOT REPAIRS, CAL	Extends remedial coverage through the first five years of product ownership and provides four calibrations (one per year) during years two, three, four, and five.
M4 plus ONE YEAR PRODUCT WARRANTY =	ONE YEAR PRODUCT WARRANTY, CAL	DEPOT REPAIRS, CAL, CAL	DEPOT REPAIRS, CAL, CAL			Extends remedial coverage through the first three years of product ownership and provides five calibrations: one in year one, and two each in years two and three.
M5 plus ONE YEAR PRODUCT WARRANTY =	ONE YEAR PRODUCT WARRANTY, CAL	DEPOT REPAIRS, CAL, CAL	DEPOT REPAIRS, CAL, CAL	DEPOT REPAIRS, CAL, CAL	DEPOT REPAIRS, CAL, CAL	Extends remedial coverage through the first five years of product ownership and provides nine calibrations: one in year one, and two each in years two, three, four, and five.
M6 plus ONE YEAR PRODUCT WARRANTY =	ONE YEAR PRODUCT WARRANTY	DEPOT REPAIRS, CAL				Extends remedial coverage through the second year of product ownership and provides one calibration in year two.
M7 plus ONE YEAR PRODUCT WARRANTY =	ONE YEAR PRODUCT WARRANTY	CAL	CAL			Provides two calibrations: one each in years two and three of product ownership.
M8 plus ONE YEAR PRODUCT WARRANTY =	ONE YEAR PRODUCT WARRANTY	CAL	CAL	CAL	CAL	Provides four calibrations: one each in years two, three, four, and five of product ownership.
M9 plus ONE YEAR PRODUCT WARRANTY =	ONE YEAR PRODUCT WARRANTY	DEPOT REPAIRS	DEPOT REPAIRS			Extends remedial coverage through the first three years of product ownership.

All calibrations and repairs are performed at Tektronix service depots.
All calibrations, if applicable, are traceable to NIST (National Institute of Standards and Technology).

Test and Measurement products (Instruments & Instrument Systems) and Communications products are serviced at Tektronix service depots or on-site at the customer's facility. Types of services cover a broad range of calibrations, performance tests, preventive maintenance, repairs, a combination of services, and much more. Whatever your need, Tektronix can provide fast, flexible service that keeps your products operating at peak performance. Contact your local Service Representative and ask for a free *Calibration and Repair Services Guide*. It will give you detailed information on service offerings for Tektronix Test and Measurement products and Communications products.

WARRANTY-PLUS

One Good Purchase Deserves Another

When you purchase or lease a Tektronix product, you can make another great purchase that provides the most cost-effective, long-term service available: *Warranty-Plus*. It can be secured only as a one-time investment on new purchases or leases, so be careful not to miss your window of opportunity! Ask your sales engineer to identify which options are available on the products of your choice. Then include them with your purchase. You can put them on the same purchase order, or on a separate one, but the transaction must be completed before the product ships.

The large array of *Warranty-Plus* options is divided into three families: M-Options, Q-Options, and W-Options. Each family (M,Q, and W) reflects the type of services best suited for specific product types. To find out what options apply for your product interests, check the product option information in this catalog or contact your local sales representative.

ORDERING INFORMATION

Contact your local Field Office or Tektronix subsidiary.
Or call our toll-free numbers:
Test and Measurement: 1-800-547-5000
Visual Systems: 1-800-835-6100

WARRANTY-PLUS BENEFITS

- Provides the most comprehensive coverage at the lowest cost
- Quantity discounts applied to product purchases also apply to *Warranty-Plus*
- Purchased with one up-front fee, no extra paperwork or approvals when service is required
- No investment required for training, spares or documentation
- Provides priority service over non-agreement customers
- Product uptime is optimized
- Serviced only by Tektronix factory-trained technicians for quality workmanship and efficiency

WARRANTY-PLUS M-OPTIONS

M-Options provide extended Warranty-like coverage as well as calibration services for up to five years. There are a total of nine offerings providing calibrations, repairs, and various combinations. All services are performed at Tektronix service depots. Your local Tektronix field office can direct you to the location nearest you. If you are within a service depot region, you may qualify for pick up and delivery services or your product may be shuttled from a nearby field office. If you ship your product directly to a Tektronix service depot, it will be shipped back to you at our expense.

To help you determine the best M-Option for your needs, first analyze your measurement precision requirements. If precise measurements are very critical, you might want two calibrations per year for either a three or a five-year period. If so, M4 or M5 would be your choice. If your measurement requirements need precision but are used in standard applications, M1 or M3 would be the best fit. For customers with their own calibration facilities, repair coverage only (M2 or M9) may be desired. And for those customers who want accurate measurements, but choose not to have repair coverage, M7 and M8 are their choices.

No matter what your requirements, we have a plan. If you can't find the perfect match in a *Warranty-Plus* package, contact your local Tektronix service representative for a tailor-made Maintenance Agreement.

DEPOT SERVICE

TEKTRONIX *WARRANTY-PLUS* M-OPTIONS

For products with a **THREE-YEAR** product warranty

M-OPTIONS AND PRODUCT WARRANTY	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	*WARRANTY-PLUS* M-OPTION DESCRIPTIONS
M2 plus 3 YEAR PRODUCT WARRANTY =	3 YEAR PRODUCT WARRANTY	3 YEAR PRODUCT WARRANTY	3 YEAR PRODUCT WARRANTY	DEPOT REPAIRS	DEPOT REPAIRS	Extends remedial coverage through the first five years of product ownership.
M3 plus 3 YEAR PRODUCT WARRANTY =	3 YEAR PRODUCT WARRANTY	3 YEAR PRODUCT WARRANTY CAL	3 YEAR PRODUCT WARRANTY CAL	DEPOT REPAIRS CAL	DEPOT REPAIRS CAL	Extends remedial coverage through the first five years of product ownership and provides four calibrations (one per year) during years two, three, four, and five.
M4 plus 3 YEAR PRODUCT WARRANTY =	3 YEAR PRODUCT WARRANTY CAL	3 YEAR PRODUCT WARRANTY CAL CAL	3 YEAR PRODUCT WARRANTY CAL CAL			Provides five calibrations: one in year one, and two each in years two and three of product ownership.
M5 plus 3 YEAR PRODUCT WARRANTY =	3 YEAR PRODUCT WARRANTY CAL	3 YEAR PRODUCT WARRANTY CAL CAL	3 YEAR PRODUCT WARRANTY CAL CAL	DEPOT REPAIRS CAL CAL	DEPOT REPAIRS CAL CAL	Extends remedial coverage through the first five years of product ownership and provides nine calibrations: one in year one, and two each in years two, three, four, and five.
M7 plus 3 YEAR PRODUCT WARRANTY =	3 YEAR PRODUCT WARRANTY	3 YEAR PRODUCT WARRANTY CAL	3 YEAR PRODUCT WARRANTY CAL			Provides two calibrations: one each in years two and three of product ownership.
M8 plus 3 YEAR PRODUCT WARRANTY =	3 YEAR PRODUCT WARRANTY	3 YEAR PRODUCT WARRANTY CAL	3 YEAR PRODUCT WARRANTY CAL	CAL	CAL	Provides four calibrations: one each in years two, three, four, and five of product ownership.

ORDERING INFORMATION

Contact your local Field Office or Tektronix subsidiary.
Or call our toll-free numbers:
Test and Measurement: 1-800-547-5000
Visual Systems: 1-800-835-6100

ON-SITE SERVICE

TEKTRONIX ON-SITE *WARRANTY-PLUS* Q-OPTIONS

For products with a **90-DAY** product warranty

Q-OPTIONS AND PRODUCT WARRANTY	OTHER	90 DAYS	YEAR 1	YEAR 2	YEAR 3	*WARRANTY-PLUS* Q-OPTION DESCRIPTIONS:
Q8 plus 90 DAY PRODUCT WARRANTY =	ON-SITE INSTALLATION	90 DAY PRODUCT WARRANTY				On-site installation and product verification.
Q1 plus 90 DAY PRODUCT WARRANTY =		90 DAY PRODUCT WARRANTY	ON-SITE REPAIRS, CAL			Provides on-site remedial hardware coverage through the first year of product ownership and provides one scheduled on-site calibration, performance test, or preventive maintenance call.
Q2 plus 90 DAY PRODUCT WARRANTY =		90 DAY PRODUCT WARRANTY	ON-SITE REPAIRS, CAL	ON-SITE REPAIRS, CAL		Provides on-site remedial hardware coverage through the first two years of product ownership and provides two scheduled on-site calibrations, performance tests, or preventive maintenance calls (one per year) during years one and two.
Q3 plus 90 DAY PRODUCT WARRANTY =		90 DAY PRODUCT WARRANTY	ON-SITE REPAIRS, CAL	ON-SITE REPAIRS, CAL	ON-SITE REPAIRS, CAL	Provides on-site remedial hardware coverage through the first three years of product ownership and provides three scheduled on-site calibrations, performance tests, or preventive maintenance calls (one per year) during years one, two, and three.
Q4 plus 90 DAY PRODUCT WARRANTY =		90 DAY PRODUCT WARRANTY	ON-SITE REPAIRS			Provides on-site remedial hardware coverage during the first year of product ownership.
Q5 plus 90 DAY PRODUCT WARRANTY =		90 DAY PRODUCT WARRANTY	ON-SITE REPAIRS	ON-SITE REPAIRS		Provides on-site remedial hardware coverage during the first two years of product ownership.
Q6 plus 90 DAY PRODUCT WARRANTY =		90 DAY PRODUCT WARRANTY	ON-SITE REPAIRS	ON-SITE REPAIRS	ON-SITE REPAIRS	Provides on-site remedial hardware coverage during the first three years of product ownership.
Q9 plus 90 DAY PRODUCT WARRANTY =		90 DAY PRODUCT WARRANTY	SOFTWARE SUBSCRIPTION			Provides one year of Software Subscription Service.

ORDERING INFORMATION

Contact your local Field Office or Tektronix subsidiary.
Or call our toll-free numbers:
Test and Measurement: 1-800-547-5000
Visual Systems: 1-800-835-6100

WARRANTY-PLUS Q-OPTIONS

Warranty-Plus Q-Options differ from M-Options by providing on-site service at the customer's facility. Instead of shipping your product to a service depot, we come to you. A Tektronix specialist will provide on-site installations and repairs, as well as calibrations, performance tests, or preventive maintenance (whichever is applicable to your product).

Q-Options extend warranty-like coverage for up to three years while adding the convenience of on-site servicing. Remember to check the product options to determine if Q-Options are applied to the products of your choice.

If you can't order Q-Options but you like what they provide, contact your local Tektronix service representative and ask for a tailor-made Maintenance Agreement.

INTERNATIONAL *WARRANTY-PLUS* OPTIONS

Warranty-Plus is available in most countries, but service is provided only in the country where the product and the plan were purchased. Response and turnaround time may be different than those provided in the United States. Please consult your Tektronix subsidiary or approved distributor for your country.

CUSTOMER RESPONSIBILITIES

When service is due under any *Warranty-Plus* program, the customer is responsible for delivering or shipping depot-serviced products or for requesting an on-site service call (depending on plan coverage). When requesting an on-site service call, the Tektronix specialist must be supplied with the following data: system or product type, serial number, and description of any malfunction.

Warranty-Plus Coverage Exclusions

Warranty-Plus service purchased in the United States is valid only in the United States.

Warranty-Plus coverage does not apply if a failure is caused by misuse or inadequate care or maintenance, such as:

- Abuse or cannibalization of products
- Damage from repair attempts by non-Tektronix personnel
- Improper use or connection to incompatible equipment
- Modification or integration that increases the difficulty in servicing the product.

OTHER TEKTRONIX SERVICES

MAINTENANCE AGREEMENTS

Maintenance Agreements are the next best thing to *Warranty-Plus*. Once your product warranty expires or your *Warranty-Plus* coverage comes to an end, you can sign up for a Maintenance Agreement. It provides a planned maintenance program with priority service over Per-Incident customers. It also adds the convenience of multi-year coverage that minimizes paperwork and maintains tighter controls over ownership costs. But most important, it helps you get maximum performance from your investment with increased uptime.

Tektronix Maintenance Agreement programs include two types of calibration offerings, repair, and two types of combined offerings of calibration and repair. A Maintenance Agreement can be written to cover a wide menu of offerings for a large product mix. Consult with your local Tektronix service manager for more information.

PER-INCIDENT SERVICE

Products that are not under any kind of an agreement are serviced as Per-Incident. These are calibration and repair services requested on an as-needed basis. There are two ways to charge for Per-Incident service: Firm Price and Time and Material.

Firm Price

Current Tektronix products have published prices for two types of calibration service, two types of repair, and three types of combined services of calibration and repair. These published Firm Prices can be obtained through your local Tektronix service manager.

Time and Material

Products that are obsolete or that have been damaged or abused are serviced as Time and Material with set labor rates and parts-usage costs.

ADDITIONAL SERVICES

Other services offered are: Before and After Test Data Recording, Instrument Wash, Shuttle Services, Pick up and Delivery, and Next Day Calibrations.

TEKTRONIX ON-SITE *WARRANTY-PLUS* Q-OPTIONS

For products with a **1-YEAR** product warranty

Q-OPTIONS AND PRODUCT WARRANTY	OTHER	YEAR 1	YEAR 2	YEAR 3	*WARRANTY-PLUS* Q-OPTION DESCRIPTIONS
Q0 plus ONE YEAR PRODUCT WARRANTY =	ON-SITE INSTALLATION	ONE YEAR PRODUCT WARRANTY			On-site installation and product verification.
Q1 plus ONE YEAR PRODUCT WARRANTY =		ONE YEAR PRODUCT WARRANTY; ON-SITE REPAIRS; CAL			Provides on-site remedial hardware coverage through the first year of product ownership and provides one scheduled on-site calibration, performance test, or preventive maintenance call.
Q2 plus ONE YEAR PRODUCT WARRANTY =		ONE YEAR PRODUCT WARRANTY; ON-SITE REPAIRS; CAL	ON-SITE REPAIRS; CAL		Provides on-site remedial hardware coverage through the first two years of product ownership and provides two scheduled on-site calibrations, performance tests or preventive maintenance calls (one per year) during years one and two.
Q3 plus ONE YEAR PRODUCT WARRANTY =		ONE YEAR PRODUCT WARRANTY; ON-SITE REPAIRS; CAL	ON-SITE REPAIRS; CAL	ON-SITE REPAIRS; CAL	Provides on-site remedial hardware coverage through the first three years of product ownership and provides three scheduled on-site calibrations, performance tests or preventive maintenance calls (one per year) during years one, two, and three.
Q4 plus ONE YEAR PRODUCT WARRANTY =		ONE YEAR PRODUCT WARRANTY; ON-SITE REPAIRS			Provides on-site remedial hardware coverage through the first year of product ownership.
Q5 plus ONE YEAR PRODUCT WARRANTY =		ONE YEAR PRODUCT WARRANTY; ON-SITE REPAIRS	ON-SITE REPAIRS		Provides on-site remedial hardware coverage through the first two years of product ownership.
Q6 plus ONE YEAR PRODUCT WARRANTY =		ONE YEAR PRODUCT WARRANTY; ON-SITE REPAIRS	ON-SITE REPAIRS	ON-SITE REPAIRS	Provides on-site remedial hardware coverage through the first three years of product ownership.
Q9 plus ONE YEAR PRODUCT WARRANTY =		ONE YEAR PRODUCT WARRANTY; SOFTWARE SUBSCRIPTION			Provides one year of Software Subscription Service.

All installations, calibrations, preventive maintenance, performance tests, and repairs are performed at the customer's site.
All product calibrations, if applicable, are traceable to NIST (National Institute of Standards and Technology).

ORDERING INFORMATION

Contact your local Field Office or Tektronix subsidiary.
Or call our toll-free numbers:
Test and Measurement: 1-800-547-5000
Visual Systems: 1-800-835-6100

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Visual Systems: 1-800-835-6100

WARRANTY-PLUS W-OPTIONS

The third family of *Warranty-Plus* options are Comprehensive W-Options designed for Systems products. They provide both depot and on-site repair. In addition, software subscription and telephone hotline services are bundled with repairs or can be selected alone as a W9-Option. Consult your Tektronix Sales Representative for more information.

TEKTRONIX *WARRANTY-PLUS* W-OPTIONS

For products with a **90-DAY** product warranty

W-OPTIONS AND PRODUCT WARRANTY	90 DAYS	YEAR 1	YEAR 2	YEAR 3	*WARRANTY-PLUS* W-OPTION DESCRIPTIONS
W1 plus 90 DAY PRODUCT WARRANTY =	90 DAY PRODUCT WARRANTY	ON-SITE REPAIRS, SOFTWARE SUBSCRIPTION, HOTLINE			Provides on-site remedial hardware coverage through the first year of product ownership and provides Software Subscription Service and telephone Hotline support.
W2 plus 90 DAY PRODUCT WARRANTY =	90 DAY PRODUCT WARRANTY	ON-SITE REPAIRS, SOFTWARE SUBSCRIPTION, HOTLINE	ON-SITE REPAIRS, SOFTWARE SUBSCRIPTION, HOTLINE		Provides on-site remedial hardware coverage through the first two years of product ownership and provides Software Subscription Service and telephone Hotline support during years one and two.
W3 plus 90 DAY PRODUCT WARRANTY =	90 DAY PRODUCT WARRANTY	ON-SITE REPAIRS, SOFTWARE SUBSCRIPTION, HOTLINE	ON-SITE REPAIRS, SOFTWARE SUBSCRIPTION, HOTLINE	ON-SITE REPAIRS, SOFTWARE SUBSCRIPTION, HOTLINE	Provides on-site remedial hardware coverage through the first three years of product ownership and provides Software Subscription Service and telephone Hotline support during years one through three.
W4 plus 90 DAY PRODUCT WARRANTY =	90 DAY PRODUCT WARRANTY	DEPOT REPAIRS, SOFTWARE SUBSCRIPTION, HOTLINE	DEPOT REPAIRS, SOFTWARE SUBSCRIPTION, HOTLINE		Provides depot remedial hardware coverage through the first two years of product ownership and provides Software Subscription Service and telephone Hotline support during years one and two.
W5 plus 90 DAY PRODUCT WARRANTY =	90 DAY PRODUCT WARRANTY	DEPOT REPAIRS, SOFTWARE SUBSCRIPTION, HOTLINE	DEPOT REPAIRS, SOFTWARE SUBSCRIPTION, HOTLINE	DEPOT REPAIRS, SOFTWARE SUBSCRIPTION, HOTLINE	Provides depot remedial hardware coverage through the first three years of product ownership and provides Software Subscription Service and telephone Hotline support during years one through three.
W9 plus 90 DAY PRODUCT WARRANTY =	90 DAY PRODUCT WARRANTY	SOFTWARE SUBSCRIPTION, HOTLINE			Provides Software Subscription Service and telephone Hotline support during the first year of product ownership.

Hardware repairs are performed either at the customer's site or at Tektronix service depots, depending on the option selected.

TEKTRONIX *WARRANTY-PLUS* W-OPTIONS

For products with a **1-YEAR** product warranty

W-OPTIONS AND PRODUCT WARRANTY	YEAR 1	YEAR 2	YEAR 3	*WARRANTY-PLUS* W-OPTION DESCRIPTIONS
W1 plus ONE YEAR PRODUCT WARRANTY =	ONE YEAR PRODUCT WARRANTY, ON-SITE REPAIRS, SOFTWARE SUBSCRIPTION, HOTLINE			Provides on-site remedial hardware coverage through the first year of product ownership and provides Software Subscription Service and telephone Hotline support.
W2 plus ONE YEAR PRODUCT WARRANTY =	ONE YEAR PRODUCT WARRANTY, ON-SITE REPAIRS, SOFTWARE SUBSCRIPTION, HOTLINE	ON-SITE REPAIRS, SOFTWARE SUBSCRIPTION, HOTLINE		Provides on-site remedial hardware coverage through the first two years of product ownership and provides Software Subscription Service and telephone Hotline support during years one and two.
W3 plus ONE YEAR PRODUCT WARRANTY =	ONE YEAR PRODUCT WARRANTY, ON-SITE REPAIRS, SOFTWARE SUBSCRIPTION, HOTLINE	ON-SITE REPAIRS, SOFTWARE SUBSCRIPTION, HOTLINE	ON-SITE REPAIRS, SOFTWARE SUBSCRIPTION, HOTLINE	Provides on-site remedial hardware coverage through the first three years of product ownership and provides Software Subscription Service and telephone Hotline support during years one through three.
W4 plus ONE YEAR PRODUCT WARRANTY =	ONE YEAR PRODUCT WARRANTY, SOFTWARE SUBSCRIPTION, HOTLINE	DEPOT REPAIRS, SOFTWARE SUBSCRIPTION, HOTLINE		Provides depot remedial hardware coverage through the first two years of product ownership and provides Software Subscription Service and telephone Hotline support during years one and two.
W5 plus ONE YEAR PRODUCT WARRANTY =	ONE YEAR PRODUCT WARRANTY, SOFTWARE SUBSCRIPTION, HOTLINE	DEPOT REPAIRS, SOFTWARE SUBSCRIPTION, HOTLINE	DEPOT REPAIRS, SOFTWARE SUBSCRIPTION, HOTLINE	Provides depot remedial hardware coverage through the first three years of product ownership and provides Software Subscription Service and telephone Hotline support during years one through three.
W9 plus ONE YEAR PRODUCT WARRANTY =	ONE YEAR PRODUCT WARRANTY, SOFTWARE SUBSCRIPTION, HOTLINE			Provides Software Subscription Service and telephone Hotline support during the first year of product ownership.

Providing You With Worldwide Service and Support to Complement Your New Product Purchase

Visual Systems Group products are paired with first class customer service to provide you with unbeatable product up-time. Your local sales engineer or customer service representative can help you select the Maintenance Agreement that best suits your needs. You can choose from a variety of annual or multi-year maintenance agreements. And remember, purchasing multi-year agreements can save you hundreds of dollars over the cost of annual renewals.

COMPREHENSIVE SERVICE OPTIONS (E OPTIONS*1)

E Options provide you with access to our Customer Support Center Hotline, Software or Firmware Subscription Service and on-site Hardware Support. All calls to the Hotline number, if not immediately connected to a technician, will be returned within two hours. If the technical support specialists in our support center cannot resolve your software, hardware, or system questions, an on-site service specialist will be dispatched to your site.

WARRANTY-PLUS SERVICE OPTIONS (S OPTIONS*1)

S Options provide you with on-site service. This includes priority response time service (within eight hours) and on-site hardware coverage (parts, labor, and travel). Response-time service within four hours is available for purchase, if you require more immediate coverage.

DEPOT SERVICE OPTIONS (U OPTIONS*1)

U Options provide you with depot level service. Turnaround time is five days from receipt of product.

MAINTENANCE AGREEMENTS*2

Maintenance agreements are an annual renewal of the service coverage on your product. You may order your renewal following the expiration of a product's warranty or service agreement. If you already have a Tek product, but no service support, and would like to sign up for the first time, you may also purchase support through these agreements.

SOFTWARE OR FIRMWARE SUBSCRIPTION SERVICES*3

Software or Firmware Subscription Services protect your investment. As a subscriber to either service, you will receive a new version of software or firmware when one is released, along with documentation updates.

TRAINING COURSES

Hands-on training for UTek, TekniCAD, and 2D/3D interactive graphics are taught in sites across the United States. They may be customized and taught on-site to meet your specific training needs. Please call our Training Department at (503) 685-3412.

HOTLINE AVAILABILITY: 1-800-872-7924

The Customer Support Center Hotline is available if you have a question about hardware, software or system integration; just call 1-800-872-7924. Our hotline is inclusive with some of our Maintenance Agreements. If your agreement does not include this service, it is available at $125 per hour with a minimum of one hour.

SPECIAL PROGRAMS FOR VARS, VADS AND DISTRIBUTORS

To complement the Tektronix products sold by our Value-Added Resellers, Value-Added Dealers, and Distributors we offer competitively priced maintenance agreements for their customers. These agreements can include pass-through warranties, attractive discounts, and other service and training options. For additional information, contact Visual Systems Group Service Marketing at (503) 685-2492.

ORDERING INFORMATION

Contact your local Field Office or Tektronix subsidiary.
Or call our toll-free numbers:
Test and Measurement: 1-800-547-5000
Visual Systems: 1-800-835-6100

Service Offerings for Visual Systems Products

	Offering	Product Series: 0A70	420X	XN	421X	422X	423X	43XX	XD88	45XX	46XX	Appl. S/W
E1	1 yr: hotline, subscription service, on-site hardware/system support					▨	▨	▨	▨			
E2	2 yrs: hotline, subscription service, on-site hardware/system support					▨	▨	▨	▨			
E3	3 yrs: hotline, subscription service, on-site hardware/system support					▨	▨	▨	▨			
E9	1 yr: hotline, and subscription service					▨	▨	▨	▨			
S0	Installation	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	
S1	1 yr: on-site hardware service support *	▨		▨	▨					▨	▨	
S2	2 yrs: on-site hardware service support *	▨	▨	▨	▨					▨	▨	
S3	3 yrs: on-site hardware service support *	▨	▨	▨	▨					▨	▨	
S7	1 yr: hotline support											^^^
S8	1 yr: firmware subscription service		▨		▨							
S9	1 yr: software subscription service											▨
U1	1 yr: return to depot hardware support *	▨										
U2	2 yrs: return to depot hardware support *	▨		▨								
U3	3 yrs: return to depot hardware support *	▨		▨								
SS	1 yr: subscription service		⋰⋱		⋰⋱							⋰⋱
MA	1 yr: maintenance agreement **	⋰⋱	⋰⋱	⋰⋱	⋰⋱	⋰⋱	⋰⋱	⋰⋱	⋰⋱	⋰⋱	⋰⋱	

Note: Service is included with certain leases and is available on most older and reconditioned products; please contact VSG Service Marketing for more information. * Hotline support included with 4211, XN5, XN11. ** Depending on product, agreement may include on-site hardware service or hardware/system support, access to the Customer Support Center Hotline, and subscription service.

▨ Available with product purchase. Includes warranty period. ⋰⋱ Available after product purchase ^^^ Available on selected products only

NOTE: While Tektronix Service is available worldwide, response times, services, use of U.S. toll-free telephone numbers, and turnaround times may differ from those provided through the U.S. field offices. Please contact your approved distributor or international field office for details.

*1 *Orderable with product purchase through Tek sales engineers.*

*2 *Orderable through Telemarketing (1-800-835-6100).*

*3 *Orderable with product purchase through Tek sales engineers and renewals orderable through Telemarketing (1-800-835-6100).*

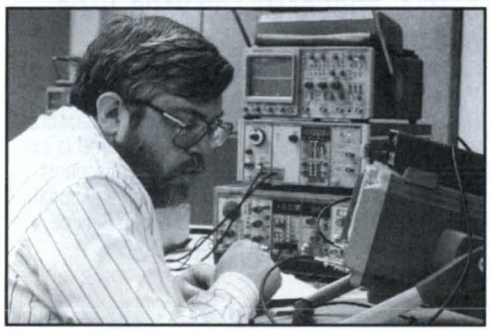
TRAINING FOR USERS AND SERVICE TECHNICIANS

Test and Measurement (T&M) Customer Training Offerings:

- ***T&M Product Service Training***
- ***T&M Measurement Technology Workshops***
- ***T&M Self-Study Material***
  - *Self-Study Packages*
  - *Video Tapes*
  - *Audio Tapes*
- ***T&M Training Documentation***
  - *Instructor/Training Guides*
  - *Service Manuals*

ORDERING INFORMATION

To register for the formal training classes or information on other training services:
Call:
1 (800) 835-9433 ext. WR1407
or write:
Tektronix, Inc.
Walker Road Industrial Park
Attention: T&M Training Registrar
P.O. Box 4600, M/S 94-925
Beaverton, OR 97076



T&M 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.

T&M MEASUREMENT TECHNIQUES WORKSHOPS

Tektronix instruments and programmable instrument systems represent the upper limits of productivity potential. Tektronix has designed workshops to help enhance your understanding of the capabilities of your equipment and to enable you to achieve maximum performance.

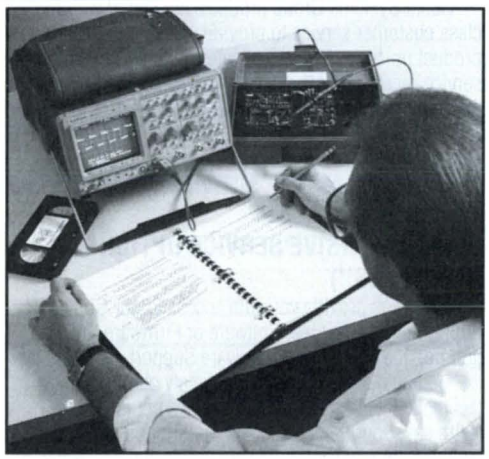
T&M Measurement Techniques Workshops naturally complement the Tektronix commitment to help you achieve optimum utilization of your equipment – a commitment that begins with engineering excellence and continues through training – helping you to develop new and more productive applications fast!

These fast paced courses combine classroom lectures with supervised hands-on laboratory sessions. Participants receive manuals and workbooks containing detailed course notes and lab exercises.

For your convenience, Tektronix also offers on-site Measurement Techniques Workshops conducted at your facilities.

T&M 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 T&M product user self-study training packages provide interactive, hands-on instruction for comprehension of product operation and applications. T&M product service packages cover troubleshooting and repair techniques at your own bench. Our tapes are quality products that introduce basic concepts to novice technicians and advanced multimedia packages for experienced service specialists. Build your own library of relevant training tapes and materials. Training packages are the next best thing to being in class.

T&M TRAINING DOCUMENTATION

Tektronix T&M 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 T&M 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 T&M Training.

CALL TEKTRONIX T&M TRAINING TODAY

Formal classroom training is available at the Tektronix training facilities in Beaverton, Oregon, as well as in Atlanta, GA; Boston, MA; Chicago, IL; Dallas, TX; Denver, CO; Irvine, CA; Santa Clara, CA, and Washington, D.C. On-site classes and workshops are also available upon request.

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; or c) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

THIS WARRANTY IS GIVEN BY TEKTRONIX WITH RESPECT TO THE LISTED PRODUCTS IN LIEU OF ANY OTHER WARRANTIES, 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 POSSIBLITY OF SUCH DAMAGES.

PRODUCT CATEGORIES	WARRANTY PERIOD	SERVICE LOCATION
Oscilloscopes (except 2200, 2300, 2400 Series): TM 500/TM 5000 Series; Communications Network Analyzers (except 834, 835, 836); Logic Analyzers; Spectrum Analyzers (except 3052); Television Products: Waveform Digitizers; Curve Tracers; Photometers/Radiometers; Cameras; Carts (except K217S, K318); Probes; CRTs; Isolators; Test System Interface Series; PEP Systems Controllers; Personal Test Systems; Display Stations XN5, XN11; Color Display Terminal	1 year from date of shipment	Service Center designated by Tektronix
Oscilloscopes: 2200 (except 2205), 2300, 2400 Series; Communications Network Analyzers: 834, 835, 836	3 years from date of shipment	Service Center designated by Tektronix
Monitors: 606B, 608, 609, 620, 634, 0A70, GMA201, GMA202, GMA 251, GMA213S, GMA263S	3 months, except 1 year from date of shipment for CRT	Service Center designated by Tektronix
4000 Series: Graphics Workstations, Color Graphics Terminals (except those listed below), Color Graphics Output Systems, Graphics Tablets; 4041 Controller; Microprocessor Development Products (except V-Systems, MV Systems); Digital Analysis Systems: 9200 Series; XD88 Series Graphics Super Workstations; 3052 Spectrum Analyzer	3 months, except 1 year from date of shipment for CRT	Customer's site if within normal on-site service area
Color Graphics Terminals: 4205, 4207, 4208, 4209; Color Graphics Netstation: 4211	1 year from date of shipment	Customer's site if within normal on-site service area
Custom Test Systems: Semiconductor Test Systems, Microprocessor Development Products: V-Systems, MV Systems	3 months, except 1 year for CRT, beginning on the date of installation by Tektronix, or one month from date of shipment, whichever is earlier	Customer's site if within normal on-site service area
Parts, Assemblies, Supplies and Test Fixtures: All 9-digit part numbered items except Probes, CRTs; Carts: K217S, K318	3 months from date of shipment	Service Center designated by Tektronix
Service	3 months from date of shipment or date of completion if performed on-site	Location where original service was performed

SOFTWARE WARRANTY SUMMARY

Tektronix warrants that 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 POSSIBILTY OF SUCH DAMAGES.

WORLDWIDE SALES AND SERVICE OFFICES

For customers in areas not listed, see below for your nearest office.

Customers in Eastern Europe, Near- and Middle East contact: Tektronix Ges.m.b.H., Austria

Customers in Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Congo, Djibouti, Equatorial Guinea, Gabon, Guinea, Malagasy, Mali, Mauritius, Niger, Senegal, Togo, Zaire contact: Tektronix S.A., France

Customers in Andorra, Angola, Azores, Gibraltar, Spanish West Africa contact: Tektronix Española, S.A., Spain

Customers in unlisted African, South American, or Asian locations contact:
Tektronix , Inc., U.S.A.
Export Sales
P.O. Box 500 D/S 73-323
Beaverton, OR 97077 USA
Phone: (800) 835-9433 x1916
Telex: 4742110 TEKEXP
Fax: (503) 627-6905

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(Service)
Entreprise Nationale Des Industries Electroniques
MCE 1
Unite de Maintenance et Calibration des Equipements Electroniques
MCE 1, BP 121
Route de Mascara Zone - Industrielle
Sidi Bel-Abbes
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Telex: 16021 MCE1 DZ
MCE 2
Lotissement El-Idrissi
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Telex: 66108 DELNA DZ

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Fax: 61 (7) 397-8679

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FAX: 61 (62) 51-4509

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Fax: 61 (9) 221-2397

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FAX: (604) 291-1624
Telex: 04354602 TEKTRONIX VCR

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Cable: SELECTRONICA

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Telex: (375) 2645 ELEPEX CR

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Telex: 605 2395

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Phone: 593 (2) 52-6759/-9684
Telex: (393) 22865 PROTEC ED,
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Giza Systems Engineering Co.
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DOKKI, A.R.E.
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Rennes Region Center
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35510 Cesson Sévigné
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Telex: (842) 740829 TEKREN

Strasbourg Region Center
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67380 Lingolsheim
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Telex: (842) 890470

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Peri-Sud 2, Z.I. du Palays
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Telex: (383) 1772962 TEKME

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Place Khaibar
Angle Bd de la Gironde et
Rue d'Ifni
Casablanca 03
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Telex: 25992

Universel Computer
7, rue Franche Compté - Gauthier
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Auckland Office
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Glenfield
P.O. Box 34521
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Phone: 64 (9) 444-0760
FAX: 64 (9) 444-0755

Christchurch Office
87 Wrights Rd.
P.O. Box 8388
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Phone: 64 (3) 382-773
FAX: 64 (3) 388-212

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Obodex Nigeria Ltd.
21A Airport Road
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FAX: 47 (2) 644704
Telex: (856) 77690 TEK N

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Muscat
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FAX: 968 (*) 603-606 Ext 121
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