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February, 1991

We live in a world of change. In the last few years we've seen enemies become allies, once impenetrable boundaries crumble and the cold war come to an end.

As a member of the high technology community, we're accustomed to change. Technologies change. Markets change. Products change. Even so, at Tektronix, a key part of our foundation remains the same. Our Values, including our Commitment to our customers, have never changed. We continue providing you solutions to help you do your job better, easier and more cost effectively.

On the cover of this 1991 Tektronix Product Catalog is the Tek logo. It's based on the cathode ray tube, a technology we modified, enhanced and continue using in our products even today. It is the graphic symbol, developed 45 years ago, which continues to represent Tektronix' Commitment to Excellence.

Over the years, our markets have broadened and our products have become far more complex. But our commitment to you, our customers, remains the same. We continue providing you unexcelled products and services limited only by the state of the art.

Even in this world of change, some things remain the same. At Tektronix, our foundation – our values – have not changed. We maintain our Commitment To Excellence.

Sincerely,

A handwritten signature in black ink, reading "Stephen D. Kerman". The signature is fluid and cursive, with a long, sweeping underline that extends to the right.

Stephen D. Kerman, V.P.  
World Wide Marketing, Sales & Service

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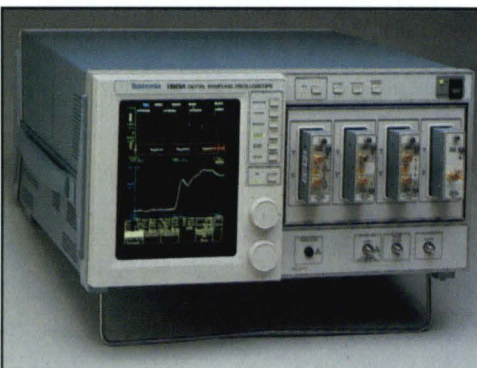
DSA 601A, DSA 602A Digitizing Signal Analyzers—see page 40.



SD-14 High Impedance Probe Sampler—see page 48.



SD-32, SD-30, Sampling Heads—see page 48.



11801A Digital Sampling Oscilloscope—see page 46.

**DSA 601A/  
DSA 602A**

**DIGITIZING SIGNAL  
ANALYZERS**

- 2 GSample/s Sampling Rate
- 8-bit Vertical Resolution
- 1 GHz System Bandwidth
- Live FFT
- Histograms
- Built-in Disk Drive

**11801A**

**DIGITAL SAMPLING  
OSCILLOSCOPE**

- 10 femtosecond Equivalent-Time Sampling Interval
- Modular Architecture—up to 136 Channels
- “Real-Time” Feel for Waveform Control
- Statistical Measurements
- TDR Capability

**SD-14**

**SAMPLING HEAD**

- 100 K $\Omega$ , 0.25 pF Typical
- 7 V p-p Dynamic Range
- 2.5 GHz Bandwidth
- ECL, CMOS and GaAs Device Characterization

**SD-30**

**SAMPLING HEAD**

- 40 GHz Bandwidth
- Single Channel

**SD-32**

**SAMPLING HEAD**

- 50 GHz Bandwidth
- Single Channel
- High Bandwidth Communications and Microwave Applications

**7623B/R7623B**

**CRT STORAGE OSCILLOSCOPE**

- Able to Capture and Store Transients and Low Repetition Rate Signals
- 1000 cm/ $\mu$ s Stored Writing Speed
- Multimode Storage

# NEW PRODUCTS OSCILLOSCOPES

## CSA 404

### COMMUNICATION SIGNAL ANALYZER

- Optical-to-Electrical (O/E) Capability
- Direct Jitter and Noise Measurements
- Automatic Measurements on Eye-Diagrams

## 11403A

### DIGITIZING OSCILLOSCOPE

- Color Display
- 1 GHz Bandwidth
- Built-in Pass/Fail Testing
- 10-bit Vertical Resolution, 14-bits with Averaging
- Built-in FFT Display and Measurements



CSA 404 Communications Signal Analyzer—see page 44.



11403A Digitizing Oscilloscope—see page 54.

## 11A16

### CURRENT AMPLIFIER

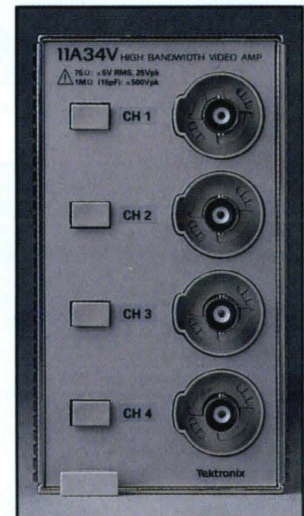
- Two Channels
- 50 MHz Bandwidth at Probe Tip
- Full Use of all 11000 Series Measurements
- Fully Compatible with all 11000 Series and DSA Mainframes



11A16 Current Amplifier—see page 63.



11T5H Video Trigger—see page 63.



11A34V Video Amplifier—see page 61.

## 11T5H

### MULTI-STANDARD VIDEO TRIGGER

- Trigger on Individual Lines—Up to 1280 Lines/Frame
- Compatible with All Major TV Standards—including HDTV
- Fully Programmable via GPIB
- Operates with 11A34V High Bandwidth Video Amp

## 11A34V

### HIGH BANDWIDTH VIDEO AMPLIFIER

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



SIU 800 Static Isolation Unit—see page 50.

## SIU 800

### STATIC ISOLATION UNIT

- Use for TDR Circuit Board Test & Cable Test
- 40 ps Reflected RiseTime/ < 80mp Reflection Coefficient
- Manual or Program Control



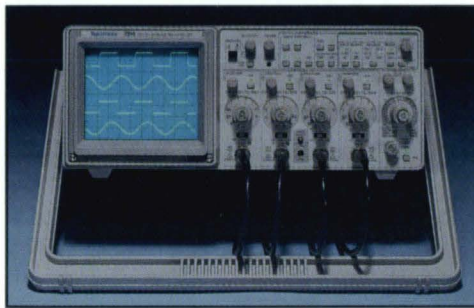
2439 Digitizing Oscilloscope—see page 87.



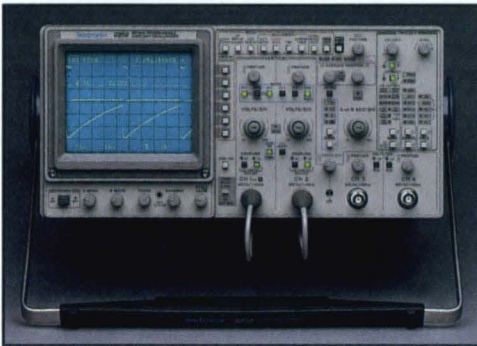
2402A TekMate Instrument Controller—see page 92.



2221A Digital Plus Analog Oscilloscope—see page 96.



2214 Digital Plus Analog Oscilloscope—see page 100.



2252 Dual Time Base Oscilloscope—see page 126.



222PS Handheld Oscilloscope—see page 112.

## 2439

### DIGITIZING OSCILLOSCOPE

- 500 MS/s Digitizing
- 300 MHz Bandwidth (200 MHz Single-shot)
- 8-Bit Vertical Resolution
- 0.0015% Crystal-Controlled Time Base

## 2402A

### TEKMATE™ INSTRUMENT CONTROLLER

- Full Performance IBM®—Compatible GPIB Controller
- Environmentally Rugged, Compact in Size
- Instrument Extension for 2400 Series DSO's
- Powerful DSO Utility Software

## 2221A

### DIGITAL PLUS ANALOG OSCILLOSCOPE

- 100 MHz Analog and Digital Storage Bandwidth
- 100 MS/s Per Channel Sampling Rate
- 10 ns Glitch Capture, Any Sweep Speed

## 2214

### DIGITAL PLUS ANALOG OSCILLOSCOPE

- 20 MHz Analog Bandwidth
- 16 MS/s Per Channel Concurrent Sampling
- 16K Per Channel Records
- Hardcopy Out Interface

## 2252

### DUAL TIME BASE OSCILLOSCOPE

- 100 MHz, Four Channels
- Voltmeter with Smart Cursors
- Fully-Automated GPIB (Standard)

## 222PS

### BATTERY OPERATED, HANDHELD OSCILLOSCOPE

- Floatable to  $\pm 850$  V/Channel
- Unique Motor Trigger
- Fully Programmable via RS-232 Optional
- 10 MHz Bandwidth
- 10 MS/s Dual Digitizers
- Auto Setup/Save Setup/Recall

# NEW PRODUCTS

## DIGITIZERS/MICROWAVE AND RF

### ANALYTEK SERIES 2000

#### 2004A

##### AMPLIFIER-ATTENUATOR MODULE

- Four Channels of Amplification or Attenuation
- Each Channel Independently Programmable between 100X Attenuation and 10X Gain

#### 2000AZ1

##### INTERACTIVE MEASUREMENT SYSTEMS SOFTWARE

- Enables Analytek Series 2000 to Operate from an IBM PC/AT or Compatible
- Connecting Link is GPIB IEEE-488.2
- Maximum Simultaneous Display Capacity of 48 Waveforms

#### 92A96

##### 100 MHZ ACQUISITION MODULE

- 96-384 Channels @ 100 MHz Sync or Async
- 24-96 Channels @ 400 MHz Async
- 16 State Triggering at All Speeds
- Time-Correlated to Other State/Timing Modules
- Bus-Form Timing Display
- Compact, High Bandwidth Probes

#### 2712

##### LOW COST SPECTRUM ANALYZER

- $5 \times 10^{-7}$  Frequency Accuracy
- Sensitivity to  $-139$  dBm ( $-92$  dBmV) with Built-in Preamp
- Internal Frequency Counter
- Full Programmability
- Real Time Clock
- 124K of NV RAM

#### 2721/2722

##### NON-INTERFERING CATV/ BROADBAND SWEEP

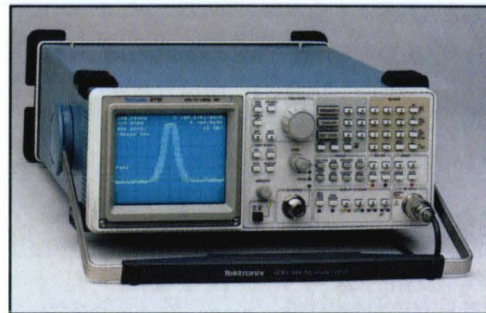
- Full Alpha Keyboard
- LCD Display Visible Even in Bright Sunlight
- Lightweight, compact receiver
- Frequency-agile Telemetry
- 50-waveform NVRAM Storage
- RS-232-C Downloads Stored Waveform to PC or Serial Printer



Analytek Series 2000 Waveform Capture Systems—see page 126.



92A96 100 MHz Acquisition Module—see page 144.



2712 Spectrum Analyzer—see page 178.



2721 Non-interfering Sweep Transmitter, 2722 Non-interfering Sweep Receiver—see page 182.

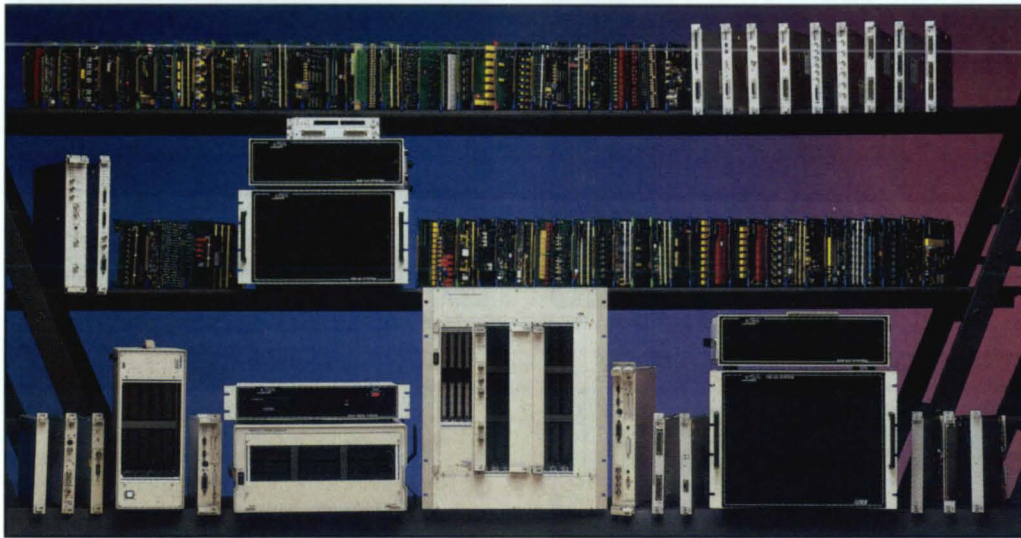
# NEW PRODUCTS

## DIGITAL SIGNAL PROCESSING/VXI & CDS CARD INSTRUMENTATION/MODULAR INSTRUMENTATION

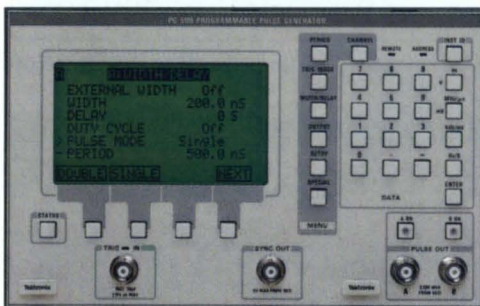
NEW



RF162 Down Converter—see page 186.



VXIbus/CDSbus Card Modular Instruments—see page 190.



PG 5110 Programmable Pulse Generator—see page 207.



TM 503B Power Module—see page 243.



SG 5030 Programmable Leveled Sinewave Generator—see page 238.

### RF162

#### DOWN CONVERTER

- Extends 3052 Analysis Capabilities up to 325 GHz
- Accepts 21.4 or 321.4 MHz Wide-Band IF Signals from RF Spectrum Analyzers and Receivers
- Down Converts IF Signals for Rigorous 3D Modulation Analysis on the 3052

### 73 Series

#### VXIbus

- State of the Art Standard for Modular Instrumentation
- Flexible
- Defines Device Type Hierarchy
- Automatic Configuration Protocol

### 53 Series

#### CDSbus

- Flexible Test Environment that Reduces System Integration Complexity
- Improve Test System Reliability
- Reduce Test Equipment Cost
- Reduce Software Development Costs

### PG 5110

#### PROGRAMMABLE PULSE GENERATOR

- Two Independent 50 MHz Output Channels
- Repetition Rates from 0.1 Hz to 50 MHz (Periods from 20 ns to 10 ns)
- Variable Transitions from 6 ns to 10 ms

### SG 5030

#### PROGRAMMABLE LEVELED SINEWAVE GENERATOR

- 0.1 Hz to 550 MHz
- 4.5 mV to 5.5 V Amplitude Range
- Amplitude Flatness from  $\pm 1.5\%$  to  $\pm 4\%$  of 50 kHz Reference Frequency

### TM 503B

#### POWER MODULE

- Three Compartment Mainframe
- Interface Connections on Rear Panel Via Option 02

# NEW PRODUCTS

## BASIC BENCH INSTR./SEMICONDUCTOR TESTING/ SOFTWARE

### DM250

#### DIGITAL MULTIMETER

- 3 1/2 Digit LCD with Analog Bar Graph
- Auto Power Off After 30 minutes from Last Function or Mode Change
- Autoranging, Data Hold, Memory Offset

### DM253

#### COMPONENT CHECKER

- 3 1/2 Digit LCD
- Overrange Indication
- Low Battery Indication

### CMC250

#### MULTIFUNCTION COUNTER

- 5 Hz to 100 MHz (CH 1)
- 80 MHz to 1.3 GHz (CH 2)
- Multifunctions:  
Frequency, Period Average, Period, Totalize, Self Check
- 8 Digit LED Display
- Overrange Indication

### CDC250

#### UNIVERSAL COUNTER

- 5 Hz to 175 MHz
- 8 Digit LED Display:  
Autodecimal Measurement Unit
- Frequency Ratio
- Time Interval
- Totalize

### 370A/371A

#### CURVE TRACERS

- Automatic Test Sequences
- GPIB Programmable Storage
- 3 1/2" MS-DOS Compatible Disk Storage
- Non-volatile Storage via GPIB Interface
- Waveform Comparison

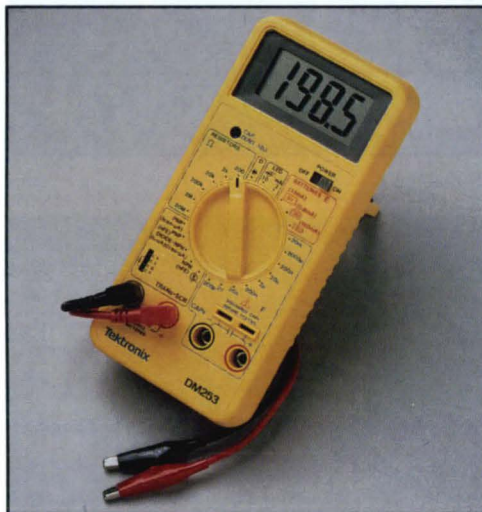
### T&M Software

#### WAVESAVER FOR DIGITAL STORAGE OSCILLOSCOPES

- Data Communications, Data Management, and Waveform Graphics in One Package
- Easy-to-Use Windows and Pop-up Menus
- Easy Creation of Reference Libraries



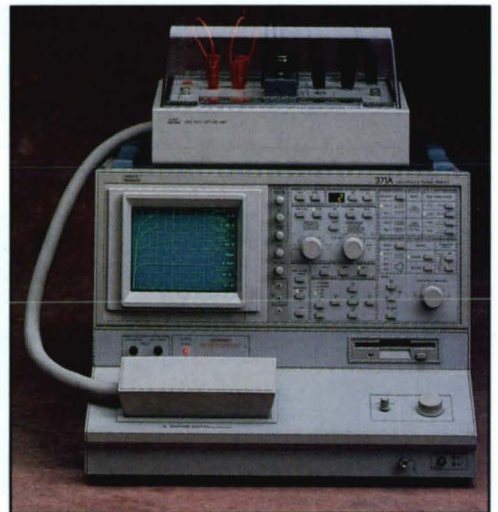
DM250 Digital Multimeter—see page 245.



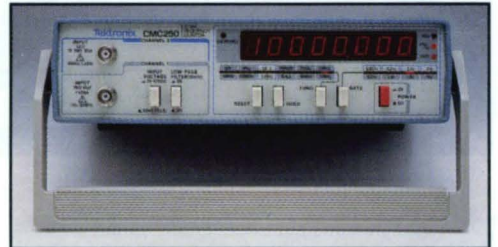
DM253 Component Checker—see page 245.



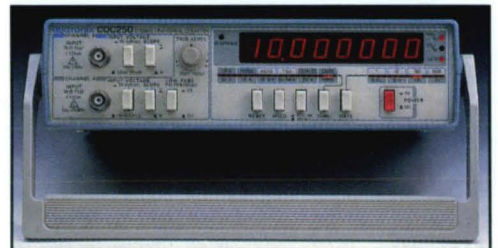
Wavesaver Software for Digital Storage Oscilloscope—see page 270.



370A, 371A (shown) Curve Tracers—see page 249.



CMC250 Multifunction Counter—see page 248.



CDC250 Universal Counter—see page 248.

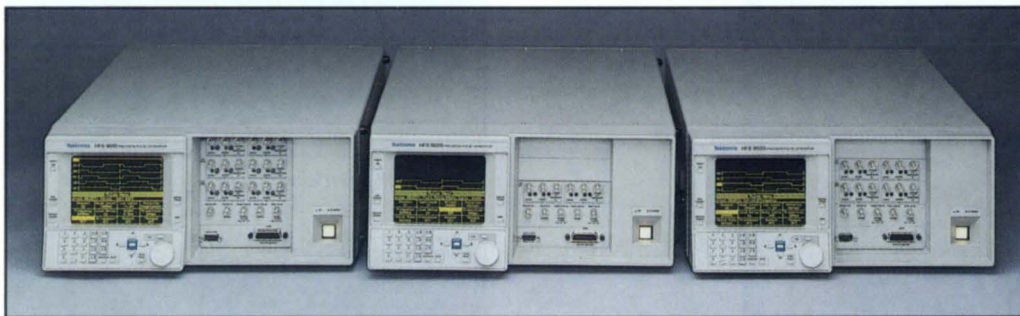




2505 TestLab Multi-Channel Analyzer—see page 277.



2641 (shown), 2642 Personal Fourier Analyzers—see page 280.



HFS 9010, HFS 9020, HFS 9030 Pulse Generators—see page 282.



PG2010, PG2011, PG2012 Pulse Generators—see page 284.

## 2505

### TestLab™ MULTI-CHANNEL ANALYZER

- Simultaneous Multi-Channel Acquisition: 2 to 96 Channels and Optional Signal Conditioning
- Long Record Lengths, High Resolution: Up to 256K Samples per Channel, 10 and 12 Bit Capabilities
- Portable—Under 34 pounds

## 2641/2642

### PERSONAL FOURIER ANALYZERS

- Real Time Spectrum, Network (Frequency Response), and Waveform Analysis
- Complete Modal Systems for Structural Analysis
- Easy-to-Learn Pull-down Menus
- Up to Four Input Channels

## HFS 9010/ HFS 9020/HFS 9030

### PULSE GENERATORS

- Up to 600 MHz Repetition Rate
- Fully Digital Implementation for Maximum Control and Flexibility
- Multi-channel Architecture—2 to 6 Channels per Mainframe
- Independent Edge Placement and Channel Deskew
- Precision Channel-to-Channel Time Alignment

## PG2010/PG2011/ PG2012

### PULSE GENERATORS

- New User Interface with Output Waveforms and Parameters on the Display
- Selectable 250 ps, 800 ps or 1.8 ns with 2.5 V Output into 50  $\Omega$
- Variable 5.5 ns to 10 ms Transition Time with 10 V Output into 50  $\Omega$

# NEW PRODUCTS OPTOELECTRIC/CAMERA/CART/ACCESSORIES

## P6701A/P6703A

### OPTICAL-TO-ELECTRICAL CONVERTERS

- Improved dc Performance
- 450 to 1050 nm, dc to 700 MHz (P6701A) 1100 to 1700 nm, dc to 1 GHz (P6703A)

## P6711/P6713

### OPTICAL TO ELECTRICAL CONVERTERS

- High Gain/High Sensitivity
- 450 to 1050 nm, dc to 250 MHz (P6711) 1100 to 1700 nm, dc to 300 MHz (P6713)

## P6721

### OPTICAL TO ELECTRICAL CONVERTER

- 450 to 1050 nm, dc to 300 MHz
- Large Area Detector

## OIG 501

### OPTICAL IMPULSE GENERATOR

- 850 nm, 35 ps laser impulse
- Low Energy, 35 ps, 15 mW
- High Energy, 300 ps, 30 mW

## C-9

### LOW COST CAMERA

- Uses Polaroid 3 1/4" in. x 4 1/4 in. Pack Films
- Graticule Flash
- Autoback Available
- Auto Power-on

## K220

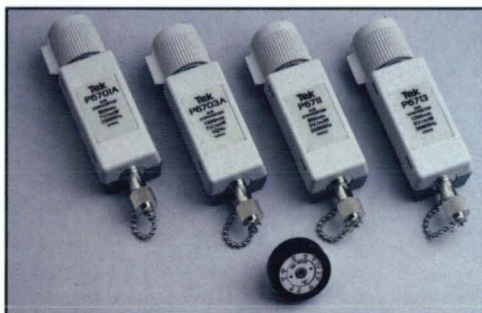
### RACK INSTRUMENT CART

- Sturdy, Mobile Instrument Platform
- 3 Rack-width Trays
- 4 Outlet Surge Protector
- Locking Wheels
- 4 Securing Straps

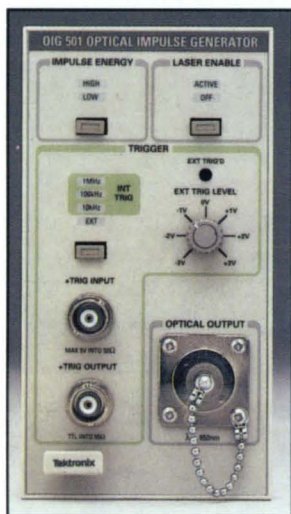
## TVC 501

### TIME INTERVAL TO VOLTAGE CONVERTER

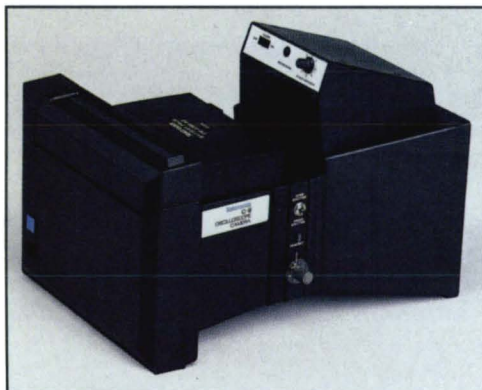
- Real-time Scope Display of Time-interval Variations vs. Time
- > 2 Million Uninterrupted Event-by-Event Measurements/Second
- Time delay, pulse width, and period measurements
- Works with Analog or Digital Oscilloscopes



P6701A, P6703A, P6711, P6713, P6721  
Optical to Electrical Converters—see page 287.



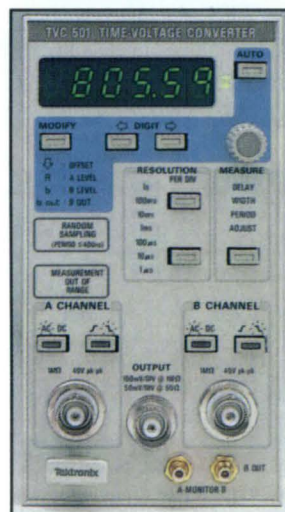
OIG 501 Optical Impulse Generator—see page 290.



C-9 Low Cost Camera—see page 302.



K220 Rack Instrument Cart—see page 307.



TVC 501 Time Interval to Voltage Converter—see page 338.



TFP2 FiberMaster OTDR—see page 345.



ASG100 Audio Signal Generator—see page 348.



1725 PAL/NTSC Vector Monitor—see page 349.



TSG 1001 Programmable TV Generator—see page 350.



SPG 1000 HDTV Sync Generator—see page 350.



TSG 130 (shown), TSG 131 Multiformat Generators—see page 350.

## TFP2

### FIBERMASTER™ OTDR

- 2 Plug-in Module Capacity
- Available in Color or Monochrome Display
- Also Available: High Resolution Internal Printer, Mass Data Storage Options

## ASG100

### AUDIO SIGNAL GENERATOR

- Short Duration Audio Test Sequence for Rapid Automatic Checkout of Audio Lines
- Connects In-line for Easy Test Signal Insertion

## 1725

### DUAL STANDARD VECTORSCOPE

- Performance and Economy
- Simultaneous Channel A & B Display
- Stereo Audio Phase Measurement
- R-Y Output for Differential Phase Measurement

## TSG 1001

### PROGRAMMABLE TV GENERATOR

- Programmable Test Signal Generator
- Programmable Zone Plate Generator
- SDP 1000 Signal Development Package
- Internal or External Clock Operation

## SPG 1000

### HDTV SYNC GENERATOR

- Master Sync Generator for High Definition
- Genlocks to HDTV, NTSC, and PAL
- Supports Proposed HDTV Production Standards

## TSG 130/TSG 131

### MULTIFORMAT GENERATORS

- NTSC or PAL; Y, B-Y, R-Y; Y, C and Y/C; CTDM Outputs
- Betacam® or MII Levels
- Stereo Audio Outputs

# NEW PRODUCTS TELECOMMUNICATIONS AND TELEVISION TEST EQUIPMENT

## TSG 120/TSG 121

### SIGNAL GENERATORS

- NTSC or PAL; Y, C and Y/C Outputs
- Stereo Audio Outputs

## TSG 273

### PAL SIGNAL GENERATOR

- Analog and Parallel Digital Test Signal Outputs
- Serial and Parallel Digital Audio Outputs

## VS211

### PAL VIDEO SYNCHRONIZER

- 10 Bit Digitizing
- 8 Field Memory
- Processing Amplifier Functions

## CSA 907

### BIT ERROR RATE TESTER

- 1 to 700 MHz PLL Internal Clock Source
- PRBS Patterns  $2^{N-1}$ , Where  $N=7, 15, 17, 20,$  or  $23$
- Up to 32K Bit Programmable WORD
- SONET/FDDI/CUSTOM Pattern Generation
- Auto Search Synchronization

## 2467BHD

### HDTV OSCILLOSCOPE

- Automatic Pushbutton Setup on Video Signals
- Standard Presets for Quick Recall
- Bi-level and Tri-level Sync Separation
- Brightly Display Single Lines and Pixel Detail on Video Signals



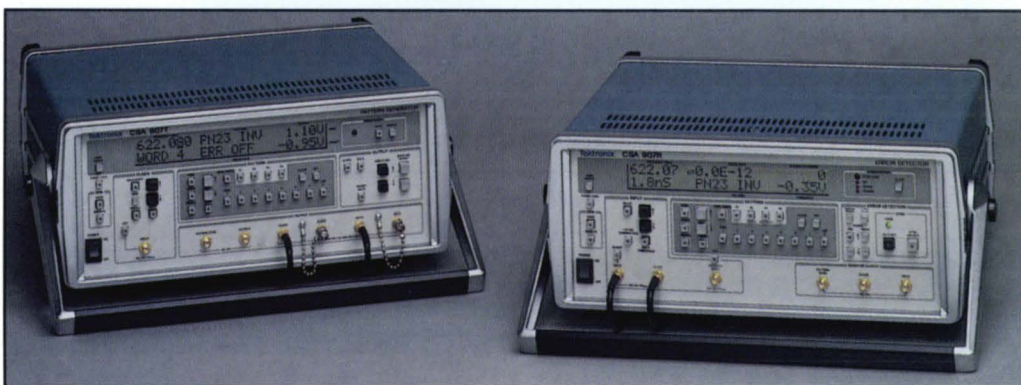
TSG 120 (shown), TSG 121 Signal Generators—see page 350.



TSG 273 PAL Signal Generator—see page 351.



VS211 PAL Video Synchronizer—see page 352.



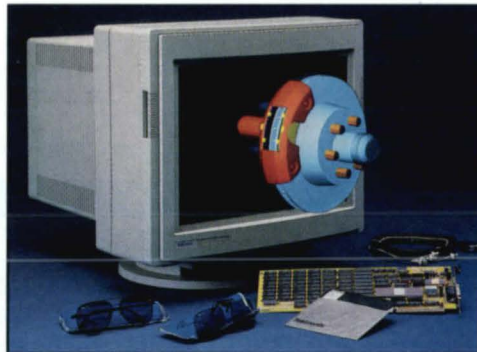
CSA 907 Bit Error Rate Tester—see page 356.



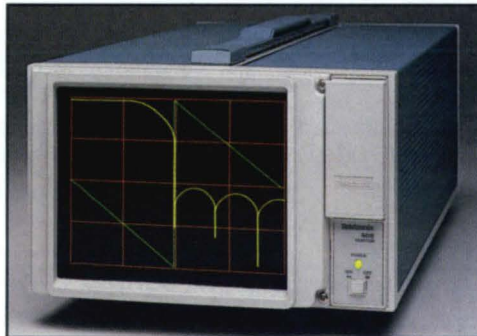
2467BHD HDTV Oscilloscope—see page 358.



TekXpress Terminals (XP27 shown)—see page 362.



SGS 630, SGS 635 Stereoscope 3D Systems—see page 365.



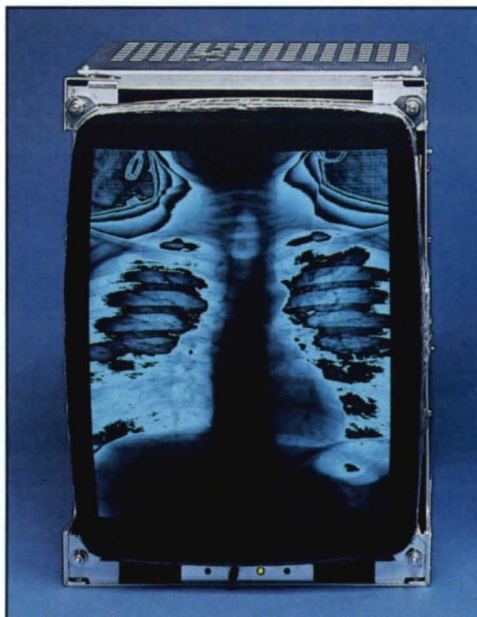
608 With Color Display Monitor—see page 367.



Phaser II PX Color Printer—see page 364.



RP88 Coprocessor Package — see page 368.



GMA 212 (shown), GMA 213T Ultra High Resolution Displays—see page 366.

## TEKXPRESS FAMILY

### X TERMINALS

- High-Performance Interactive Terminals for the X Window System™
- Easy-to-use Interface for Quick Setup and Simple Color Matching

## PHASER II

### COLOR PRINTERS

- 300 dpi Thermal Wax
- PostScript-Compatible and HP-GL
- For Macintoshes, PCs and Workstations
- Network Shareable

## GMA 212/GMA 213T

### ULTRA HIGH RESOLUTION DISPLAYS

- 50 fL (GMA 212)
- 165 fL (GMA 213T)
- Up to 256 Gray Scale Levels

## SGS 425

### MULTIMODE MONITOR

- Easy Adaptability to Many Workstations and Imaging Card Sets Supporting 1280 x 1024 Resolution

## SGS 630/635

### STEREOSCOPE 3D SYSTEMS

- SGA Card
- Supports All Common 2D Primitives, Such As Move, Line, Circle, etc.

## 608

### WITH COLOR DISPLAY MONITOR

- High Brightness
- High Resolution
- Excellent Gray Scale
- High Ambient Viewing
- Photographic Quality Images
- Bi-Primary Color-Enhanced Images (608 w/ Color Option)

## RP88B16/RP88B33

### COPROCESSORS PACKAGE

- Increased Processing Power for Mac II (up to 50 times)
- Up to 28 MIPS and 9 MFLOPS (with RP88B33)

# OSCILLOSCOPE REFERENCE

## Contents

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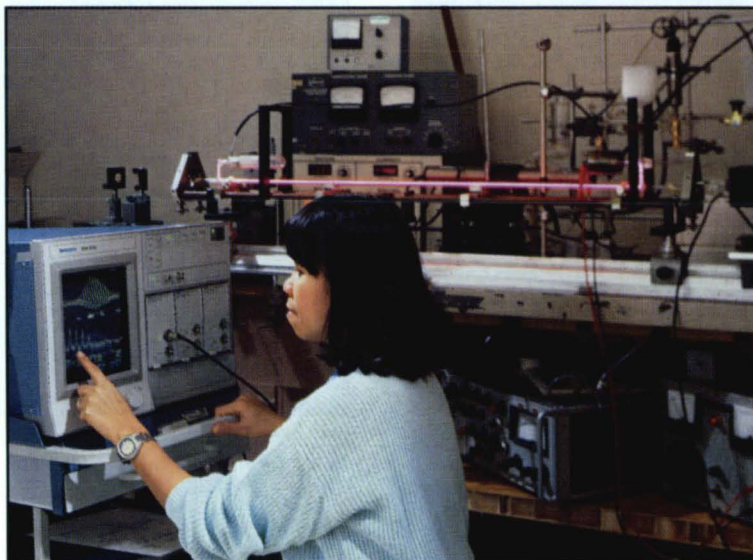
## INTRODUCTION

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 600A 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 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 Instruments	Transforms analog acquisitions into digital data for waveform processing, storage, and analysis in the DCS01, SCD1000, SCD3000 and SCD5000 with single-shot bandwidths up to 4.5 GHz.
• Advanced, On-Board Waveform Processing	Reduces the need for external computations, and gives you real time results in the 11000 Series, CSA Series and DSA 600A 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.
• Communications Signal Analyzers	Provides high bandwidth and on-board signal processing including eye pattern analysis, mask testing and statistical measurements on random data.
• 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*4 Begin at
DSA 601A	Real-Time DSO	Modular	1 GHz	1 GS/s	50 ps/div	67/30.4	40	\$24,745
DSA 602A	Real-Time DSO	Modular	1 GHz	2 GS/s	50 ps/div	71/32.2	40	\$32,635
11801A	Digital Sampling	Modular	50 GHz	200 kS/s	1 ps/div	49/22.3	45	\$27,500
CSA 803	Digital Sampling	Modular	50 GHz	200 kS/s	1 ps/div	49/22.3	44	\$25,150
CSA 404	Random ET DSO	Modular	1 GHz	20 MS/s	500 ps/div	41.6/19	44	\$22,000
11403A	Random ET DSO	Modular	1 GHz	20 MS/s	500 ps/div	41.6/19	54	\$18,950
11402A	Random ET DSO	Modular	1 GHz	20 MS/s	500 ps/div	41.6/19	54	\$15,700
7934	CRT Storage	Modular	500 MHz	N/A	500 ps/div	37.8/17.2	67	\$16,100
7904A	Analog	Modular	500 MHz	N/A	500 ps/div	37.8/17.2	*3	\$15,100
7623B	CRT Storage	Modular	100 MHz	N/A	5 ns/div	30/13.6	68	\$12,350
7603	Analog Sampling	Modular	100 MHz	N/A	5 ns/div	30/13.6	68	\$5,625
7104	BrightEye™	Modular	1 GHz	250 GS/s w/DC 501	200 ps/div	45/20.4	66	\$31,550
5441	CRT Storage	Modular	50 MHz	N/A	10 ns/div	23/10.4	72	\$7,995
5440	Analog	Modular	50 MHz	N/A	10 ns/div	23/10.4	72	\$5,275
5113	CRT Storage	Modular	2MHz	N/A	100 ns/div	23/10.4	74	\$5,995
5111A	CRT Storage	Modular	2 MHz	N/A	100 ns/div	23/10.4	74	\$4,195
5110	Analog	Modular	2 MHz	N/A	100 ns/div	23/10.4	74	\$2,895
2467B	BrightEye™	Portable	400 MHz	100 GS/s w/DC 501	500 ps/div	20.5/9.3	82	\$12,950
2465B *2	Analog	Portable	400 MHz	N/A	500 ps/div	20.5/9.3	84	\$6,460
2445B	Analog	Portable	150 MHz	N/A	1 ns/div	20.5/9.3	84	\$4,395
2440	Real-Time DSO	Portable	300 MHz	500 MS/s	2 ns/div	23.9/10.9	87	\$12,390
2439	Real-Time DSO	Portable	300 MHz	500 MS/s	2 ns/div	23.9/10.9	87	\$9,995
2432A	Real-Time DSO	Portable	300 MHz	250 MS/s	2 ns/div	23.9/10.9	87	\$10,900
2431L	Real-Time DSO	Portable	300 MHz	250 MS/s	2 ns/div	23.9/10.9	87	\$7,990
2430A *2	Real-Time DSO	Portable	150 MHz	100 MS/s	5 ns/div	23.9/10.9	87	\$6,950
2252	Analog	Portable	100 MHz	N/A	2 ns/div	17.3/7.9	102	\$3,495
2247A	Analog	Portable	100 MHz	N/A	2 ns/div	17.3/7.9	102	\$2,995
2245A	Analog	Portable	100 MHz	N/A	2 ns/div	17.3/7.9	102	\$2,295
2236A	Analog	Portable	100 MHz	N/A	5 ns/div	16.2/7.3	105	\$3,595
2235A	Analog	Portable	100 MHz	N/A	5 ns/div	13.5/6.1	105	\$1,995
2232	Analog/ET DSO	Portable	100 MHz	100 MS/s	5 ns/div	18/8.2	96	\$4,995
2225	Analog	Portable	50 MHz	N/A	5 ns/div	15.2/6.9	106	\$1,195
2221A	Analog/ET DSO	Portable	100 MHz	100 MS/s	5 ns/div	18/8.2	96	\$3,995
2214	Analog/RT DSO	Portable	20 MHz	16 MS/s	10 ns/div	17.4/7.9	100	\$3,995
2211	Analog/RT DSO	Portable	50 MHz	20 MS/s	5 ns/div	16.8/7.6	98	\$2,795
2205	Analog	Portable	20 MHz	N/A	10 ns/div	14.8/6.7	107	\$695
2201	Analog/RT DSO	Portable	20 MHz	10 MS/s	10 ns/div	16.8/7.6	98	\$1,695
336A	Analog/ET DSO	Handheld	50 MHz	20 MS/s	10 ns/div	11.1/5	110	\$6,000
314	CRT Storage	Handheld	10 MHz	N/A	100 ns/div	10.5/4.7	111	\$5,700
305	Analog (w/DMM)	Handheld	5 MHz	N/A	500 ms/div	13.1/6	111	\$3,610
222/222PS	ET DSO	Handheld	10 MHz	10 MS/s	5 ns/div	4.4/2	112	\$2,595
221	Analog	Handheld	5 MHz	N/A	500 ms/div	3.8/1.9	114	\$2,950
214	CRT Storage	Handheld	500 kHz	N/A	500 ms/div	3.8/1.9	114	\$3,225
212	Analog	Handheld	500 kHz	N/A	200 ms/div	3.8/1.9	114	\$2,450

## MAKING AN EDUCATED CHOICE – A GUIDE TO OSCILLOSCOPE SELECTION

Here you will find a complete listing, in decreasing numerical order, of all Tektronix oscilloscopes – from the DSA 600A and CSA 803 benchtops to the 200 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

\*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 109.

\*3 Contact your local sales representative.

\*4 The prices listed for modular instruments do not include the cost of plug-ins or sampling heads.

## 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

---

*What is your signal's repetition rate?*

---

*What are your signal's frequency and rise time characteristics?*

---

*What is the smallest increment of voltage you need to discern from your signal?*

---

*What is the largest voltage swing of your signal?*

---

*How far is your signal from ground?*

---

*What are your signal's timing requirements?*

### Selection Considerations

**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 600A Series.

**Frequency and Rise Time** – *What is the highest frequency component of interest to you? Or, what is the fastest rise time you want to capture? Characterize your signal in either of these terms using the following approximation:*

$$\text{Bandwidth} \approx 0.35/\text{Rise Time}$$

**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.*

**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.*

**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.

**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

**How accurate do your measurements need to be?**

**How many signals do you need to acquire simultaneously?**

**What are your storage requirements?**

**What are your transportability requirements?**

**What are your packaging and environmental constraints?**

## Selection Considerations

**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.

**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, 2465B; benchtop, twelve channel, the 11801A with expansion option to 136 channels; or the Digitizing Camera MUX16 option with 256 channels.*

**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.

**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.

**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 overall 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.

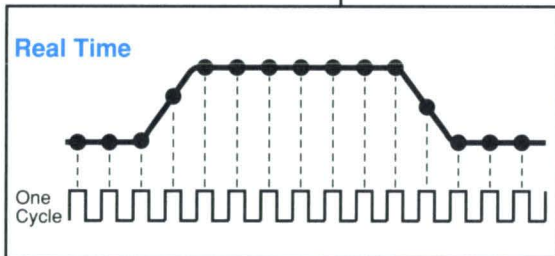


Figure 1. Real-time sampling captures a complete waveform with a single trigger event.

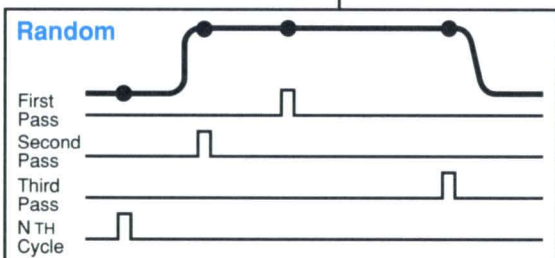


Figure 2. Random-equivalent time sampling digitally reconstructs a waveform using several trigger events.

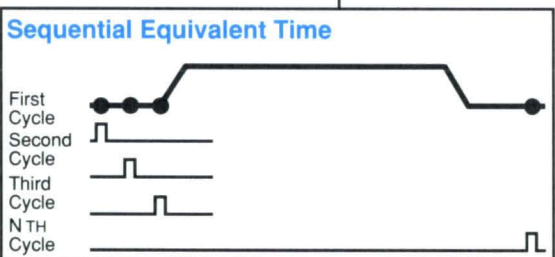


Figure 3. Sequential sampling digitally reconstructs a waveform at a rate of one point per trigger event.

#### 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 602A Digitizing Signal Analyzer – ideal for single-shot applications. Some real-time instruments, like the DSA 600A 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 2221A portable scope has a maximum sample rate of 100 MS/s, but a repetitive signal bandwidth of 100 MHz. 11403A has a sample rate of 20 MS/s, but a repetitive signal bandwidth of 1 GHz.

##### 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 50 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 4.5 GHz SCD5000 Transient Digitizer. The fastest sampling rate is achieved with a 7104/R7103 and the DC 501 at 250 GS/s.

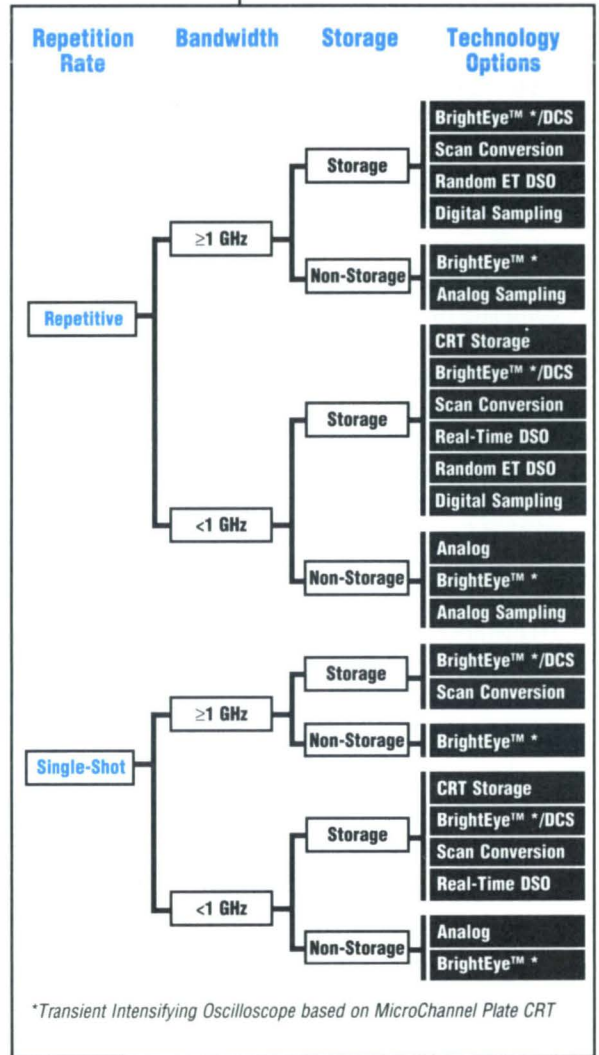
Whether you choose analog or digital technologies, each have benefits and tradeoffs. Analog scopes display the actual signal, letting you see the waveform's shape directly – as it occurs.

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
<b>Analog</b>	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.
<b>CRT Storage</b>	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.
<b>BrightEye™</b>	Tektronix's proprietary microchannel plate (MCP), transient-intensifying analog scopes – such as the portable 2467B 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 (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.
<b>BrightEye™/DCS</b>	The CCD-based DCS01 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.

### 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

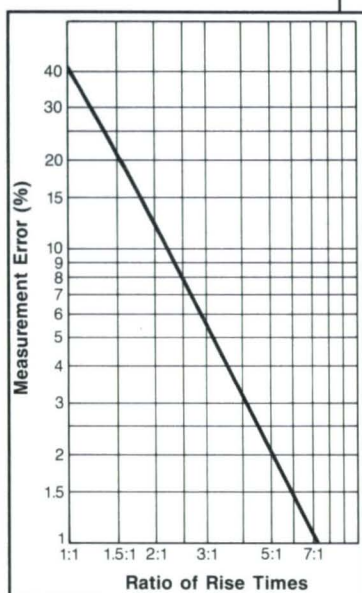


Figure 4. Relates the % Error incurred given the ratio of the signal's rise time to the instrument's rise time.

Key Specifications & Features	Selection Considerations
<b>Bandwidth &amp; Rise Time</b>	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.
<b>Sampling Rate</b>	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.
<b>Horizontal Resolution &amp; Record Length</b>	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 600A Series Digitizing Signal Analyzers, for example, provides user-selectable record lengths from 512 to 32,000 points.
<b>Horizontal Magnification</b>	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.
<b>Update Rate</b>	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 600A Series, however, update the display so fast that they have the look and feel of real-time analog systems.
<b>Visual Writing Rate</b>	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.
<b>Dual Time Base</b>	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.

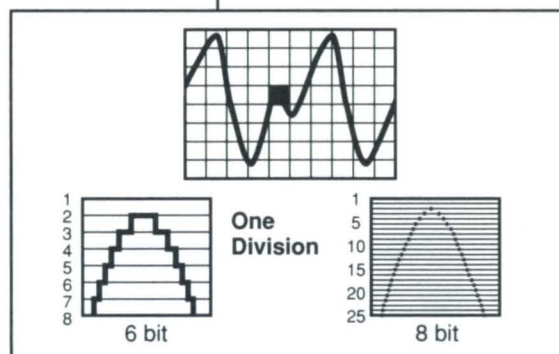


Figure 5. The level of detail available using a scope with 6-bit resolution is shown in the close-up on the left. By comparison, a scope with 8-bit resolution lets you see more waveform details (right).

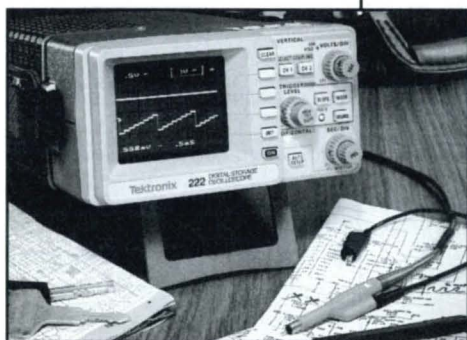
# OSCILLOSCOPE REFERENCE

## 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 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, waveform pass/fail and standard waveform math. The DSA 600A Series Digitizing Signal Analyzers also includes de jitter, 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

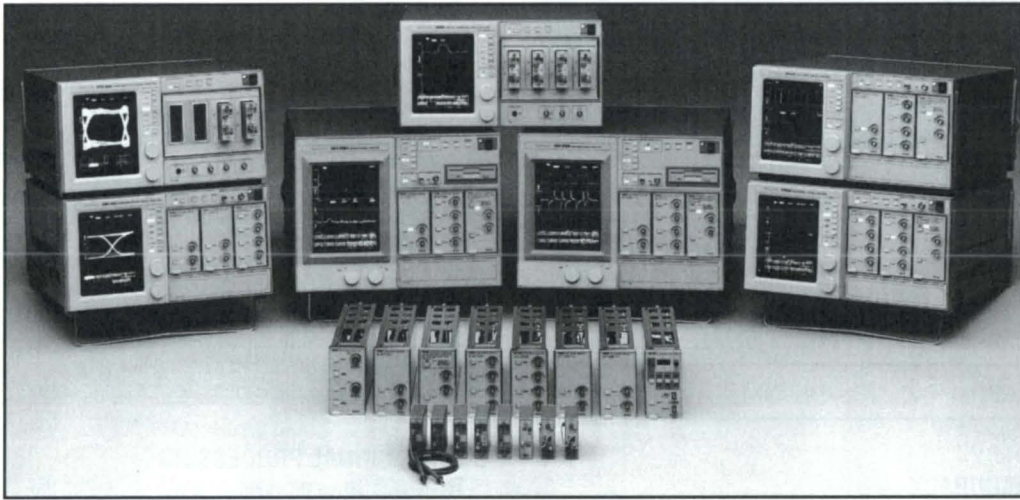
- High Impedance
- Low-Loading FET
- High Voltage
- Current
- Differential
- Others Available

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.

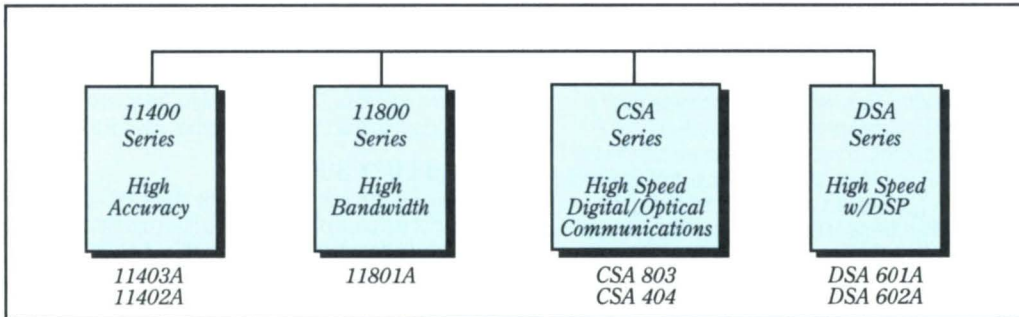


### 11000 SERIES

The Tektronix 11000 Series is a powerful set of analysis tools that alters your fundamental expectations of an oscilloscope. Most revolutionary is the simplification and automation of the entire measurement and analysis process. Accuracy, sensitivity, bandwidth, offset, and overdrive recovery are provided by a well-planned instrument family having plug-in versatility and performance. Multi-processor architecture allows for simultaneous display of up to eight waveforms and up to six dynamic, "live" measurement readouts. The automation needs of scientific and production environments are easily met by integrating these instruments into a measurement system through RS-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 and CSA 404 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
	≤ 1 GHz	✓	Real Time	DSA 600A
		✓	Random Equivalent Time	11400, CSA 404
Single-Shot	≤ 1 GHz	✓	Real Time	DSA 600A

### ACCURACY

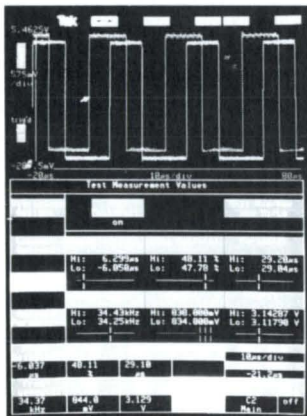
Measurement accuracy sets the 11000 Series apart from all other oscilloscopes. The analog front end is the most advanced in any oscilloscope – digital or analog. The plug-in amplifiers are built to maintain signal integrity over a wide dynamic range. The 11000 Series delivers accuracy across widely varying 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. Seven plug-in amplifiers, ten sampling heads, and a variety of probes are currently available to tailor a signal conditioning solution to your measurement needs.

Whether it is multi-channel (up to 136), 50  $\Omega$ /1 M $\Omega$  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 32 K points in the DSA 600A) can be specified separately for main waveforms and window waveforms, as the application dictates. Two windows allow you to view and measure two separate events at fast sweep speed, improving the accuracy of measurements of those events.



Automatic Measurements using the 11403A Digitizing Oscilloscope.

The 11000 Series architecture uses three 16-bit microprocessors and additional processors as needed.

The DSA 600A Series uses the Tektronix TriStar Digital Signal Processor (DSP). These processors provide unsurpassed signal acquisition and analysis. This not only yields very fast waveform update rates, but also provides the power to define and display, at "live" speeds new waveforms based on complex mathematical relationships to other waveforms. Nowhere else will you find this power and flexibility.

The CSA 803 and CSA 404 offer histograms and mask testing to specifically perform the measurements on signals that are typical in communication applications. Histograms are powerful measurement tools for measuring jitter and noise. Mask testing is a very beneficial tool in ATE applications for measuring noise margin and jitter tolerance.

### DIGITAL SIGNAL PROCESSING

The 11000 Series provides capability far beyond the basic four math functions of +, -, x, and ÷. It also provides more complex waveform processing such as differentiation, integration, square root, logarithms, and more. In all, more than 10 different signal processing options are available. The DSA 600A Series with its TriStar Digital Signal Processor provides 14 different options; including averaging at 180 waveforms per second, signal de jitter, "live" FFT, and single-shot smoothing.

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

### AUTOMATION

Each 11000 Series Oscilloscope provides both RS-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, Tek HC200 printer, Epson printer, Centronics printer, HP Inkjet/Laserjet printers or HPGL plotters.



**11000 SERIES SELECTION GUIDE**

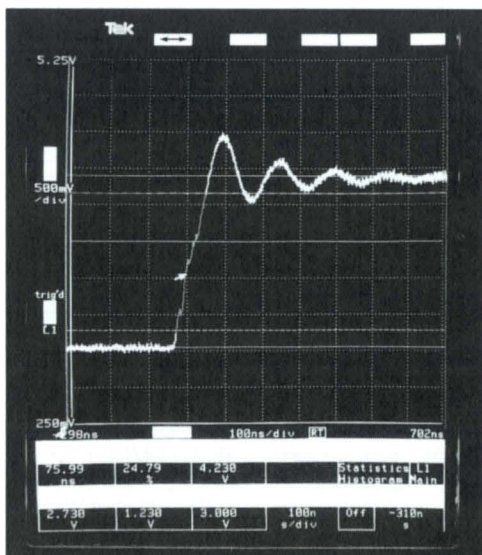
Instrument	Bandwidth	Maximum # of Channels	Sample Rate	Maximum Record Length	Vertical Resolution	Technology
DSA 601A	1 GHz	12	1 GS/s	20 K	8 bits	Real Time
DSA 602A	1 GHz	12	2 GS/s	32 K	8 Bits	Real Time
CSA 803	50 GHz	4	200 KS/s	5 K	8 bits	Sequential Equivalent Time
11801A	50 GHz	136	200 KS/s	5 K	8 bits	Sequential Equivalent Time
11400/CSA 404	1 GHz	12	20 MS/s	10 K	10 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 31 predefined 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  $\Delta V$  and  $\Delta t$ . In addition to horizontal and vertical bar cursors, the 11000 Series offers dot and split dot cursors which track one or two waveforms.



Powerful measurement functions of the 11000 Series.

**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 three 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.

**LEADING EDGE PERFORMANCE**

When your application demands state-of-the-art performance, the 11000 Series gives you the answers you need.

**A Technology for Every Application**

**DSA 600A Series**

- Providing real-time digitizing at 2 GS/s, the Digitizing Signal Analyzers are the most powerful members of the 11000 Series. These instruments contain a dedicated digital signal processor that processes waveforms at unprecedented speeds.
- The DSA offers live FFT, signal de jitter, fast averaging at more than 180 waveforms per second, and more. For the highest level of performance in single-shot acquisition and signal processing, the DSA Series provides the measurement solution.

**CSA 404 and CSA 803**

- The CSA 404 and CSA 803 Communications Signal Analyzers are designed for viewing communication signals up to 50 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 50 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 11801A. The 11800 Series provides the highest timing resolution and measurement repeatability of any of the 11000 Series.

**11400 Series**

- 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.

**D**igitizing 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
- Histograms
- Built-in Disk Drive

### DSA 601A/DSA 602A 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 32 K points, the DSA 601A and DSA 602A 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 processing by an external computer.

Equipped with three plug-in compartments and true dual time bases, the DSA 600A 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 600A Series include basic and extended triggering functions. In the DSA 600A Series, basic triggering simply initiates main and window record acquisition. Extended triggering functions include time, event, level, and Boolean qualified triggering.

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; spectral analysis, including total harmonic distortion; twelve 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 600A 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-domain 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 16 K points. The information in the frequency domain can be expanded to provide a closer look at magnitude and phase plots.

Information can be modified in the frequency domain and the resultant changes displayed in the time domain using the inverse FFT function.

Cross correlation and auto correlation provide the capability for finding periodic noise on either a single waveform or between two waveforms.

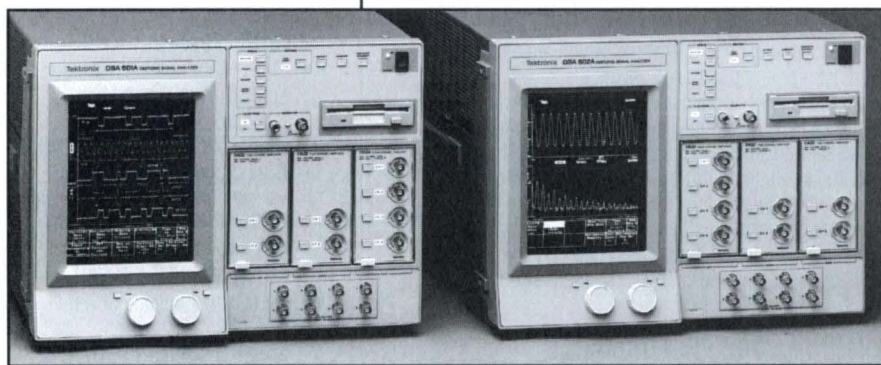
#### ACT ON DELTA (PASS/FAIL TESTING)

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 generated internally or externally 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.



**GPIB\***  
IEEE-488

#### BUILT-IN DISK DRIVE

The DSA 600A Series has as standard a floppy disk drive for storing waveforms and settings.

MS-DOS formatted disks provide easy transfer to a host computer. With the removable disk, each user has their own personal disk for storing waveform data and settings.

#### ADVANCED WAVEFORM PROCESSING

The dedicated TriStar DSP provides waveform capture, processing, and analysis features that place the DSA 600A 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

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

## 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 600A 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 601A 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 602A 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 600A 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.

## DATA STORAGE

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 600A Series comes standard with more than 210,000 points of volatile RAM memory which is shared between acquired and stored waveforms. Also standard is sufficient non-volatile memory for approximately five settings.

The built-in floppy disk provides an additional 1.44 megabytes of storage for waveform data and settings.

Option 4C, Non-Volatile RAM, provides more than 450,000 points of storage – especially useful when using

the repetitive single-shot acquisition. NVRAM also stores waveform data and settings 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, TRIG A is associated with the main record and is referred to as the main trigger, while TRIG B 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 determined to be either a high or low logic level. You can 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 ns.

## 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 average repetition rate is up to 155 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 600A 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.

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

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

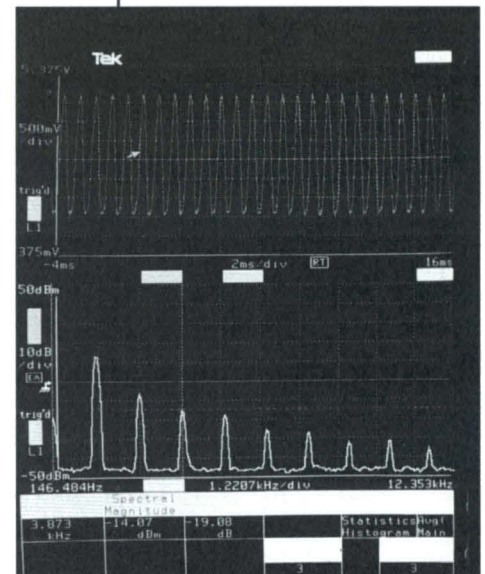


Figure 1. The TriStar Digital Signal Processor allows simultaneous display of "live" frequency-domain data concurrent with the real-time, time-domain signal.

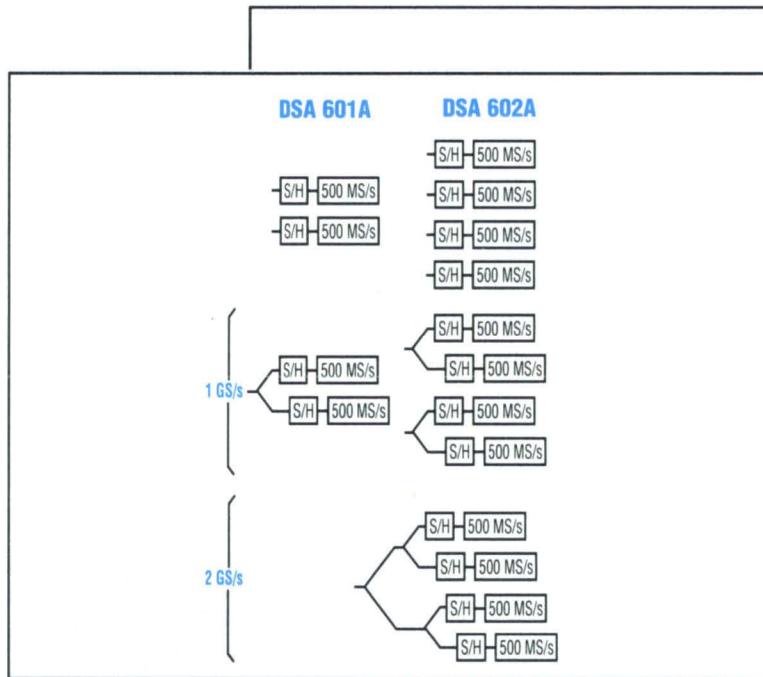


Figure 2. Digitizer interleaving allows for 1 GS/s maximum sample rate in the DSA 601A and 2 GS/s in the DSA 602A.

### 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 can also be used to search for particular characteristic waveforms.

### COLOR DISPLAY

The DSA 600A Series color display lets you easily distinguish superimposed waveforms and, 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.

### Single-Shot Acquisitions –

Sample Rate	DSA 601A		DSA 602A		
	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 10 K pts	512 to 20 K pts	512 to 10 K pts	512 to 20 K pts	512 to 32 K pts

Color-keyed waveform names can be attached to the traces to further enhance waveform clarity and documentation.

## CHARACTERISTICS

### VERTICAL SYSTEM

**Accuracy With Enhanced Accuracy** –  $\leq 1\%$  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 59.

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

### HORIZONTAL SYSTEM

#### Time Bases

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

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

**Time Base Accuracy** –  $+0.005\%$ ,  $-0.015\%$ : 0 to  $45^\circ\text{C}$ .

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

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

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

**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.

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

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

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

### TRIGGERING SYSTEM

**Range** – ± Full Screen.

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

**Coupling and Sensitivity** – Dc Coupled: 0.4 div from dc to 10 MHz, increasing to 1 div at maximum trigger bandwidth. Dc Noise Reject Coupled: 1.2 divs from dc to 10 MHz, increasing to 3 divs at maximum trigger bandwidth. Dc HF Reject Coupled: 0.5 divs from dc to 30 kHz. Ac Coupled: 0.4 div from 60 Hz to 10 MHz, increasing to 1 div at maximum trigger bandwidth. Ac Noise Reject Coupled: 1.2 divs from 60 Hz to 10 MHz, increasing to 3 divs at max trigger bandwidth. Ac HF Reject Coupled: 0.5 div from 60 Hz to 30 kHz. Ac LF Reject Coupled: 0.5 div from 80 kHz to 10 MHz, increasing to 1 div at max trigger bandwidth.

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

### WAVEFORM PROCESSING

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

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

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

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

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

### MEASUREMENT SYSTEM

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

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

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

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

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

### INPUT/OUTPUT SYSTEM

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

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

### DISK DRIVE

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

### CRT AND DISPLAY FEATURES

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

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

### POWER REQUIREMENTS

**Line Voltage Ranges** – 90 to 132 Vrms; 180 to 250 Vrms.

**Line Frequency** – 48 to 72 Hz.

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

### ENVIRONMENTAL AND SAFETY

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

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

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

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

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

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

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

### QUICKSTART TRAINING PACKAGE

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

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

## ORDERING INFORMATION

**DSA 601A** **\$24,745**

Digitizing Signal Analyzer  
Includes:  
Tutorial Manual (070-7249-01),  
User Reference (070-7250-01),  
Programmer Ref. (070-7251-01),  
Command Ref. (070-7252-02),  
Service Reference (070-7254-01),  
Sub-miniature Probe Tip-to-BNC  
Adapter (013-0226-00), Power  
Cord, U.S., 120 V (161-0066-00).

**DSA 602A** **\$32,635**

Digitizing Signal Analyzer  
Includes: Same as DSA 601A.

#### INSTRUMENT OPTIONS

**Opt. 1C** – Cable Feedthrough Connectors. **+\$200**  
**Opt. 1R** – Rackmount **+\$300**  
**Opt. 4C** – Non-Volatile RAM. Adds over 450,000 points of nonvolatile storage **+\$1,500**  
**Opt. 1P** – HC100 Four-Color Plotter **+\$990**  
**Opt. 2P** – 4697 Color Quick Ink-jet Printer **+\$2,495**  
**Opt. 3P** – 4693DX Color Image Printer **+\$8,995**

See page 64 for additional option information.

#### INTERNATIONAL POWER PLUG OPTIONS

**Opt. A1-A5** – Available **NC**  
See page 374.

#### WARRANTY-PLUS SERVICE PLAN OPTIONS

See page 378.  
**DSA 601A:**  
**Opt. Q0** – On-site Product Installation and Setup **+\$560**  
**Opt. Q1** – 1-Year On-Site Service **+\$745**  
**Opt. Q2** – 2-Year On-Site Service **+\$2,745**  
**Opt. Q3** – 3-Year On-Site Service **+\$4,195**  
**Opt. M7** – 2 Annual Calibrations **+\$1,085**  
**Opt. M9** – Additional 2-Year Warranty and Repair **+\$800**  
**DSA 602A:**  
**Opt. Q0** – On-site Product Installation and Setup **+\$695**  
**Opt. Q1** – 1-Year On-Site Service **+\$975**  
**Opt. Q2** – 2-Year On-Site Service **+\$3,595**  
**Opt. Q3** – 3-Year On-Site Service **+\$5,525**  
**Opt. M7** – 2 Annual Calibrations **+\$1,350**  
**Opt. M9** – Additional 2-Year Warranty and Repair **+\$1,000**

#### ACCESSORIES

**Blank Panel** – See page 64.  
**Cables** – See page 64.  
**Hard Copy Units** – See page 64.  
**Recommended Cart** – K217S **\$725**  
**Recommended Probes** – See page 64.  
**Recommended Software** – See page 64.

#### PHYSICAL CHARACTERISTICS

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

**NEW CSA 404/CSA 803**

- Designed for Communications Applications
- "Real-Time" Feel
- Optical-to-Electrical (O/E) Capability
- Direct Jitter and Noise Measurements
- Automatic Measurements on Eye-Diagrams
- On-board Histograms
- Infinite, Variable Persistence, & Color Graded Display Modes
- Comprehensive Waveform Processing
- Fully Programmable
- Mask Testing
- Constellation Diagrams
- Hardcopy
- Color Display

**ORDERING INFORMATION**

**CSA 404** Communications Signal Analyzer **\$22,000**  
Includes:  
Tutorial manual (070-8185-00),  
User Reference (070-8186-00),  
Programmer Reference (070-8187-00),  
Quick Reference (070-8188-00),  
Service Reference (070-8189-00),  
Power Cord, U.S., 120 V (161-0066-00).  
CSA 803 Communications Signal Analyzer

See page 47 for CSA 803 ordering information.

**PHYSICAL CHARACTERISTICS**

	Cabinet		Rackmount	
	mm	in.	mm	in.
Dimensions				
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	19.0	41.6	22.0	48.0
Shipping	28.0	62.0	31.4	68.0

\*The CSA 404/803 comply with IEEE Standard 488.1-1987, RS-232C and Tektronix Standard Codes and Formats.

**COMMUNICATIONS SIGNAL ANALYZERS**

With state-of-the-art technology, histograms, persistence, mask testing, and constellation diagrams, the CSA 803 and CSA 404 are specifically designed to meet the needs of the communications industry. (For Lightwave and optical communication applications, the CSAs have O/E converters that allows you to directly analyze at the optical signal.) For triggering on high speed signals, the CSAs offer built-in as well as external trigger units that allow you to trigger up to 20 GHz.

**HISTOGRAMS**

Time and Voltage histograms are a powerful statistical tool for measuring noise and jitter in communication signals. The CSA 404 and CSA 803 offer 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.

**STATISTICAL MEASUREMENTS**

The CSAs have a built-in statistical database to accumulate waveform data. The database is a 256 x 512 x 16 bit data array and it accumulates data indefinitely. The data is available over the GPIB and can be viewed in the color-graded display mode. Using the database, the CSAs can make direct and automatic jitter and noise measurements and also make automatic pulse parametric measurements on random data such as eye-diagrams.

**CSA 803**

The CSA 803 is based on sequential sampling architecture giving it extremely high timing resolution (0.01 ps) and bandwidth (up to 50 GHz) capabilities. Refer to pages 45-52 for more information about the CSA 803.

**CSA 404**

The CSA 404 is based on random Equivalent Time sampling architecture and is a versatile instrument with 1 GHz bandwidth and extensive triggering capabilities. Refer to pages 57-58 for more information about the CSA 404.

**RELATED PRODUCTS**

For the communication industry, Tektronix also has the CSA 907 Bit Error Rate Tester, PCM testers, etc. Refer to pages 348-358 for more products for the communication industry.

**CSA 404 AND CSA 803 FEATURE COMPARISON**

Feature	CSA 404	CSA 803
Acquisition B/W	1 GHz <sup>1</sup>	12.5/20/40/50 GHz
Trigger B/W	1 GHz <sup>1</sup>	2.5/10/20 GHz
Optical B/W	1 GHz <sup>2</sup>	20 GHz <sup>3</sup>
Optical Wavelength	450-1700 nm*	1200-1600 nm
Timing Resolution	10 ps	0.01 ps
Timing Accuracy	0.002%+100 ps	0.01%+10 ps
Maximum Channels(@ B/W)	6 <sup>1</sup>	4 @20, 2@ 50, 1@ 50
Input Dynamic Range	10 V	1 V
Offset Range	±25 V	±2 V
Vertical Accuracy	1%	1%
Vertical Noise (typical)	2.2 mVrms	450 μVrms <sup>4</sup>
Trigger Jitter (typical)	10 ps rms	1.8 ps +20 ppm delay rms
Pre-Trigger	Yes	No
TDR	No	Yes

<sup>1</sup>With three 11A72 plug-ins.

<sup>2</sup>With P6700-series optical probes.

<sup>3</sup>Within SD-46 Sampling Head.

<sup>4</sup>SD-22@100 mV/div.

**PERSISTENCE**

In addition to the normal persistence mode, the CSAs have 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 modes 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 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.

## CSA 803 AND 11801A

The CSA 803 communications signal analyzer and the 11801A digital sampling oscilloscope offer 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, they add single-ended and differential TDR and TDT, timing resolution to 0.01 ps, and up to 50 GHz bandwidth (depending on the sampling head used). This unmatched performance and feature set makes them ideal for semiconductor device testing; TDR characterization of circuit boards, IC packages, and cables; and high-speed digital, data-communication measurements.

- The CSA 803 accepts up to two, dual-channel SD Series sampling heads and has built in trigger capability of up to 10 GHz through the prescaler.
- The 11801A 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.

## RESOLUTION AND REPEATABILITY

The state-of-the-art digital time base in the CSA 803/11801A 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  $\mu$ V LSB at 2 mV/div). Powerful on-board waveform processing allows expansion with averaging to sensitivities in the 100  $\mu$ V/div range and beyond.

## FASTEST ACQUISITION

The CSA 803/11801A, with its multiprocessor-based architecture and high-speed analog, error-sample feedback-loop technology, has the highest sample rate of any sampling oscilloscope. The 200 kHz sampling rate gives the CSA 803/11801A a "real-time" feel for waveform controls and allows high-speed data capture for histograms and automated measurements.

## MODULARITY MAKES ROOM FOR GROWTH

In the Tektronix tradition, the CSA 803/11801A 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  $\mu$ V (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 nine heads, with more to come.

## AUTOMATED MEASUREMENTS MAKE IT EASY

The CSA 803/11801A offer 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.

For the first time in the industry, you now can make automatic jitter and noise measurements using the statistical measurement mode. Statistical measurements allow automatic pulse parameter measurements on random signals such as eye-diagrams and allow you to make stable and accurate measurements even in the presence of jitter and noise.

All measurement parameters are user-controllable and measurement levels may be set in relative (i.e., percentage) or absolute terms. Measurements are also fully annotated so there is no question about which part of the waveform is used for making the measurements.

Measurements include: 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.

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 CSA 803/11801A not only provides smooth "real-time" update rate and control response, it also allows complex waveform calculations to be performed and displayed in the same continuously updated fashion.

Calculated waveforms can be as simple as addition of two channels, or more complex, from basic operators (+, -, x, /), to specialized math functions such as square root, differentiate, log, envelope, and filter. Calculations can include acquired waveforms, stored waveforms, and constants.

All measurement functions, except hardware measurements, are allowed on calculated traces. In addition, the instrument can be set to stop acquisition after certain conditions, such as when a specified number of averages have been completed.

## WINDOWING SHOWS THE DETAILS

The CSA 803/11801A offers another first for sampling oscilloscopes – windows. Similar to the delayed sweep on conventional oscilloscopes, windows allow viewing a long interval on one trace while examining the details of a section of the waveform on a second trace.

Up to seven windows can be created on a single main trace, each with independent positions. The instrument can even be programmed to automatically locate a window on a specified transition within the main waveform. Like the other oscilloscopes in the 11000 Series, windows in the CSA 803/11801A 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.

**H**igh resolution instruments capable of viewing very fast digital signals.

- *High Resolution and Repeatability*
- *8.8 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)*

**NEW 11801A/CSA 803**

- 8.8 ps Rise Time
- 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 and Statistical Measurements
- Comprehensive Waveform Processing
- Fully Programmable
- Easy to Use
- Hardcopy
- Eight Channels, Expandable to 136 (with an 11801A and SM-11 Multi-Channel Units)

**TIME DOMAIN REFLECTOMETRY (TDR)**

With the SD-24 Dual-Channel TDR/Sampling Head, the CSA 803/11801A 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 rise time (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. 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 CSA 803/11801A allows 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 CSA 803/11801A 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  $\Omega$  terminator for removal of unwanted aberrations due to cabling and fixturing.

Autoset provides a convenient, fast method for displaying a signal on the CSA 803/11801A. Just select a channel and press autoset. Usually autoset is complete in less than two seconds.

**ATE APPLICATIONS**

The CSA 803/11801A 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 through the front panel. Documentation is simple using the flexible hardcopy features of the CSA 803/11801A. Full screen printouts, including time/date stamp can be printed on a variety of devices including dot matrix, laser printers, pen plotters and ink jet.

**SOFTWARE SUPPORT**

All the 11000 Series software products are compatible with the CSA 803/11801A, including the Template Waveform Processing Program and Utility software. See page 64 for more information on software for the 11000 Series.

**CSA 803 COMMUNICATIONS SIGNAL ANALYZER**

The CSA 803 is aimed at high-speed digital communication applications. It has extensive measurement features specifically optimized for digital data communications applications – such as automated eye-diagram analysis, histograms, and masks. 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.

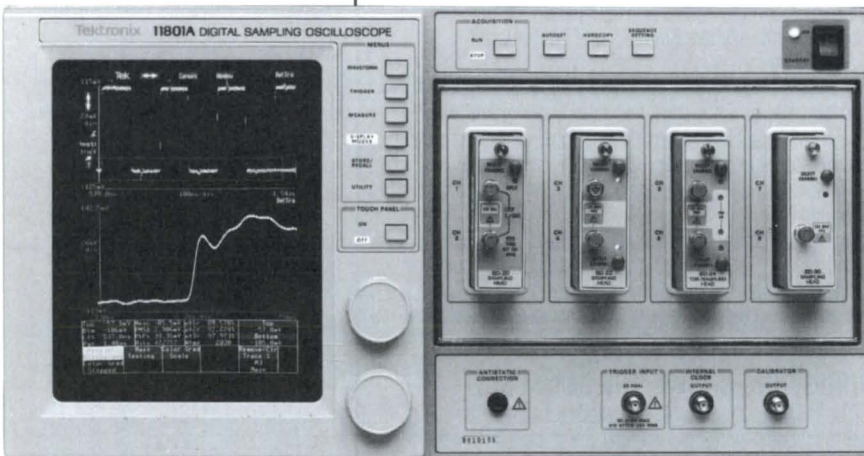
**TRIGGER BANDWIDTH**

The CSA 803 provides a built-in, full function, dc coupled, 2.5 GHz trigger with slope and level control that provides 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 stable triggering on high-speed signals. By using an external delay line, the trigger point can also be viewed.

**11801A DIGITAL SAMPLING OSCILLOSCOPE**

The 11801A supports to eight acquisition channels in the mainframe and provides 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 CSA 803/11801A.

**HARNESSING THE POWER**

Virtually all operations of the CSA 803/11801A is through the touch-sensitive front-panel. A simple three-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 always available. The two multi-function knobs allow controlling two related parameters, such as volts/division and offset, for less button pushing.

**GPIB\***  
IEEE-488

\*The CSA 803/11801A Series complies with IEEE Standard 488.1-1987, RS-232-C and Tektronix Standard Codes and Formats.



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, multi-channel 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 11801A with the SD-24 TDR/Sampling head, moves TDR from the position of an occasional tool to an integral part of your measurement strategy.

## CHARACTERISTICS

Characteristics apply to both the CSA 803 and 11801A unless noted.

### VERTICAL SYSTEM

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

**Vertical Resolution** – 8 bits full screen (80  $\mu$ V LSB at 2 mV/div deflection factor).

**Amplifier Gain Accuracy** –  $\pm 1\%$  of all settings.

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

**Offset Range** –  $\pm 2$  V.

<sup>1</sup> See Sampling Head Characteristics on page 48. The CSA 803/11801A mainframes have no acquisition bandwidth limits.

### HORIZONTAL SYSTEM

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

**Time Base Accuracy**<sup>2</sup>

Time interval	Accuracy
$\geq 10$ ns	0.01% x time interval + 10 ps
1 ns	10 ps
100 ps	5 ps
10 ps	2 ps

<sup>2</sup> Interpolate linearly between cardinal points.

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

**Windows** – Any number of window records may be placed on any number of main records, up to a maximum of 8 displayed traces. All window records have the same duration, but may be independently positioned on any main record. The window may be set to automatically track a moving edge on the main record.

**Maximum Sample Rate** – 200 kHz.

### TRIGGER SYSTEM

**Trigger Bandwidth** – CSA 803: 2.5 GHz (direct), 2 to 10 GHz (Prescaled); 11801A: 2 GHz.

**Trigger Sensitivity**<sup>3</sup> – CSA 803: Direct: Dc Coupled, 30 mV p-p, dc – 200 MHz; 200 MHz – 2.5 GHz increasing linearly to 250 mV; Prescaled: Ac Coupled, 600 mV p-p, 11801A: Dc Coupled, 40 mV p-p dc – 200 MHz; 200 MHz – 2.0 GHz increasing linearly to 200 mV; Ac Coupled: Attenuates signals below 30 kHz, 40 mV p-p from 30 kHz to 200 MHz, 250 mV p-p at 2 GHz.

**Delay Jitter** – 2.5 ps +20 ppm of selected delay (rms).

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

**Trigger Level Range** –  $\pm 1.0$  V ( $\pm 5.0$  V with 10X trigger attenuator activated).

**Trigger Input Range** – CSA 803:  $\pm 1.5$  V (direct),  $\pm 2.5$  V (Prescaled); 11801A:  $\pm 1.5$  V.

<sup>3</sup> CSA 803/11801A has external trigger only; requires > 40 ns pretrigger or use of DL-11 Delay Lines to view trigger point.

### MEASUREMENT SYSTEM

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

**Measurement Set** – Max, min, mid, p-p, mean, rms, amplitude, extinction ratio, overshoot, undershoot, noise<sup>4</sup>, rise, fall, frequency, period, prop delay, cross, width, phase, duty cycle, jitter<sup>4</sup>, 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.

<sup>4</sup> Available only in statistical measurement mode.

### 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 49.

## ORDERING INFORMATION

**COMMUNICATIONS SIGNAL ANALYZER  
CSA 803 Communications Signal Analyzer** **\$25,150**

Includes:  
Tutorial manual (070-7718-00),  
User Reference (070-7719-00),  
Command Reference (070-7720-01),  
Programmer Reference (070-7738-01),  
Service Reference (070-7721-00),  
12 inch SMA-SMA cable,  
2 ea. 8 1/2 inch SMA-SMA cable,  
1 wrist strap, Power Cord, U.S.,  
Power Cord, U.S., 120 V  
(161-0066-00).

### PHYSICAL CHARACTERISTICS

Dimensions	Cabinet		Rackmount	
	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
<b>Weights =</b>	<b>kg</b>	<b>lb</b>	<b>kg</b>	<b>lb</b>
Net	22.3	49	23.2	51
Shipping	25.9	57	26.8	59

### DIGITIZING SAMPLING OSCILLOSCOPE

**11801A Digital Sampling Oscilloscope** **\$27,500**

Includes:  
Tutorial manual (070-8025-00),  
User Reference (070-8021-00),  
Programmer Reference (070-7038-01),  
Command Reference (070-7020-01),  
Service Reference (070-8024-00),  
12 inch SMA-SMA cable,  
2 ea. 8 1/2 inch SMA-SMA cable,  
1 wrist strap, Power Cord, U.S.,  
120 V (016-0066-00).

### INSTRUMENT OPTIONS

**Opt. 1R** – Rackmount. **+\$250**  
**Opt. 1M** – Multi-Channel Conversion (11801A only). **+\$1,000**  
**Opt. 10** – **–\$1,000**  
Deletes the 10 GHz prescaler capability. This does not affect the 2.5 GHz trigger. For additional option information see page 64.

### WARRANTY-PLUS SERVICE PLAN OPTIONS

See page 378.  
**Opt. Q0** – On-Site Product Installation and Setup **+\$460**  
**Opt. Q1** – 1 Year On-Site Service **+\$670**  
**Opt. Q2** – 2 Year On-Site Service **+\$2,010**  
**Opt. Q3** – 3 Year On-Site Service **+\$3,310**

### ACCESSORIES

See pages 52 and 294.

### PHYSICAL CHARACTERISTICS

Dimensions	Cabinet		Rackmount	
	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
<b>Weights =</b>	<b>kg</b>	<b>lb</b>	<b>kg</b>	<b>lb</b>
Net	22.3	49	23.2	51
Shipping	25.9	57	26.8	59

**H**igh performance sampling heads provide high bandwidth sampling for a multitude of applications.

### NEW SD-14

- 100 k $\Omega$ , 0.25 pF typical
- 7 V p-p Dynamic Range
- 2.5 GHz Bandwidth
- ECL, CMOS and GaAs Device Characterization

### SD-20

- Loophrough Sampling Head
- Underterminated
- General-Purpose TDR

### SD-22

- 12.5 GHz Bandwidth
- Low-Noise
- Digital Data Communications
- Dual-Channel

### SD-24

- TDR/Sampling Head
- Dual-Channel, Differential TDR
- 20 GHz Bandwidth
- 35 ps Reflected Risetime
- Line Impedance & Crosstalk Characterization

### SD-26

- 20 GHz Bandwidth
- Dual-Channel

### NEW SD-30

- 40 GHz Bandwidth
- Single-Channel
- High Bandwidth Communications and Microwave Applications

### NEW SD-32

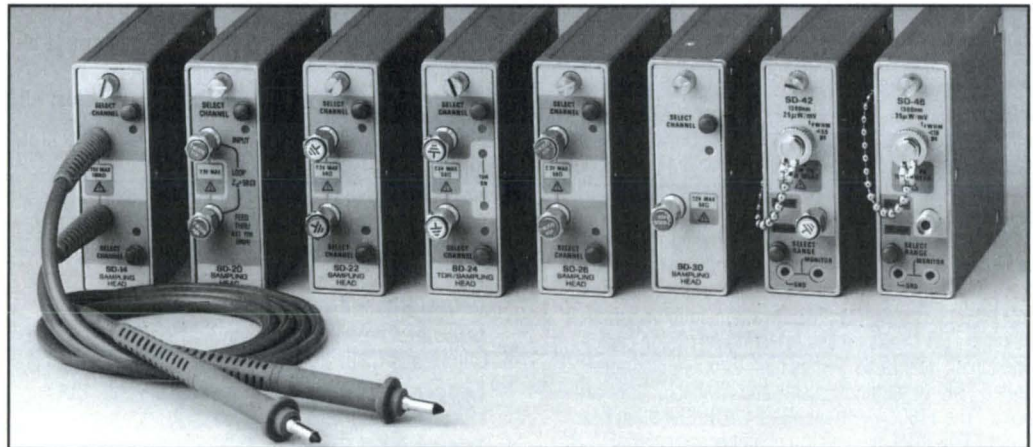
- 50 GHz Bandwidth
- Single Channel

### SD-42

- Optical-to-Electrical Converter
- DC to 6.4 GHz Optical Bandwidth
- 1000-1700 nm Wavelength Range

### SD-46

- Optical-to-Electrical Converter
- 20 GHz Optical Bandwidth
- 1200 nm to 1650 nm Spectral Response



### SD-14 HIGH IMPEDANCE PROBE SAMPLER

The SD-14 is a dual channel, 2.5 GHz probe sampler designed for high impedance signal acquisition where a 50  $\Omega$  acquisition system is not the optimal solution. The SD-14 is ideal for high speed device characterization such as ECL, CMOS, ACL, and GaAs testing. The 100 k $\Omega$  input impedance and 0.25 pF capacitance results in very low loading of the device under test. The 7 volt dynamic range and  $\pm 3.5$  V offset range, makes the SD-14 suitable for testing all digital logic families as well as most analog circuits.

The SD-14 consists of two samplers, each attached at the end of a 0.6 meter cable for easy circuit probing. The modular architecture of the CSA 803/11801A enables the use of extended samplers, bringing a new level of performance to sampling scopes. In conjunction with the 11801A and SM-11 multichannel unit, it is possible to configure up to 136 channels of high impedance, high-bandwidth acquisition with measurement accuracy approaching 140 ps.

### SD-20 LOOPTHROUGH SAMPLING HEAD

The SD-20 is a single channel, 20 GHz loophrough 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  $\mu$ V rms of noise (350  $\mu$ V with smoothing) to ensure clean, undistorted signals.

The SD-20 is non-terminated, and keeps losses to a minimum by routing the signal of interest directly through the sampling head – without the need of a power divider. The SD-20 can also be used for customized TDR measurements of transmission lines and controlled impedance devices. An external signal generator may be used, instead of the SD-24 pulse generator, to tailor the TDR pulse to fit a particular situation. For instance, slower slew rates or higher amplitude may be utilized, or you may perform half-sine or impulse testing.

In digital communications, the SD-20 is useful for viewing and triggering on the clock signal without the use of a power divider.

### SD-22 LOW-NOISE SAMPLING HEAD

The SD-22 is a dual channel, 12.5 GHz sampling head specifically designed for low-noise measurement in digital communications and device characterization applications. It provides an acquisition rise time of 28 ps, and typically 450  $\mu$ V rms of displayed noise. With smoothing, noise levels are 180  $\mu$ V rms.

In order to precisely capture and display the switching characteristics of high-speed, communications circuits, to make accurate statistical measurements of signal noise and signal timing jitter, or to obtain stable timing measurements of fast digital ICs, the noise floor of the test equipment must be kept to a minimum. The SD-22 is the ideal instrument for these low-noise applications.

### SD-24 TDR/SAMPLING HEAD

The SD-24 is a dual-channel TDR/Sampling Head. This sampling head has a rise time of 17.5 ps or less, with a typical 20 GHz equivalent bandwidth.

Each channel of the SD-24 is also capable of generating a fast rising step for use in Time Domain Reflectometry (TDR). In TDR mode, the acquisition portion of the sampling head monitors the incident step and any reflected energy. The reflected rise time of the TDR step is 35 ps or less. The polarity of each channel's TDR step can be selected independently of the other channel. This allows for differential or common-mode testing of two coupled lines, in addition to the independent testing of isolated lines. The SD-24 can be used to characterize crosstalk by using the TDR step to drive one line while monitoring a second with the other channel.

The "filter" function on the CSA 803/11800 can be used with TDR or crosstalk measurements to characterize a system at a slower risetime.

### SD-26 SAMPLING HEAD

The SD-26 is a dual-channel, 20 GHz equivalent bandwidth sampling head. This sampling head has the same acquisition capability as the SD-24 TDR/Sampling Head but does not include the TDR step generators.

### NEW SD-30 SAMPLING HEAD

The SD-30 is a single-channel, 40 GHz bandwidth sampling head for use in high bandwidth applications. This sampling head was specifically designed for characterizing high-speed devices used in advanced data communications and microwave systems research. This performance is available for any new or existing CSA 803/11800 mainframe without having to upgrade to a new system, a result of the modular architecture of the CSA 803/11800 family. The SD-30 has a measured bandwidth of greater than 40 GHz and a calculated rise time of less than 8.8 ps.

### NEW SD-32 SAMPLING HEAD

The SD-32 is a single-channel, 50 GHz bandwidth sampling head. The SD-32 performance is available for any new or existing CSA 803/11800 mainframe. The SD-32 has measured bandwidth of greater than 50 GHz and calculated rise time less than 7.0 ps.

### SD-42 OPTICAL-TO-ELECTRICAL CONVERTER

The SD-42 Optical-to-Electrical Converter head can be used to analyze optical signals in the 1000 nm to 1700 nm wavelength range. The pulse response of the measurement system is less than 55 ps FWHM (Full-Width, Half-Maximum) which is equivalent to a calculated bandwidth of dc to 6.4 GHz. The electrical output on the

front panel is coupled to the adjacent sampling head via the semi-rigid coaxial link provided.

The SD-42 is also equipped with an optical power meter for average power monitoring through a pair of voltage outputs on the front panel. Power from 5 nW to 5 mW can be measured.

For more information on this instrument, see the Opto-Electronics Instruments section, page 286.

### SD-46 OPTICAL-TO-ELECTRICAL CONVERTER

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, SD-26, SD-30, or SD-32 Sampling Head. The SD-46 is linear up to 25 mW peak input with a calibrated deflection factor from 50  $\mu$ W/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 286.

### 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.

#### Sampling Head Characteristics

	Channels	Bandwidth	Risetime	Impedance	Noise	Applications (Typical)
SD-14	2	2.5 GHz	140 ps	100 k $\Omega$ /25 pF	2 mV	ECL, CMOS, ACL GaAs Dev. Characterization
SD-20	1	20 GHz	17.5 ps	50 $\Omega$ unterminated	750 mV	Special TDR, communications
SD-22	2	12.5 GHz	28 ps	50 $\Omega$	450 mV	Communications
SD-24	2	20 GHz	17.5 ps	50 $\Omega$	750 mV	TDR/TDT Crosstalk
SD-26	2	20 GHz	17.5 ps	50 $\Omega$	750 mV	Device Characterization
SD-30	1	40 GHz	8.8 ps	50 $\Omega$	1.8 mV	High Bandwidth Communications & Microwave
SD-32	1	50 GHz	7.0 ps	50 $\Omega$	1.8 mV	High Bandwidth Communications & Microwave
SD-42	1	6.4 GHz				Optical to Electrical
SD-46	1	20 GHz				Optical to Electrical

#### ENVIRONMENTAL AND SAFETY CHARACTERISTICS (11801A, CSA 803, SM-11, SD-Series Heads)

**Operating Temperature** - 0°C to 50°C.

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

**Altitude, Vibration, Shock, Bench Handling** - Operating and Non-Operating: 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.

**Electromagnetic Compatibility** - Meets the following requirements of MIL-STD-461C: CE-03 Pt 4 Curve 1, CS-01 Pt 7, CS-02 Pt 4, CS-06 Pt 5, RE-02, Pt 7, RS-01 Pt 4, RS-02 Pt 5, RS-03, Pt 7 (limited to 1 GHz). Meets FCC Part 15, subpart J, Class A.

For Germany: Meets VDE 0871/6.78 Class B.

**Humidity** - To 95% RH at up to 50°C.

#### ORDERING INFORMATION

<b>SD-14</b> High Impedance Probe Sampler Includes: Installation/User Manual (070-8286-00); Service Manual (070-8285-00); 4-post ECB mount ground socket; Edge tab ground socket; 10 ea. Wire-form ground, .050 spacing; 10 ea. Wire-form ground, .040 spacing; plastic accessories case.	\$4,400
<b>SD-20</b> Loophrough Sampling Head 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).	\$5,250
<b>SD-24</b> Dual TDR/Sampling Head Includes: Installation/User Reference (070-7052-00); Service Reference (070-7053-00), SMA short-circuit terminations (015-1021-00).	\$3,780
<b>SD-26</b> Dual Sampling Head Includes: Installation/User Reference (070-7226-01); Service Reference (070-7227-01), 2 SMA short-circuit terminations (015-1020-00).	\$3,780
<b>SD-22</b> Low-Noise Sampling Head Includes: Same as SD-26.	\$9,450
<b>SD-30</b> Sampling Head Includes: Installation/User Manual (070-7904-00); Service Manual (070-7905-00); 1 SMA short circuit termination (015-1020-00).	\$3,845
<b>SD-32</b> Sampling Head Includes: Installation/User Reference (070-8268-00); Service Reference (070-8269-00); 1 SMA short-circuit termination (015-1020-00).	\$3,845
<b>SD-42</b> Optical-to-Electrical Converter Includes: See the Opto-Electronics Instruments section, page 286.	\$8,925
<b>SD-46</b> Optical-to-Electrical Converter Includes: See the Opto-Electronics Instruments section, page 286.	\$3,500
<b>SD-51</b> Trigger Head Includes: Installation/User Manual (070-7338-00); Service Reference (070-7339-00), 12' SMA male-to-male (174-1364-00).	\$3,500

#### WARRANTY-PLUS SERVICE PLAN OPTIONS

See page 378.

<b>Opt. Q1</b> - 1-Year On-Site Service.	
SD-20	+\$190
SD-24	+\$235
SD-26	+\$165
SD-22	+\$165
<b>Opt. Q2</b> - 2-Year On-Site Service.	
SD-20	+\$610
SD-24	+\$760
SD-26	+\$535
SD-22	+\$535
<b>Opt. Q3</b> - 3-Year On-Site Service.	
SD-20	+\$1,260
SD-24	+\$1,260
SD-26	+\$880
SD-22	+\$880

\*1 Contact your local sales representative.

## ORDERING INFORMATION

SIU800 Static Isolation Unit **\$1,550**Includes:  
12 VDC power supply, two SMA  
Male-to-Female adapters, foot switch,  
two 50  $\Omega$  terminators, and an  
instruction/performance verification  
manual.

## 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

## CHARACTERISTICS

**Acquisition System** – SD-14, SD-22, SD-24, SD-26: dual channel; SD-20, SD-30: Single channel.

**Rise Time** – SD-14: 115 ps; SD-20, SD-24, SD-26: 17.5 ps; SD-22: 28 ps, all from 10% to 90%.

**Bandwidth** – 3 GHz for the SD-14; 20 GHz for the SD-20, SD-24, and SD-26; 12.5 GHz for the SD-22; 40 GHz for the SD-30.

**Dynamic Range** – 1 V p-p within a  $\pm 1.6$  V range for the SD-20, SD-22, SD-24, SD-30; 7 V p-p within a  $\pm 3.5$  V offset range for the SD-14.

**Dot Transient Response** – Accuracy after calibration at operating temperature is  $\pm 5\%$  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  $\Omega$   $\pm 0.5 \Omega$ . SD-14 is 100 k $\Omega$  and 0.25 pF. 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 $\mu$ V
SD-22	800 $\mu$ V	450 $\mu$ V
SD-14	4 mV	2 mV
SD-30	2.3 mV	1.8 mV

With smoothing:

SD-20, SD-24, SD-26	550 $\mu$ V	350 $\mu$ V
SD-22	400 $\mu$ V	180 $\mu$ V
SD-30	1 mV	700 $\mu$ V

**Maximum Input Voltage** –  $\pm 3$  volts.

**Isolation Between Channels** – 1% p-p voltage transmission from the channel driven by the 067-1338-00, to the quiescent channel (see page 51).

**Time Coincidence Between Channels** – 10 ps accuracy; < 0.2 ps/ $^{\circ}$ 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  $\pm 1\%$ .

**Reflected** – 35 ps or less, 10% to 90%, at +250 mV or –250 mV output.

**TDR Pulse Amplitude** – Adjustable to  $\pm 250$  mV (polarity of either pulse may be inverted).

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

**Source Resistance** –  $50 \pm 0.5 \Omega$ .

**Aberrations (at  $\pm 250$  mV amplitude)** –

10 ns to 20 ps before step:	$\pm 3\%$ or less.
< 300 ps after step:	+10%, –5% or less.
300 ps to 5 ns after step:	$\pm 3\%$ or less.
Elsewhere:	$\pm 1\%$ or less.

## SD-51 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  $\Omega$ , 5 V p-p max.

**Input Characteristics** – 50  $\Omega$  SMA (3 mm) connector. Open termination paralleled by 1 pF.

**Trigger Output** – Approximately 200 mV into 50  $\Omega$ . 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.

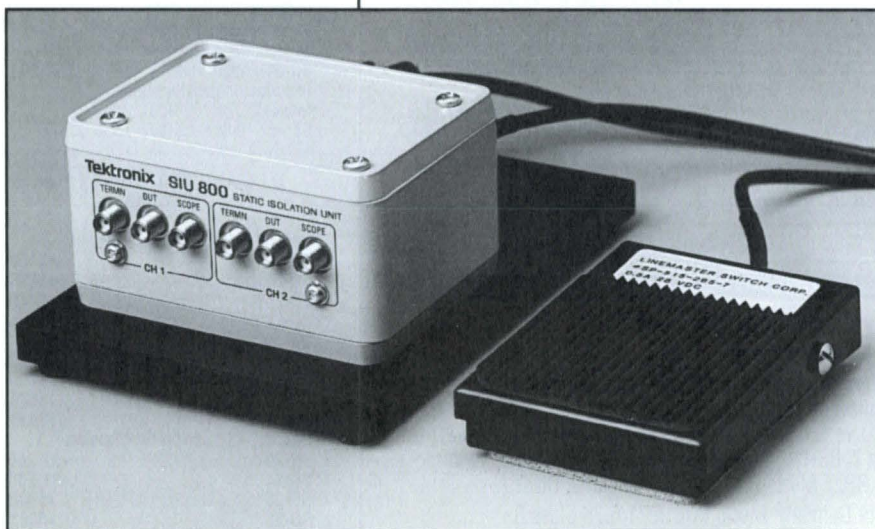
## ENVIRONMENTAL AND SAFETY

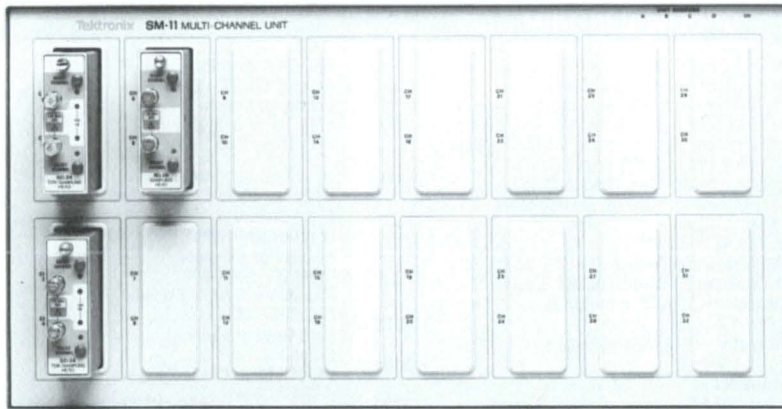
See page 49.

## SIU 800 STATIC ISOLATION UNIT

The SIU 800 protects the sampling bridge from damage due to static discharge from circuit boards and cables. The SIU 800 is intended for use in applications such as TDR circuit board testing and cable testing where large static charges can be stored. When used with the SD-24 TDR/Sampling Head, the SIU 800 provides a reflected risetime of less than 40 ps and a reflection coefficient of less than 80 mp.

The SIU 800 is installed between the DUT and sampling head and is controlled manually by a foot switch or under program control through a TTL-compatible input. When the foot switch is in the normal position (not pressed), the DUT is grounded through a 50  $\Omega$  termination resistor. This will discharge any static charge stored in the DUT. Pressing the foot switch connects the DUT to the sampling head input allowing a measurement to be made. Both channels are controlled simultaneously by the foot switch or TTL input.





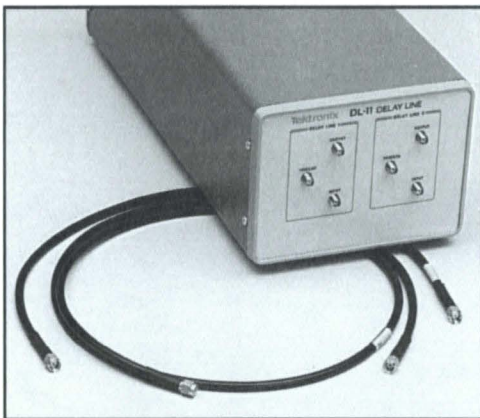
The SM-11 Multi-Channel Unit can accept up to 16 SD-Series Sampling Heads.

### SM-11 MULTI-CHANNEL UNIT

The SM-11 Multi-Channel Units expand the 11801A Digital Sampling Oscilloscope to 136 channels. Each SM-11 accepts up to 16 of the SD-Series Sampling Heads; an 11801A mainframe, with Option 1 M added, is capable of driving up to four SM-11 Units. The entire system can then be driven through a single GPIB address.

The 11801A/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 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.



The DL-11 Delay Line contains two delay lines each with 47.5 ns delay. The DL-11 is used for showing the triggering event of a signal displayed on an 11801A or a CSA 803.

### 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 11801A 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.

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.

### CALIBRATION STEP GENERATOR

The Calibration Step Generator is a very fast rise time, 250 mV step generator that verifies specifications of the SD-20, SD-22, SD-24, and SD-26 sampling heads. It is supplied with a certificate and test report, stating the rise time of the step based on a measurement-controlled,

### SM-11

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

### DL-11

- 47.5 ns Compensated Dual Delay Line
- 5 GHz Bandwidth

### Calibration Step Generator

#### ORDERING INFORMATION

**SM-11 Multi-Channel Unit** **\$24,500**  
Includes: Installation/User Manual (070-7048-00), Service Reference (070-7049-00), Power Cord, U.S., 120 V (161-0066-00).

#### INSTRUMENT OPTIONS

**Opt. 1R - Rackmount.** **+\$250**  
See page 64 for additional option information.

#### WARRANTY-PLUS SERVICE PLAN OPTIONS

See page 378.

**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 294.

#### PHYSICAL CHARACTERISTICS

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

**DL-11 Delay Line** **\$4,200**  
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
<b>Weight</b>	<b>kg</b>	<b>lb</b>
Net	2.2	10
Shipping	3.08	14

**Calibration Step Generator** **\$5,490**  
Order 067-1338-00  
Includes: Instruction sheet; SMA - female, short-circuit termination.  
See page 52 for power supply options.

**ORDERING INFORMATION**

**CALIBRATION STEP GENERATOR  
INTERNATIONAL POWER SUPPLY OPTIONS**  
**Universal European** – (240 V, 50 Hz)  
 Order 067-1338-01 **\$5,490**  
**UK** – (240 V, 50 Hz) Order 067-1338-02 **\$5,490**  
**Australia** – (240 V, 50 Hz) Order 067-1338-03 **\$5,490**  
**Switzerland** – (240 V, 50 Hz) Order 067-1338-05 **\$5,490**  
**Japan** – (100 V, 50-60 Hz) Order 067-1338-06 **\$5,490**

**RECOMMENDED ACCESSORIES**  
 The following are accessories for the CSA 803, 11800, SD-Series heads, and SM-11, unless specified otherwise.  
**SMA Accessory Kit** –  
 Order 020-1693-00 **\$2,195**  
 Includes: 2 each 2X and 5X attenuators;  
 2 each SMA Terminations, Male Short Circuit, Female Short Circuit, Male 50 Ω, Female 50 Ω,  
 2 each 50 Ω Signal Cables (2 ns),  
 2 each 500 ps Semi-Rigid Cable,  
 2 each Male-to-Male adapters,  
 2 each SMA Male-to-BNC Female,  
 2 each Female-to-Female,  
 1 each 50 Ω Power Divider,  
 1 each Combination Wrench (.312, 6 point).  
**3.5 mm Accessory Kit** –  
 Order 020-1692-00 **\$6,595**  
 Includes: 1 each 50 Ω Reference Air Line,  
 1 each Male-to-Male Adapter,  
 1 each Female-to-Female Adapter,  
 1 each 26.5 GHz 50 Ω Terminator (Male),

1 each 26.5 GHz 50 Ω Terminator (Female),  
 1 each 26.5 GHz Short Circuit (Male),  
 1 each 26.5 GHz Short Circuit (Female),  
 2 each 50 Ω Terminators (6 dB 26.5 GHz, 2.9 mm),  
 2 each 50 Ω Terminators (20 dB 26.5 GHz, 2.9 mm),  
 1 each Power Divider (26.5 GHz, 2.9 mm),  
 2 each Signal blews (2 ns, Male-to-Male),  
 2 each Signal Cables (500 ps, Male-to-Male, 2.9 mm semi-rigid),  
 1 each Torque Wrench,  
 1 each Combination Wrench (0.312, 6 point),  
 1 each Combination Wrench (0.281, 6 point).  
**2X Attenuator** – SMA Male-to-Female  
 Order 015-1001-00 **\$165**  
**5X Attenuator** – SMA Male-to-Female  
 Order 015-1002-00 **\$155**  
**Power Divider** –  
 Order 015-1014-00 **\$300**  
**Blank Sampling Head** –  
 Order 200-3395-00 **\$0.85**  
**ECL Terminator** –  
 Order 015-0558-00 **\$730**  
 Provides the bias and termination for ECL device outputs.  
 At 10 GHz bandwidth and 1% precision attenuation, accurate ac and dc measurements are ensured.  
 Attenuation: 10X ±1.0% @ dc, 20 dB ±3 dB, dc to 10 GHz  
 Aberrations: ±3% max with 100 ps rise time  
**DC Block (Coupling Capacitor)** –  
 Order 015-1013-00 **\$255**

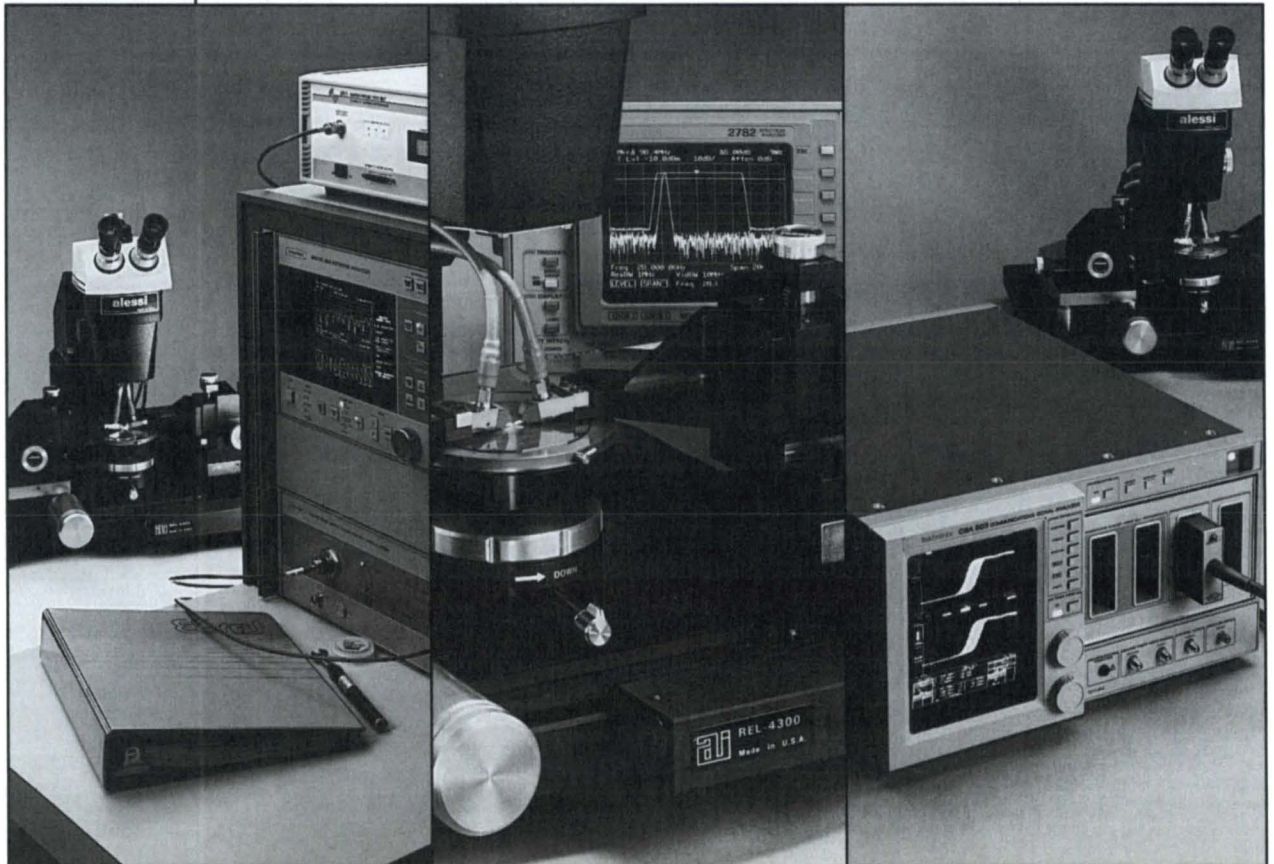
**Slip-On Connector** –  
 Order 015-0553-00 **\$38**  
**Connector Savers**  
 SMA: Order 015-0549-00 **\$165**  
 APC: Order 015-0552-00 **\$220**

**CABLES AND EXTENDERS**  
**Sampling Head Extender Cables**  
 (1 m) Order 012-1220-00 **\$645**  
 (2 m) Order 012-1221-00 **\$735**  
**Acquisition Extender** –  
 Order 067-1324-00 **\$105**  
**Acquisition System Extender** –  
 Order 067-1323-00 **\$820**  
**Card Cage Extender** –  
 Order 067-1267-00 **\$895**  
**11801A Multi Channel Kit** – **\$2**

**RECOMMENDED PROBES**  
**P6150** – 10X, dc to 9 GHz (see page 313) **\$1,295**  
**P6156** – 10X, dc to 3.5 GHz, ≤1 pF, 500 Ω (see page 313)<sup>1</sup> **\$255**

**INTERNATIONAL POWER PLUG OPTIONS**  
**Opt. A1 – A5 Available**  
 See page 374.  
<sup>1</sup> Requires SMA male-to-BNC female adapter when attached to SMA-type inputs. Order 015-0554-00.  
<sup>2</sup> Contact your local sales office

**TMP 9000 MICROWAVE PROBES**



*S-Parameter and Noise Measurement Test System*

*Spectrum Analyzer Test System*

*TDR & Device Characterization Test System*

## 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  $\Omega$  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, Micromanipulator, and Wentworth Laboratories.

Probes are available in discrete 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.

## TMP9600 SERIES CHARACTERISTICS

**Frequency Range** – Dc to 40 GHz.

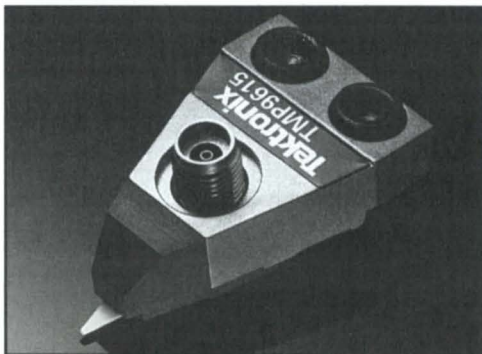
**Footprint** – Ground-Signal-Ground.

**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.



## TMP9200/TMP9300 SERIES CHARACTERISTICS

**Frequency Range** – Dc to 26.5 GHz.

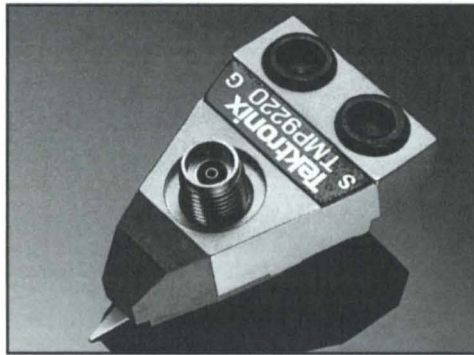
**Footprint** – Signal-Ground (TMP9200 Series)  
Ground-Signal (TMP9300 Series).

**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.



## 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 TMP 9300 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.

## 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

## ORDERING INFORMATION

TMP9200 SERIES (DC - 26.5 GHz Frequency Range, Signal-Ground Footprint)		TMP9600 SERIES (DC - 40 GHz Frequency Range, Ground-Signal-Ground Footprint)	
TMP9210 – 100 micron pitch	*1	TMP9610 – 100 micron pitch	*1
TMP9215 – 150 micron pitch	*1	TMP9612 – 125 micron pitch	*1
TMP9220 – 200 micron pitch	*1	TMP9615 – 150 micron pitch	*1
TMP9225 – 250 micron pitch	*1	TMP9617 – 175 micron pitch	*1
TMP9230 – 300 micron pitch	*1	TMP9620 – 200 micron pitch	*1
		TMP9625 – 250 micron pitch	*1
TMP9300 SERIES (DC - 26.5 GHz Frequency Range, Ground-Signal Footprint)		OPTIONAL ACCESSORIES FOR TMP9000 FAMILY PROBES	
TMP9310 – 100 micron pitch	*1	Opt. 01 – Female OS-50 Connector	*1
TMP9315 – 150 micron pitch	*1	CALIBRATION SUBSTRATES	
TMP9320 – 200 micron pitch	*1	CAL93 – For TMP9200 and TMP9300 Series Probes	*1
TMP9325 – 250 micron pitch	*1	CAL96 – For TMP9600 Series Probes	*1
TMP9330 – 300 micron pitch	*1		

## CONTACT INFORMATION

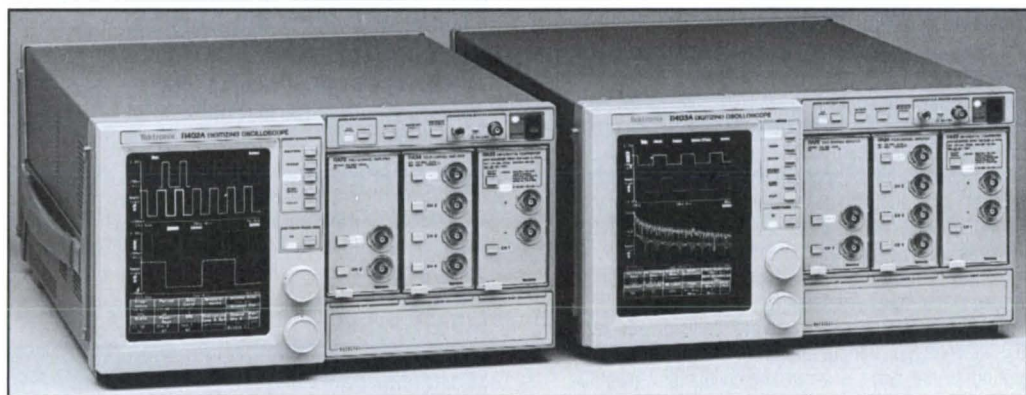
\*1 For technical information, customer support, prices, or to order Microwave Probes and Accessories, contact: ATN Microwave, Inc.

Phone: 508-667-4200

Fax: 508-667-8548.

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 at 1 GHz Concurrently
- 10-bit Vertical Resolution – 14-bit with Averaging – and 10 ps Horizontal Resolution
- Time Base Accuracy of 100 ps + 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. Now with the introduction of the 11403A, the standard is higher than ever. It now offers even more convenience and power with built-in FFT, automatic Pass/Fail testing, and measurements on multiple waveforms.

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

Controls are grouped around the display screen to minimize distractions.

Most controls are built into a menu system on the touch screen. Touch the "Define Waveform" icon, for example, to get selections for averaging, differentiation,

integration, envelope, signum, smoothing, and square root.

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

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

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

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

## 11400 SERIES APPLICATIONS

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



## 11403A AND 11402A

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

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

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

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

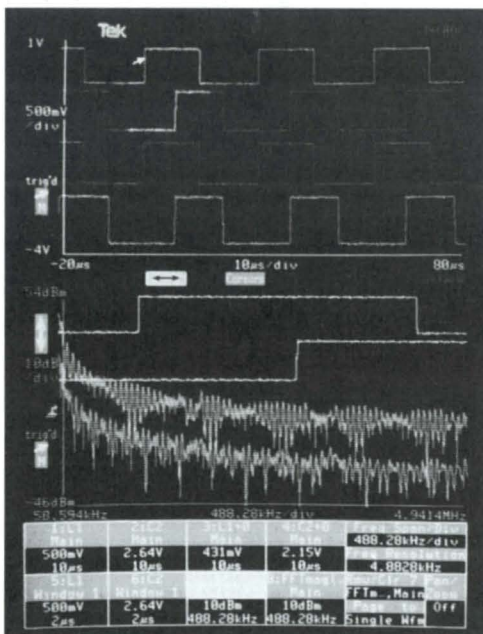


Figure 1. FFT display and measurements in the 11403A offer additional analysis power to the engineer or scientist.

## THE USER INTERFACE

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

## ADVANCED ANALYSIS WITHOUT DELAY

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

Advanced waveform calculations such as differentiation, integration, square root, logarithm, and absolute value are available at the touch of an on-screen selector. No more waiting for results while an external 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. Dedicated digital signal processing hardware provides acquisition enhancement functions such as averaging and smoothing to selectively remove noise from the display, giving you visibility into the true behavior of circuits and devices never before seen without extensive delayed signal processing.

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

## MEASUREMENT SYSTEM

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

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

## NEW 11403A/ 11402A

- Color Display (11403A)
- 1 GHz Bandwidth
- 1 GHz Trigger Bandwidth
- 10-bit Vertical Resolution, 14-bits with Averaging
- Powerful Measurement Set
- Built-in FFT Display and Measurements (11403A only)
- Automatic Pass/Fail Testing based on measurements
- 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



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

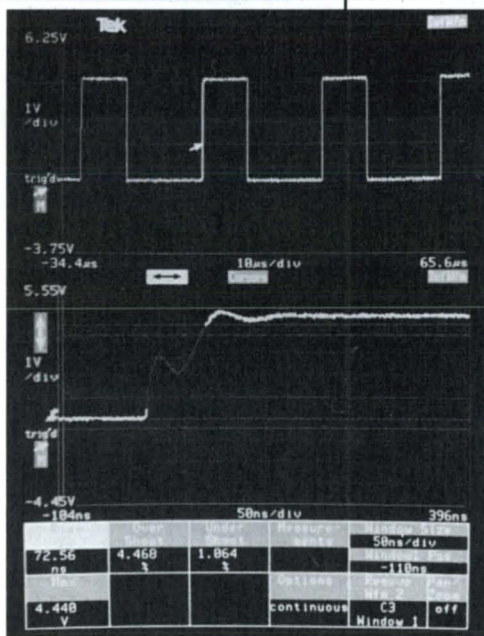


Figure 2. In the Annotation Mode, horizontal cursor bars and highlighting serve to focus your attention on the portion of the waveform being measured.

### ANNOTATIONS

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

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

### PASS/FAIL TESTING

Both the 11403A and 11402A offer Pass/Fail testing on measurements. ATE and production test applications can use Pass/Fail testing to speed throughput and simplify circuit adjustment. Maximum and minimum limits are set for each active measurement, then the instrument gives indication of whether the signals Pass or

Fail. A horizontal scale with a vertical bar serves as visual indication of where the measurement fell between the set limits. If the test failed, the scale indicates whether the signal was high or low. The 11403A adds the visual indication of color – Pass is green, Fail is red.

### MULTIPLE WAVEFORM MEASUREMENTS

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

### PLUG-IN MODULARITY

The 11403A and 11402A are equipped to handle up to three 11000 Series plug-ins. (For a list of plug-ins and characteristics, see page 59.) Several plug-ins are available, offering a range of bandwidths, channels, and input impedances to choose from. Plug-in installation is a simple matter of sliding each unit into place. Plug-ins are controlled through the mainframe, either from the touch screen interface, or via the IEEE 488 or RS-232-C.

### RECORD LENGTH

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

### WAVEFORM MEMORY AND NONVOLATILE STORAGE

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

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

### DOCUMENTATION

Documenting your results with the 11403A and 11402A is as easy as pressing one button. HARDCOPY

sends a high-resolution copy of the current screen, complete with label and time and date stamp, through your choice of a standard Centronics parallel printer, RS-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).

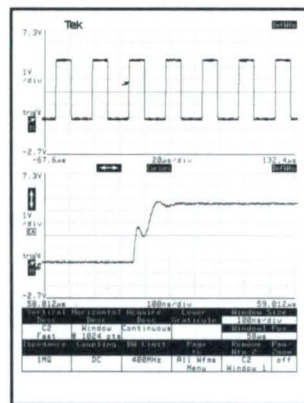


Figure 3. 11400 hardcopy output.

### APPLICATIONS

#### DEVICE CHARACTERIZATION

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

Dual built-in time bases allow windowing for detailed timing analysis of devices. Time A to B measurements can be made with 200 ps resolution single shot, or 10 ps resolution with repetitive acquisitions. Multiple signal acquisition and display eliminates the need to multiplex channels, and allows you to see cause and effect relationships on the same screen. For critical applications, the 10-bit vertical resolution can be increased to 14-bits with averaging. The 11403A offers a unique level of analysis power when Option 1S, Statistical Database Analysis Package, is added. With this option, the 11403A can make direct jitter and noise measurements on your incoming signals. It builds up a history – a statistical database – of acquisitions and provides histograms, measurements, special color graded displays, and mask

testing options which allow you to more fully characterize and analyze your circuitry than ever before. These techniques are excellent for analyzing random data such as computer bus data streams, making timing analyses on digital signals, and characterizing metastability. And the color display of the 11403A lets you easily distinguish among multiple waveforms.

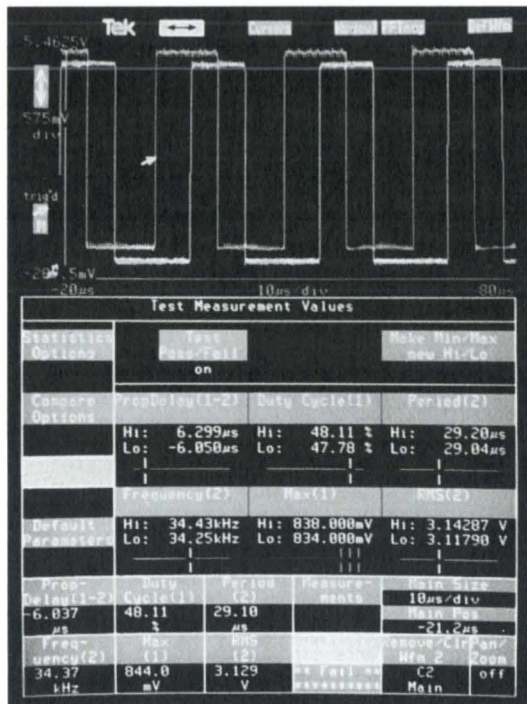


Figure 4. Pass/Fail testing offers a fast, easy method of adjusting circuit operation or sorting parts in production applications.

## POWER SUPPLY TESTING

The 11403A and 11402A with 11000 Series plug-ins provide ac coupling, fast overdrive recovery, high vertical resolution, and one-touch measurements; making this combination an ideal tool for power supply 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 8000 divisions\* of overdrive.

The 11403A and 11402A can extend the sensitivity and offset of the plug-ins by increasing their normal 10-bit vertical resolution to 14 bits with high-precision averaging. With this kind of resolution, and the 11A33 Differential Comparator plug-in, small signals riding on larger signal swings or high dc voltages (such as ripple and noise) can be easily spotted and isolated.

## PRODUCTION TESTING

ATE and production test users reap many benefits from the 11403A and 11402A. Full programmability and commands optimized for fast operation ensure the highest throughput in ATE applications. Flexibility of configuration and high performance of 11000 Series

\* With an 11A33.

plug-ins mean a production testing system can be tailored to fit your needs today – and expanded tomorrow as your needs change and grow. Special features like Pass/Fail testing, multiple waveform measurements, and a full range of automatic measurements give the 11403A and 11402A the ability to perform many more functions than ordinary oscilloscopes and can even replace other test equipment. The high accuracy of the 11403A and 11402A provides an extra margin of safety for your tests, and their fast measurements reduce test times which saves you money.

## CHARACTERISTICS

(11403A, 11402A, CSA 404)

### 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 instrument will prompt you to connect the probes to the CALIBRATOR.

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

**Equivalent-Time Bandwidth** – 1 GHz max determined by plug-in. See page 59.

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

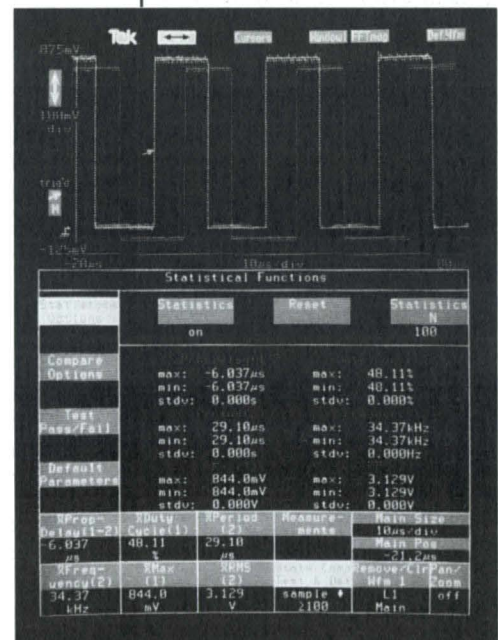


Figure 5. Statistical analysis of measurements provides maximum, minimum, mean, and standard deviation for up to six measurements at once. This feature is useful for statistical quality control, ATE test development, and device characterization.

## ORDERING INFORMATION

**11403A 1-GHz Color Digitizing Oscilloscope. \$18,950**

Includes: Tutorial (070-8190-00); User Reference (070-8191-00); Programmer Reference (070-8192-00); Quick Reference (070-8193-00); Service Reference (070-8194-00); Power Cord, U.S. 120 V (161-0066-00).  
**11402A 1-GHz Monochrome Digitizing Oscilloscope. \$15,700**  
 Includes: Same as 11403A except Service Reference (070-7848-00).

## INSTRUMENT OPTIONS

**Opt. 1C** – Cable Feedthrough Connectors. +\$200  
**Opt. 1R** – Rackmount. +\$250  
**Opt. 1S (11403A only)** – Statistical Data Base Analysis Package. +\$4,000  
 Adds statistical data base measurement functions, color graded display, mask testing, direct Jitter and Noise measurements, and histogram analysis.  
**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

## INTERNATIONAL POWER PLUG OPTIONS

**Opt. A1-A5** – Available NC  
 See page 374.

## WARRANTY-PLUS SERVICE PLAN OPTIONS

See page 378.  
**Opt. Q0** – On-Site Product Installation and Set-up. +\$475  
**Opt. Q1** – 1-Year On-Site Service  
 11403A +\$385  
 11402A +\$365  
**Opt. Q2** – 2-Year On-Site Service  
 11403A +\$1,330  
 11402A +\$1,295  
**Opt. Q3** – 3-Year On-Site Service  
 11403A +\$2,195  
 11402A +\$2,150

## ACCESSORIES

**Recommended Probes and Hard Copy Units** – See page 64.  
**Recommended Software** – See page 64.

## PHYSICAL CHARACTERISTICS

	Benchtop		Rackmount	
	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

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

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

## TRIGGERING SYSTEM

**Range** – ± Full Scale.

**Main Trigger, Coupling and Sensitivity**

**Jitter (Typical, CSA 404 only)** – 10 ps rms; 70 ps peak-to-peak.

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

**Noise Reject Coupled** – 1.2 div or less from dc to 50 MHz; 3 div from 50 MHz to 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** – 0.65 div from dc to 30 kHz.

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

**Window Trigger, Coupling and Sensitivity**

**DC Coupled** – 0.5 div from dc to 50 MHz; 1.5 div from 50 MHz to 500 MHz.\*1

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

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

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

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

**Holdoff Range**

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

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

## MEASUREMENT SYSTEM

**Waveform Processing Functions**

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

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

**Measurement Set**

**Amplitude** – Min, max, mid, mean, gain, p-p, undershoot, overshoot, amplitude, noise<sup>2</sup>, extinction ratio, and RMS.

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

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

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

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

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

## INPUTS/OUTPUTS

Centronics, GPIB, and RS-232-C ports standard. Fully GPIB and RS-232-C programmable.

**Hardcopy Drivers** – Support for Tek HC200 and 9 pin and 24-pin Epson-graphics compatible printers; Tek HC100 and HPGL-compatible plotters; Tek 4693, 4696, 4697 color printers; alternate inkjet printers; bit map transfer to computers. Draft, high resolution, and reduced modes.

## CRT AND DISPLAY FEATURES

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

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

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

## ENVIRONMENTAL AND SAFETY

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

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

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

**Vibration** – Operating: meets MIL-T-28800C, Section 4.5.5.3.1, Type Class 5.

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

**Bench Handling** – Operating: meets MIL-T-28800C, Section 4.5.5.4.3, Type Class 5. Electromagnetic Compatibility – Meets the following requirements of MIL-STD-461B - CE-03, Part 4, Curve 1; CS-01, Part 7; CS-02, Part 4; CS-06, Part 5; RE-02, Part 7; RS-01, Part 4; RS-02, Part 5; RS-03, Part 7 (limited to 1 GHz). Meets FCC part 15, subpart J, class A. Meets VDE 0871/6.78 for Class B.

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

\*1 At minimum holdoff setting.

\*2 CSA 404 and 11403A option 1S only.

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

Control of the 11000 Series plug-ins is accomplished through the mainframe controls, either manually or over the IEEE Standard 488 or RS-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 P6703A), to sense the type (and, with some

probes, the serial number) of the probe, to supply offset voltage to probes so equipped, to detect activation of the probe's ID pushbutton, and to provide other communication between the probe and the oscilloscope as appropriate to the type of probe.

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

**CSA 803/11800 SERIES SAMPLING HEADS**

The CSA 803/11800 Series accepts SD Series Sampling Heads. See pages 48-52 for more information on CSA 803/11800 Series sampling heads.

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**11000 SERIES PROBE/PLUG-IN/MAINFRAME BANDWIDTH MATRIX**

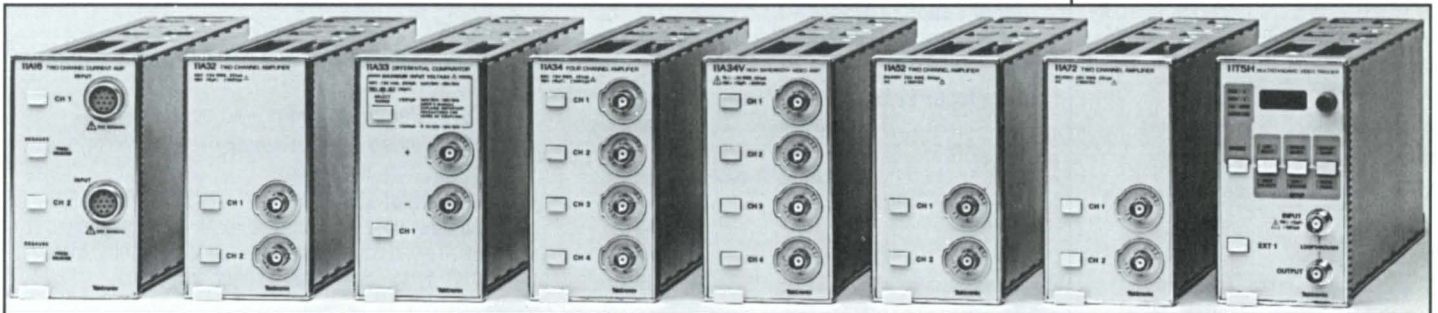
All values are in MHz and are rounded to nearest 25 MHz increment

	No probe	P6134C	P6231	P6203	P6204	P6156	P6701A <sup>*1</sup>	P6703A <sup>*1</sup>	P6711 <sup>*1</sup>	P6713 <sup>*1</sup>	P6501 Opt. 02 <sup>*2</sup>
		passive 10 MΩ 11.3 pF 10X	bias/offset 450 Ω 1.6 pF 10X	active 10 kΩ 2.0 pF 10X	active 10 MΩ 1.9 pF 10X	passive 500, 5 kΩ <1 pF, <1.1 pF 10X, 100X	optical — — —	optical — — —	optical — — —	optical — — —	active 1 MΩ 1.8 pF 10X
11A32	400	400	375	375	375	400	300	350	175	175	350
11A34	300	300	300	275	275	300	250	275	150	175	275
11A34V	300	300	—	—	—	—	—	—	—	—	—
11A52	600	—	550	500	500	600	375	475	175	200	475
11A72	1000	—	825	700	700	1000	450	575	175	200	600

\*<sup>1</sup> The bandwidths in this chart correspond to -3 dB electrical net system bandwidth. Optical/Electrical converters are often specified at a -3 dB optical point (= -6 dB electrical). To convert to -3 dB optical bandwidth, multiply the bandwidths in this chart by 1.4. For more details on Optical-to-Electrical Converters, see page 287.

\*<sup>2</sup> 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.

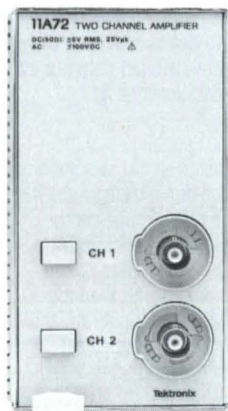


## 11A72

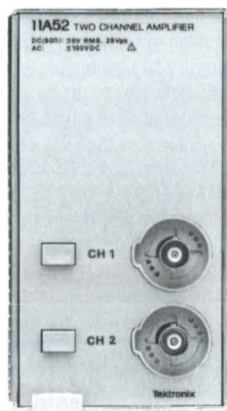
- Two Channels
- 50  $\Omega$  Input Impedance
- DC to 1 GHz Bandwidth
- 10 mV to 1 V/Div Calibrated Deflection Factors
- $\pm 25$  Division Offset

## 11A52

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



11A72 Two-Channel Amplifier



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. DC offset can be set to 40 steps/division resolution over a range of  $\pm 25$  div at all sensitivities.

## CHARACTERISTICS

**Bandwidth** – 1 GHz.

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

**Accuracy** –  $\Delta$ Volts dc accuracy:

With 11400:  $\pm(0.9\% + 0.01 \text{ div})$ .

With DSA 600:  $\pm(1.0\% + 0.02 \text{ div})$ .

Dc Balance,  $\pm 0.1 \text{ div}$ .

Offset Accuracy,  $\pm(0.4\% + 0.01 \text{ div})$ .

**Offset Range** –  $\pm 25$  divisions, 0.025 div resolution.

**Typical Noise (RMS)** – 0.022 div.

**Input Impedance** – 50  $\Omega \pm 0.5\%$ ; VSWR  $\leq 1.45:1$  @10 mV/div, dc to 1 GHz; VSWR  $\leq 1.25:1$  for deflection factors  $\geq 20 \text{ mV/div}$ , dc to 1 GHz.

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

**Input Coupling Modes** – Ac, dc, OFF.

**AC Coupled Low Frequency** –  $-3 \text{ dB}$  point; 1 kHz or less from 50  $\Omega$  source.

**Max Input Voltage** – Dc Coupled: 25 V pk or 5 Vrms  
Ac Coupled:  $\pm 100 \text{ V}$  dc additional. Input coupling is set to off when coupled signal exceeds safe limits. Manual reset by selecting either ac or dc coupling.

## 11A52 TWO-CHANNEL AMPLIFIER

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  $\mu\text{V}$  resolution and a range of  $\pm 1 \text{ V}$  (equivalent to 16 bits), giving an effective screen height of 2000 divisions and permitting absolute dc measurement accuracies to  $\pm 0.3\%$ .

## CHARACTERISTICS

**Bandwidth** –

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

**Calibrated Deflection Factors** –

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

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

**Accuracy** –  $\Delta$ Volts dc accuracy:

With 11400:  $\pm(0.8\% + 0.01 \text{ div})$ .

With DSA 600:  $\pm(0.9\% + 0.02 \text{ div})$ .

Dc Balance, 1 to 99.5 mV/div:  $\pm(0.2 \text{ mV} + 0.10 \text{ div})$ .

Offset Accuracy, 1 to 99.5 mV/div ( $\pm 1 \text{ V}$  range):  $(0.15\% + 0.4 \text{ mV})$ .

**Offset Range** –

1 to 99.5 mV/div:  $\pm 1 \text{ V}$ ; Resolution: 25  $\mu\text{V}$ .

100 mV to 0.995 V/div:  $\pm 10 \text{ V}$ ; Resolution: 250  $\mu\text{V}$ .

1 to 10 V/div:  $\pm 100 \text{ V}$ ; Resolution: 2.5 mV.

**Overdrive Recovery** – 1 to 99.5 mV/div: To within  $\pm(0.2\% + 0.1 \text{ div})$  within 20 ns from  $\pm 2 \text{ V}$  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  $\Omega \pm 0.5\%$ ; VSWR:  $< 1.3:1$  dc to 500 MHz.

**Input Coupling Modes** – Ac, dc, and OFF.

**AC Coupled Low Frequency** –  $-3 \text{ dB}$  point; 1 kHz or less from 50  $\Omega$  source.

**Max Input Voltage** – Dc Coupled: 25 V pk or 5 Vrms  
Ac Coupled:  $\pm 100 \text{ V}$  dc additional. Input coupling is set to off when coupled signal exceeds safe limits. Manual reset by selecting either ac or dc coupling.

## ORDERING INFORMATION

11A72 Two-Channel Vertical Amplifier **\$4,595**

Includes:  
User Reference (070-7255-00),  
Service Reference (070-7257-00).

11A52 Two-Channel Vertical Amplifier **\$3,295**

Includes:  
User Reference (070-6114-00),  
Service Reference (070-6786-00).

### INSTRUMENT OPTIONS

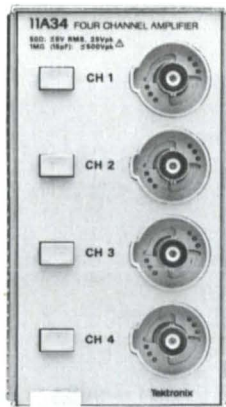
Opt. 25 – Includes two P6231 probes. **+\$1,050**

Opt. 26 – Includes two P6203 probes. **+\$1,900**

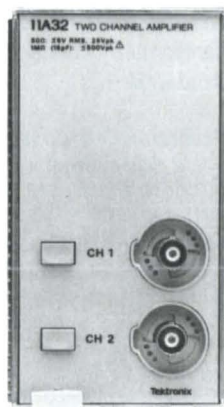
Opt. 27 – Includes two P6204 probes. **+\$2,940**

### ACCESSORIES

See page 64.



11A34 Four-Channel Amplifier



11A32 Two-Channel Amplifier

### 11A32 AND 11A34 AMPLIFIERS

The 11A32 and 11A34 are excellent, medium bandwidth amplifiers. They offer switchable 1 M $\Omega$ /50  $\Omega$  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 MHz and 20 MHz) may be activated to reduce unwanted high-frequency noise at 24 dB/octave for each channel.

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

### CHARACTERISTICS

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

#### Bandwidth –

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

#### 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 – $\Delta$ Volts dc accuracy:

With 11400:  $\pm$ (0.9% + 0.012 div).

With DSA 600:  $\pm$ (1.0% + 0.02 div).

Dc Balance, 1 to 99.5 mV/div:  $\pm$ (1.0 mV + 0.10 div).

Offset Accuracy, 1 to 99.5 mV/div ( $\pm$ 1 V range): ( $\pm$ 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:  $\pm$ 1 V; Resolution: 25  $\mu$ V.

100 mV to 0.995 V/div:  $\pm$ 10 V; Resolution: 250  $\mu$ V.

1 to 10 V/div:  $\pm$ 100 V; Resolution: 2.5 mV.

#### Overdrive Recovery –

1 to 99.5 mV/div: To within  $\pm$ (0.3% + 0.2 div) within 50 ns from  $\pm$ 2 V step.

100 to 995 mV/div: To within  $\pm$ 1% within 50 ns from  $\pm$ 20 V step.

1 to 10 V/div: To within  $\pm$ 1% within 50 ns from  $\pm$ 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 M $\Omega$  in parallel with 15 pF, or 50  $\Omega$   $\pm$ 0.5%

**Input Coupling Modes** – Ac, dc, and OFF.

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

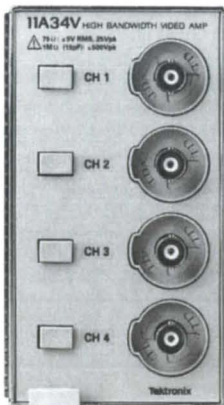
#### Maximum Input Voltage –

1 M $\Omega$  mode: 500 V (dc + peak ac).

50  $\Omega$  mode: The input impedance is switched to 1 M $\Omega$  when the input signal exceeds safe limits. Manual reset by re-selecting 50  $\Omega$  input impedance.

### NEW 11A34V HIGH BANDWIDTH VIDEO AMPLIFIER

The 11A34V is specifically designed as a companion amplifier for the 11T5H Multi-Standard Video Trigger to



11A34V Video Amplifier

meet the needs of TV/video applications. Engineers designing medical imaging equipment, HDTV components, high resolution graphics monitors, and other video systems will find the special features of the 11A34V bring new power to their design tasks. Features include convenient 75  $\Omega$ /1 M $\Omega$  switchable input impedance, display clamping and trigger source signals with the 11T5H Video Trigger. The 11A34V also offers the same high performance of the 11A34: four 300 MHz bandwidth channels, fast overdrive recovery, wide offset and dynamic range, and 1 mV/div to 10 V/div sensitivity settings.

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

### 11A34/11A32

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

### NEW 11A34V High Bandwidth Video Amplifier

- Four 300 MHz Channels
- 75  $\Omega$ /1 M $\Omega$  Switchable Input Impedance
- Companion Amplifier for 11T5H Multi-Standard Video Trigger

### ORDERING INFORMATION

**11A34** Four-Channel Vertical Amplifier **\$4,595**

Includes:

User Reference (070-5921-01),

Service Reference (070-6785-02).

**11A32** Two-Channel Vertical Amplifier **\$2,695**

Includes:

User Reference (070-5922-01),

Service Reference (070-6782-03).

**11A34V** High Bandwidth Video Amp. Includes: \*

User Reference (070-8178-00),

Service Reference (070-8179-00).

#### INSTRUMENT OPTIONS

**Opt. 3P** – (11A32, 11A34) **+\$375**

Includes: P6408 Word Recognizer/Trigger Probe.

**Opt. 22** – (11A32) **+\$360**

Includes: two P6134C probes.

**Opt. 23** – (11A34) **+\$720**

Includes: four P6134C probes.

#### ACCESSORIES

See page 64.

\*1 Contact your local sales office.

# PLUG-IN DIFFERENTIAL COMPARATOR AMPLIFIER

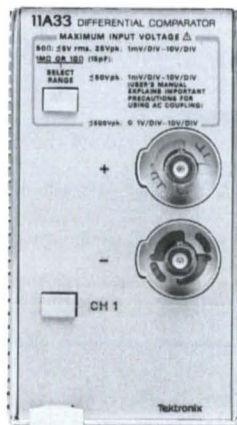
- DC to 150 MHz Bandwidth
- 1 mV to 10 V/Div Calibrated Deflection Factors in 1% Increments
- Very-High-Resolution Calibrated DC Offset 16,000-Division Effective Screen Height
- Differential DC Offset range of  $\pm 1$  V at 1 mV/Div
- High Common-Mode Rejection
- Fast Overdrive Recovery from Large Input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

## ORDERING INFORMATION

**11A33 Differential Comparator** \$3,995  
Includes:  
User Reference (070-6119-00),  
Service Reference (070-6784-01).

**INSTRUMENT OPTIONS**  
Opt. 24 - Includes a P6135A  
probe pair. +\$580

**ACCESSORIES**  
See page 64.



## 11A33 DIFFERENTIAL COMPARATOR

The 11A33 is a differential comparator amplifier plug-in with good common-mode rejection ratio (CMRR) and fast overdrive recovery.

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

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

Deflection Factor	1 mV to 99.5 mV/div	100 mV to 0.99 V/div	1 V to 10 V/div
Common-mode Signal range	$\pm 8$ V	$\pm 80$ V	$\pm 500$ V
Differential dc Offset range	$\pm 1$ V	$\pm 10$ V	$\pm 100$ V
V <sub>c</sub> range	$\pm 8$ V	$\pm 80$ V	$\pm 500$ V

## 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** -  $\Delta$ Volts dc accuracy:

With 11400:  $\pm(0.9\% + 0.01 \text{ div})$ .  
With DSA 600:  $\pm(1.0\% + 0.02 \text{ div})$ .  
Dc Balance, 1 to 99.5 mV/div:  $\pm(0.5 \text{ mV} + 0.10 \text{ div})$ .  
Differential Dc Offset Accuracy, 1 to 99.5 mV/div:  $\pm(0.25\% + 0.7 \text{ mV})$ .  
V<sub>c</sub> Accuracy, 1 to 99.5 mV/div (8 V range):  $\pm(0.15\% + 0.6 \text{ mV})$ .

For absolute dc accuracy of single point measurements using V<sub>c</sub>, add the V<sub>c</sub> Accuracy and dc balance terms.

**V<sub>c</sub> Range** -

1 to 99.5 mV/div:  $\pm 8$  V; Resolution: 25  $\mu$ V.  
100 mV to 0.995 V/div:  $\pm 80$  V; Resolution: 250  $\mu$ V.  
1 to 10 V/div:  $\pm 500$  V; Resolution: 2.5 mV.

**Differential DC Offset Range** -

1 to 99.5 mV/div:  $\pm 1$  V;  
100 mV to 0.995 V/div:  $\pm 10$  V;  
1 to 10 V/div:  $\pm 100$  V.

**Overdrive Recovery** - Recovers to within 0.25% of overdriving signal within 40 ns; to within 2 mV in 100  $\mu$ s; to within 1 mV in 300  $\mu$ s. Conditions: 1 to 99.5 mV/div; Overdriving signal steps to 0.0 V from  $\pm 8.0$  Volts; Slew rate  $\leq 0.5$  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  $\Omega$ , 1 M $\Omega$  in parallel with 15 pF, or 1 G $\Omega$  in parallel with 15 pF from 1 to 99.5 mV/div.

**Input Coupling Modes** - Dc, ac, V<sub>c</sub>, and OFF for each input. V<sub>c</sub> Coupling internally connects an amplifier input to the comparison voltage.

**Max Input Voltage** -

1 M $\Omega$  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  $\Omega$  mode: The input impedance is switched to 1 M $\Omega$  when the input signal exceeds safe limits. Manual reset by re-selecting 50  $\Omega$  input impedance.

LF Step Response aberrations: 0.1 V/div -110 V/div: less than  $\pm 1\%$  after the first 20 ns of input step.



# TWO-CHANNEL CURRENT AMPLIFIER HIGH BANDWIDTH VIDEO AMPLIFIER

11A16  
11T5H

NEW



## NEW 11A16 AMPLIFIER

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

With a sensitivity range of 1 mA/div to 2 A/div (with the A6302 probe) the 11A16 supports a wide variety of applications from medical monitors to machine control to power systems. The 11A16 is an excellent tool for power supply designers. With it, the engineer can make

simultaneous measurements on current and voltage waveforms, and use the waveform math capability of the 11000 Series and DSA 600 Series mainframes to calculate instantaneous power. You can verify power circuit design or monitor variations in power use by your target system.

## CHARACTERISTICS

(With A6302 Current probe.)

**Number of Channels** — Two.

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

**Rise Time** — 7 ns or less.

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

**Offset Range** —

1 mA/div to 99.5 mA/div;  $\pm 1$  A; Resolution: 25  $\mu$ A.  
0.1 A/div to 2 A/div;  $\pm 10$  A; Resolution: 0.025 div.

**Input Coupling Modes** — Ac, dc, and OFF.

## ENVIRONMENTAL CHARACTERISTICS

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

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

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

## INCLUDED ACCESSORIES

**Current Loop Adapter** — Part number 015-0601-00; used to calibrate current probes. The adapter connects to the mainframe Calibrator BNC. Current probes clip onto the adapter and probe calibration is performed.

**Voltage Converter** — Part number 015-0598-00. Used in service calibration procedures.

## NEW 11A16

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

## ORDERING INFORMATION

11A16 — Two-Channel Current Amplifier

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

### INSTRUMENT OPTIONS

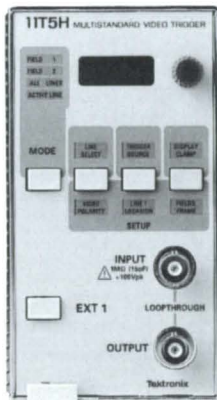
Opt. 20 — Includes two A6302 probes. \*1

## NEW 11T5H MULTI-STANDARD VIDEO TRIGGER

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

With the 11T5H, all major TV standards can be triggered on, including new HDTV standards with their high line count and tri-level sync. The 11T5H can handle line rates up to 1280 lines/frame. Engineers designing the latest HDTV components, medical imaging systems, high resolution graphics monitors, or other

state-of-the-art video equipment need the power of the 11000 Series with the 11T5H Multi-Standard Video Trigger.



## CHARACTERISTICS

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

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

**Trigger Jitter (Typical)** — 3 ns

**Input/Output** — EXT 1 input, loophrough output

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

## ENVIRONMENTAL CHARACTERISTICS

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

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

**Altitude** — Operating: to 4,570 m (15,000 ft.); Non-operating: to 15,200 m (50,000 ft.).

## NEW 11T5H

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

## ORDERING INFORMATION

11T5H Multi-Standard Video Trigger \*1

Includes:  
User Reference (070-7961-00),  
Service Reference (070-7962-00).

\*1 Contact your local sales office

## ORDERING INFORMATION

Accessory	Key Characteristics	Page	Order	Price
<i>(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.)</i>				
<b>Probes</b>				
Passive Probes (1 M $\Omega$ input)	10X, dc – 400 MHz, with readout and identify (11A32, 11A33, 11A34 only)	322	P6134C	<b>\$180</b>
	1X/10X, dc – 200 MHz with readout (11A32, 11A33, 11A34 only)	322	P6063B	<b>\$990</b>
Low-Z Probes (50 $\Omega$ input)	10X, dc – 9.0 GHz (11800 Series and CSA 803 only)	321	P6150	<b>\$1,295</b>
	10X, dc – 3.5 GHz, $\leq 1$ pF, 500 $\Omega$	321	P6156	<b>\$255</b>
	100X, dc – 3.0 GHz, $\leq 1.1$ pF, 5000 $\Omega$ (includes 10X tip)	321	P6156 Opt. 25	<b>\$315</b>
Bias-Offset Probe	10X, dc – 1.5 GHz, 1.6 pF, 450 $\Omega$	320	P6231	<b>\$525</b>
Active Probes	10X, dc – 1 GHz, $\geq 10$ M $\Omega$ input impedance, 1.9 pF	320	P6204	<b>\$1,470</b>
	10X, dc – 1 GHz, $\geq 10$ k $\Omega$ input impedance, 2.0 pF	320	P6203	<b>\$950</b>
Differential Probe	10X, dc – 150 MHz (11A33 only), 1 M $\Omega$ , 10.5 pF	327	P6135A	<b>\$695</b>
Optical-to-Electrical Converters	dc – 6.4 GHz, 1000-1700 nm (sampling head for 11800 Series and CSA 803 only)	288	SD42	<b>\$3,845</b>
	dc – 1 GHz, 1100-1700 nm	287	P6703A	**
	dc – 700 MHz, 450-1050 nm	287	P6701A	**
	dc – 300 MHz, 1000-1700 nm, High Gain	287	P6713	**
	dc – 250 MHz, 450-1050 nm, High Gain	287	P6711	**
Current Probes	dc – 50 MHz, 0-20 A (dc + peak ac)	325	AM503S	<b>\$2,400</b>
	dc – 15 MHz, 0-100 A (dc + peak ac)	325	AM503S Opt. 03	<b>\$3,030</b>
	25 kHz-1 GHz, max current of 0.5 A rms	325	CT-1	<b>\$270</b>
Cart	Instrument cart with tilt tray, drawer, power strip	307	K217S	<b>\$725</b>
Blank Panels	Plug-in (11400, DSA 600, CSA 404)	340	016-0829-00	<b>\$145</b>
	Sampling Head (11800, CSA 803 only)	340	200-3395-00	<b>\$.85</b>
Hard Copy Output and Printers	4-color pen plotter	295	HC100	<b>\$950</b>
	Dot matrix printer	296	HC200	<b>\$275</b>
	Color ink-jet printer	364	4696	<b>\$1,795</b>
Cables	GPIB, 2 m (DSA 600 only)	334	012-0630-03	<b>\$110</b>
	GPIB, 2 m (11400, 11800, CSA 803, DSA 600 only)	334	012-0991-00	<b>\$160</b>
	RS-232-C, 10 ft.	334	012-0911-00	<b>\$100</b>
	Centronics, 10 ft.	334	012-0555-00	<b>\$125</b>

Note: Other available accessories can be found on pages 294-341.

\*\*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 11400 Series, 11800 Series, CSA 803, and DSA 600 Series.

**i-Pattern™ Software** – Uses two- and three-dimensional graphic displays. Jitter and noise measurement pulse parametric measurements, mask testing, and Pass/Fail limit testing. 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. SPD MENU 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.

**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 257-270 for a complete description of the software packages available.



Complementary  
Modular Test  
Instruments available  
on page 197

### TECHNOLOGY HIGHLIGHTS

The highest performance, real-time oscilloscope is the 7104. 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 five oscilloscopes in the real-time family. A sampling rate equivalent to 250 GS/s is achieved when used with the DCS01.

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 two oscilloscopes in the real-time, crt-storage family.

Add digital storage to your 7000 Series mainframe (except the 7104) with the 7D20 Programmable Digitizer. The 7D20 has a 70 MHz bandwidth. It provides two channels of simultaneous acquisition, waveform storage, signal averaging, and cursor measurements. Typical applications include Ultrasonics, digital design, RF modulation, and automated production testing.

### 7000 SERIES SELECTION GUIDE

Instrument	Real-Time Bandwidth	Rise Time	Minimum Deflection Factor	Maximum Sweep Speed	Four Traces	Delayed Sweep	Technology
7104	1 GHz	350 ps	10 mV/div @ BW 10 $\mu$ V/div 1 mA/div	200 ps/div	yes	yes	(MCP) Real Time
7904A	500 MHz	700 ps	10 mV/div @ BW 10 $\mu$ V/div 1 mA/div	500 ps/div	yes	yes	Real Time
R7844	400 MHz	900 ps	10 mV/div @ BW 10 $\mu$ V/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 $\mu$ V/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 Persistence	Fast Variable Persistence	
7934	500 MHz	700 ps	500 ps/div	4000 cm/ $\mu$ s	yes	yes	yes	Real Time/ CRT Storage
7623B/R7623B	100 MHz	3.5 ns	5 ns/div	1000 cm/ $\mu$ s	yes	yes	yes	Real Time/ CRT Storage

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7623/R7623B 100 MHz Storage Oscilloscope .....	68

### PLUG-INS

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Time Bases .....	69

### ORDERING INFORMATION

#### 7904A OSCILLOSCOPE

**7904A** - Oscilloscope **\$15,100**  
Includes: Power cord (161-0066-00), Instruction Manual (070-4593-00).

#### 7904A OPTIONS

**Opt. 02** - X-Y Horizontal Compensation **+\$275**  
**Opt. 03** - EMC Modification **+\$500**

#### R7844 RACKMOUNT OSCILLOSCOPE

**R7844** Rackmount Oscilloscope **\$24,430**  
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).

#### R7844 OPTIONS

**Opt. 03** - EMC Modification **+\$500**  
**Opt. 22** - Writing-Speed Enhancer **+\$575**  
**Opt. 78** - BE (P11) Phosphor **+\$125**

#### INTERNATIONAL POWER PLUG OPTIONS

**Opt. A1 - A5** Available **NC**  
See page 374.

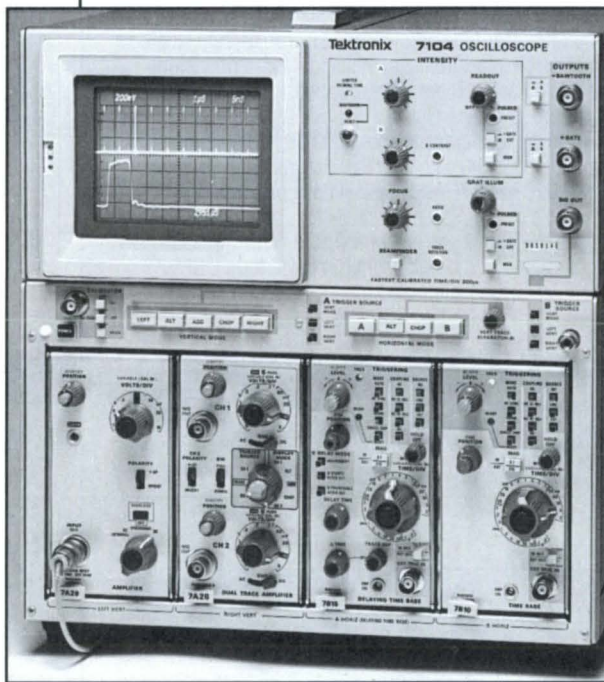
#### ACCESSORIES

**Recommended Cameras** - See page 70.  
**Recommended Carts** - See page 306.  
**Recommended Probes** - See page 70.

*For more information on the 7904A and R7844, contact your local sales representative.*

# 7104 1 GHz OSCILLOSCOPE

- 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



## HORIZONTAL SYSTEM

**Channels** – Two right-most plug-in compartments. Compatible with the 7B15, 7B85, and 7B92A, 7000 Series vertical amplifiers, and specialized plug-ins.

**Bandwidth** – Dc to 350 MHz.

**Display Modes** – A, Alt, Chop, B.

Chopped-mode repetition rate is  $\approx$  200 kHz.

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

**X-Y Mode** – With Option 02, X-Y Phase Compensation: Phase shift is  $2^\circ$  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  $2^\circ$  from dc to 50 MHz.

## CRT AND DISPLAY FEATURES

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

**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.

## ORDERING INFORMATION

(PLUG-INS NOT INCLUDED)

7104 1-GHz Oscilloscope \$31,550

Includes:  
Power cord (161-0066-00),  
Instruction Manual  
(070-2314-00),  
Operator Manual  
(070-2315-00).

### INSTRUMENT OPTIONS

Opt. 02 – X-Y Horizontal Compensation +\$450  
Opt. 03 – EMC Capability +\$500

### INTERNATIONAL POWER PLUG OPTIONS

Opt. A1-A5 – Available NC  
See page 374.

### CONVERSION KIT

EMC Modification – Order 040-0965-00 \$730

### ACCESSORIES

Recommended Cameras – DCS01. Also, see page 70.

Recommended Carts – See page 306.

Recommended Probes – See page 70.

### PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	305	12.0
Height	345	13.6
Depth	592	23.3
Weight –	kg	lb
Net	20.4	45.0
Shipping	25.4	56.0

## 7104 1-GHz OSCILLOSCOPE

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

The 7104'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. 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, Option 2, X-Y Phase-Compensation will give accurate X-Y displays to 250 MHz.

## CHARACTERISTICS

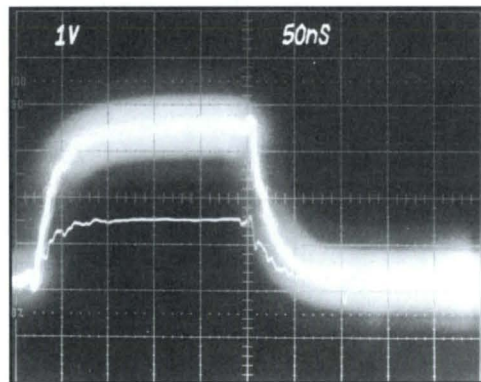
### VERTICAL SYSTEM

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

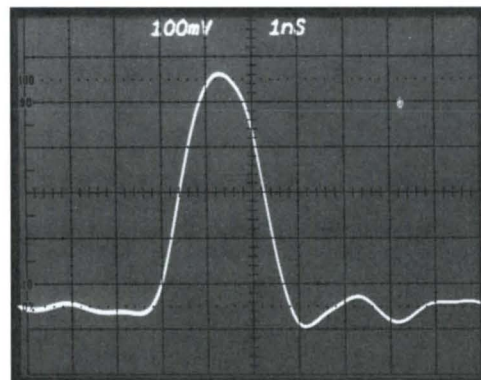
**Bandwidth, Rise Time and Deflection Factor** – Determined by the plug-in used. See page 69.

**Display Modes** – Left, Alt, Add, Chop, and Right. Chopped-mode repetition rate is  $\approx$  1 MHz.

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



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



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

## 7934 CRT-STORAGE OSCILLOSCOPE

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 wave-shapes, 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

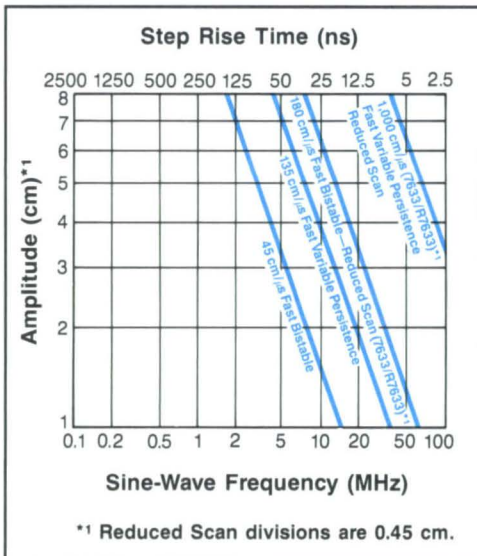
**Channels** – Two left-most plug-in compartments. Compatible with 7000 Series amplifier plug-ins.

**Bandwidth, Rise Time, and Deflection Factor** – Determined by the plug-in unit used. See page 69.

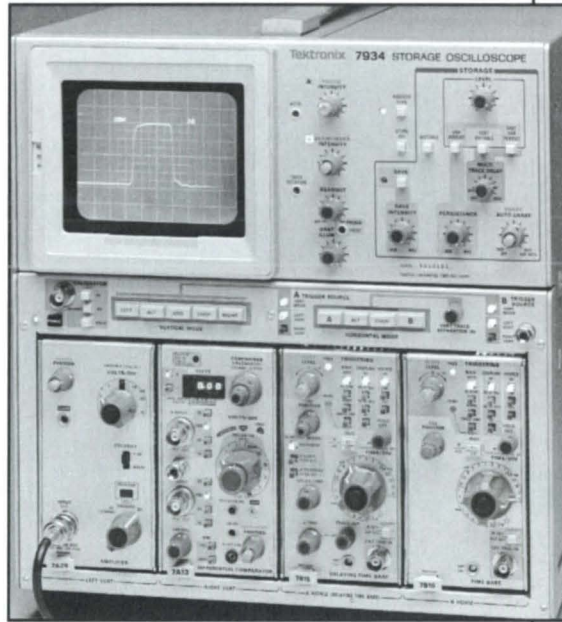
**Display Modes** – Left, Alt, Add, Chop, Right. Chopped-mode repetition rate is 1 MHz.

### HORIZONTAL SYSTEM

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



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



**Bandwidth** – Dc to at least 1 MHz.

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

### 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.

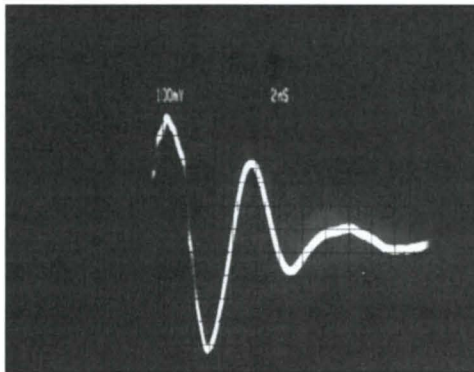
**Beam Finder** – Aids in locating an off-screen signal.

**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.



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.

- 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

## ORDERING INFORMATION

### (PLUG-INS NOT INCLUDED)

7934 – CRT-Storage Oscilloscope **\$16,100**

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 **+\$500**

### INTERNATIONAL POWER PLUG OPTIONS

Opt. A1-A5 Available **NC**  
 See page 374.

### CONVERSION KITS

X-Y Mode Phase Correction – Order 040-0942-01 **\$255**

EMC Modification – Order 040-1195-00 **\$630**

### ACCESSORIES

Service Manual – Order 070-5880-00 **\$180**

Rack Adaptor – See page 340.

Recommended Cameras – See page 70.

Recommended Cart – See page 306.

Recommended Probes – See page 70.

### 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

**7600 Series**

- DC to 100 MHz Bandwidth
- 3.5 ns Rise Time
- 5 ns/Div Fastest Calibrator Sweep Rate
- Requires only 5.25 inches of Rackmount Space

**7603 General Purpose**

- Greater than 260 cm/s Writing Speed With Optional CRT
- CRT Readout

**NEW 7623B CRT Storage**

- Able to Capture and Store Transients and Low Repetition Rate Signals
- 1000 cm/μs Stored Writing Speed
- Multimode Storage

**ORDERING INFORMATION****7603/R7603 OSCILLOSCOPE**7603 Oscilloscope **\$5,625**

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 **\$6,610**

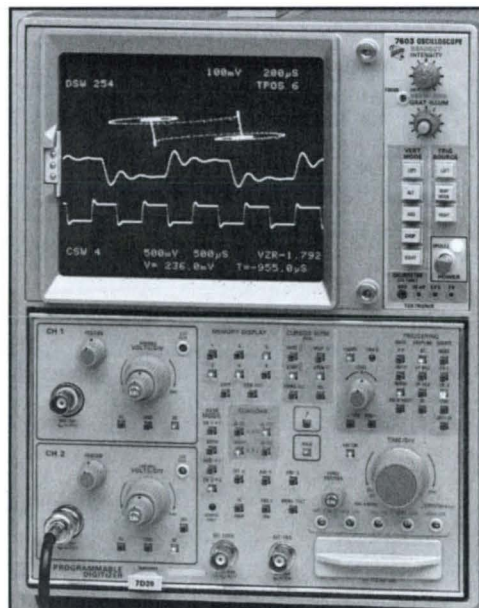
Includes: Same as 7603, plus a rackmounting hardware kit (016-0099-00).

**Opt. 03** – EMC Modification. **+\$500****Opt. 04** – High-Brightness 8 x 10-cm CRT Display. GH (P31) Phosphor.7603 **\$625**R7603 **\$600****Opt. 08 (7603)** – Protective Panel Cover. **+\$150****Opt. 20 (R7603)** – IEEE Standard 488 Interface for the 7D20 only. **+\$150****7623B/R7623B CRT-STORAGE**7623B CRT-Storage Oscilloscope **\$12,350**

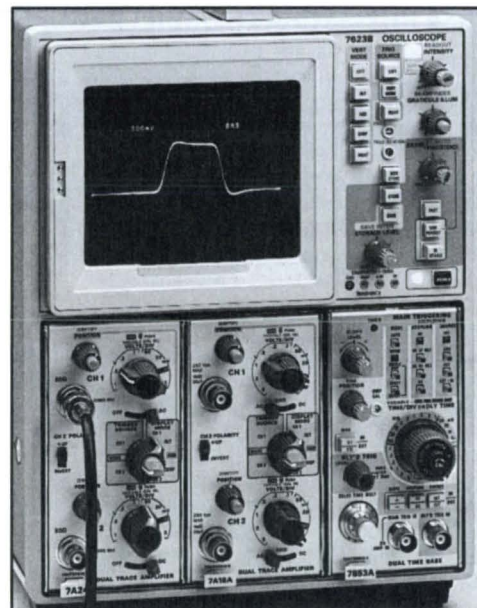
Includes: 20-in., two-pin-to-BNC cable (175-1178-00), green CRT filter (378-0625-08), power cord (161-0066-00), Instruction Manual (070-1767-00), Operator Manual (070-1766-00).

**R7623B** – Rackmount Oscilloscope **\$12,200**

Includes: Same as 7623B.

**Opt. 03** – EMC Modification. **+\$500****Opt. 08** – Protective Panel Cover. **+\$150****CONVERSION KITS****CRT Readout** – Order 040-0748-06 **\$880****EMC Modification** – Order 040-0663-01 **\$585****Rackmount Order** 040-0678-01 **\$475****Power Supply** – To light plug-in pushbuttons. Order 040-0686-01 **\$110****INTERNATIONAL POWER PLUG OPTIONS****Opt. A1-A5** Available **NC**  
See page 374.**ACCESSORIES****Recommended Cameras** – See page 70.**Recommended Carts** – See page 306.**Recommended Probes** – See page 70.**7603/R7603 OSCILLOSCOPES**

The 7603 and R7603 Oscilloscopes are general purpose 100 MHz, real-time oscilloscopes.

**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 69.**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.**7623B STORAGE OSCILLOSCOPE**

The 7623B 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. Available for rackmounting as R7623B.

**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 used. See page 69.**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.**CRT AND DISPLAY FEATURES****CRT** – Internal 8 x 10 division graticule with variable illumination. RN has additional graticule for the reduced-scan mode.**CRT Display Modes** – Nonstore, Bistable, Variable Persistence, Fast Bistable, Fast Variable Persistence. Reduced scan may be selected in all display modes.

**7000 SERIES VERTICAL AMPLIFIER SPECIFICATIONS**

Mainframes	Features	7A29	7A19	7A24	7A26	7A18A	7A13	7A22
		Widest bandwidth, single trace	High bandwidth, 50 Ω input	Dual trace, 50 Ω	Dual trace	Dual 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	1 mV/div	10 μV/div
	Accuracy <sup>1</sup>	2%	2%	2%	2%	2%	1.5%	3%
<b>7104</b> (0 to 35°C)	Bandwidth Rise Time <sup>3</sup>	1 GHz 0.35 ns	600 MHz 0.6 ns	400 MHz 0.9 ns	200 MHz 1.8 ns	100 MHz 3.5 ns	105 MHz 3.4 ns	1 MHz ±10% 350 ns ±9%
<b>7904A or 7934</b> (0 to 30°C)	Bandwidth Rise Time <sup>3</sup> SIG OUT	500 MHz 0.7 ns <sup>2</sup> 300 MHz	500 MHz 0.8 ns 300 MHz	350 MHz 1.0 ns 140 MHz	200 MHz 1.8 ns 140 MHz	100 MHz 3.5 ns 90 MHz	105 MHz 3.4 ns 100 MHz	1 MHz ±10% 350 ns ±9% 1 MHz ±10%
<b>R7844</b> (0 to 35°C)	Bandwidth Rise Time <sup>3</sup>	400 MHz 0.9 ns	400 MHz 0.9 ns	300 MHz 1.2 ns	180 MHz 1.9 ns	75 MHz 4.7 ns	100 MHz 3.5 ns	1 MHz ±10% 350 ns ±9%
<b>7600 Series</b> (0 to 50°C)	Bandwidth Rise Time <sup>3</sup> SIG OUT	100 MHz 3.5 ns 65 MHz	100 MHz 3.5 ns 65 MHz	100 MHz 3.5 ns 60 MHz	100 MHz 3.5 ns 60 MHz	75 MHz 4.7 ns 50 MHz	75 MHz 4.8 ns 55 MHz	1 MHz ±10% 350 ns ±9% 1 MHz ±10%

<sup>1</sup> Accuracy percentages apply to all deflection factors. Accuracy is without probes.

<sup>2</sup> R7903 with 7A29; rise time is 0.8 ns.

<sup>3</sup> Rise time is calculated from the bandwidth.

**7000 SERIES TIME BASE SELECTION GUIDE**

Performance Feature	7B15	7B92A	7B85	7B53A
Single-trace time base	yes	no	yes	no
Dual-trace time base	no	yes	no	yes
With mixed sweep	no	no	no	yes
TV Sync Triggering	no	no	no	yes (Opt. 05)
Can also use as delayed time base	yes	yes	yes	no
Delaying/ΔDelay sweep	yes	no	yes	no

**7000 SERIES TIME BASE/MAINFRAME RECOMMENDATION**

Mainframe	7B15	7B92A	7B85	7B53A
7104	yes	yes	no	no
7904A	yes	yes	yes	no
R7844	yes	yes	yes	no
7934	yes	yes	yes	no
7603/R7603	no	no	no	yes
7623B/R7623B	no	no	no	yes

**7D20 INFORMATION**

The 7D20 is a GPIB programmable plug-in compatible with all 7000 Series mainframes except the 7104. With a 7000 Series mainframe, it creates a fully programmable, digitizing oscilloscope.

The 7D20 offers signal averaging to reduce uncorrelated noise, envelope displays to compare dynamic characteristics of changing signals, pretrigger for viewing prior to the trigger event, storage of six independent waveforms plus a reference waveform, cursors for more accurate two-dot measurements, and user prompting menu displays to improve user-interface effectiveness.

A 40 MHz maximum sampling rate provides approximately 10 MHz single-shot bandwidth and up to 70 MHz repetitive signal bandwidth.

Since the 7D20 is completely programmable, fully automated measurement and testing is possible. Interactive test procedures, text messages, waveforms, and front-panel set-ups may be transmitted and received from the 7D20 to a controller or computer.

**ORDERING INFORMATION**

**7A29 AMPLIFIER**  
**7A29** – 1 GHz Amplifier **\$3,990**  
 Includes:  
 Instruction Manual (070-2320-00).  
**Opt. 04** – Variable Delay Line **+\$600**

**7A19 AMPLIFIER**  
**7A19** – 600 MHz Amplifier **\$3,995**  
 Includes:  
 Instruction Manual (070-2129-00).  
**Opt. 04** – Variable Delay Line **+\$550**

**7A24 AMPLIFIER**  
**7A24** – 400 MHz Amplifier **\$3,550**  
 Includes:  
 Instruction Manual (070-1485-00).

**7A26 AMPLIFIER**  
**7A26** – 200 MHz Amplifier **\$3,450**  
 Includes:  
 Instruction Manual (070-1484-01).

**7A18A AMPLIFIER**  
**7A18A** – 100 MHz Amplifier **\$2,225**  
 Includes:  
 Instruction Manual (070-4329-00).  
**Opt. 06** – DC Offset **+\$275**  
**Isolator A6902B** – See page 328.

**7A13 AMPLIFIER**  
**7A13** Differential Comparator Amplifier **\$4,795**  
 Includes:  
 Instruction Manual (070-1948-00).  
**Isolator A6902B** – See page 328. **\$2,200**  
**P6135A** – See page 70. **\$695**

**7A22 AMPLIFIER**  
**7A22** Differential Amplifier **\$2,785**  
 Includes:  
 Instruction Manual (070-0931-00).  
**P6135A** – See pages 70. **\$695**

**7B15 TIME BASE**  
**7B15** ΔDelaying Time Base **\$3,775**  
 Includes:  
 Instruction Manual (070-2318-00).

**7B92A TIME BASE**  
**7B92A** Dual Time Base **\$5,100**  
 Includes:  
 Instruction Manual (070-1751-02).

**7B85 TIME BASE**  
**7B85** ΔDelaying Time Base **\$2,800**  
 Includes:  
 Instruction Manual (070-1961-01).

**7B53A TIME BASE**  
**7B53A** Dual Time Base **\$3,025**  
 Includes:  
 Instruction Manual (070-1342-01).  
**Opt. 05** – TV Triggering **+\$210**  
 Includes:  
 Instruction Manual (070-1471-00).

**7D20 PROGRAMMABLE DIGITIZER**  
**7D20** Programmable Digitizer **\$10,750**  
 Includes:  
 Operator Manual (070-3857-01),  
 Pocket Reference Guide (070-3205-01),  
 Service Manual (070-3858-01),  
 Instrument Interface Guide (070-1728-00).

**ACCESSORIES**  
 See page 70.

7000 SERIES PROBE SELECTION GUIDE

All bandwidths given in MHz\*<sup>1</sup>

Plug-in	Passive 1 M $\Omega$ Input Probes				Low-Z, 50 $\Omega$ Input Probes		Active 50 $\Omega$ / 1 M $\Omega$ Input Probes			Differential Probes		High-Voltage Probes		
	P6062B*2 (6 ft.)	P6101A, Opt. 01 (1 m)	P6105A (2 m)	P6130, Opt. 01 (1.5 m) P6106A, Opt. 01 (1 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.)	P6135A	P6009 (9 ft.)	P6015 (10 ft.)	
7100 Family	7A13	—	34	75	105	NC	NC	105	105	105	70	90	85	—
	7A19	NC	NC	NC	NC	550	550	430	300	480	100	NC	NC	NC
	7A24	NC	NC	NC	NC	375	375	310	300	350	100	NC	NC	NC
	7A26	—	34	100	175	NC	NC	195	185	200	90	—	125	75
	7A29	NC	NC	NC	NC	950	925	660	450	800	100	NC	NC	NC
7900 Family	7A13	—	34	75	105	NC	NC	105	105	105	70	90	85	—
	7A18A	75	34	75	75	NC	NC	75	75	75	60	—	70	60
	7A19	NC	NC	NC	NC	500	500	430	300	480	95	NC	NC	NC
	7A22	1	1	NC	NC	NC	NC	—	—	—	—	1	—	—
	7A24	NC	NC	NC	NC	350	350	310	290	350	90	NC	NC	NC
	7A26	—	34	100	175	NC	NC	185	185	190	85	—	125	75
	7A29	NC	NC	NC	NC	500	500	450	350	500	700	—	NC	NC
7800 Family	7A13	—	34	100	100	NC	NC	100	100	100	70	90	85	60
	7A18A	85	34	85	85	NC	NC	90	75	90	65	—	80	60
	7A19	NC	NC	NC	NC	400	400	360	320	400	95	NC	NC	NC
	7A22	1	1	1	NC	NC	NC	—	—	—	—	1	1	1
	7A24	NC	NC	NC	NC	300	300	280	270	300	90	NC	NC	NC
	7A26	—	34	100	145	NC	NC	155	150	180	85	—	105	75
	7A29	NC	NC	NC	NC	400	400	400	350	400	100	—	NC	NC
7600 Family	7A13	70	34	70	75	NC	NC	75	75	75	55	65	65	55
	7A18A	70	34	70	70	NC	NC	75	75	75	55	—	65	55
	7A22	1	1	1	NC	NC	NC	—	—	—	—	1	—	—
	7A26	95	34	95	95	NC	NC	100	100	100	70	—	85	65

\*<sup>1</sup> 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.

\*<sup>2</sup> Bandwidths given for 10X switch position.

\*<sup>3</sup> Requires 1101/1101A Power Supply or other external source of power when used with 7603.

7000 SERIES CAMERA SELECTION GUIDE

Mainframe	Camera/Features		
	DCS01* <sup>1</sup> Digitizing	C-53 General Purpose	C-9 Low Cost
7104	yes	yes	yes
7934	N.R.	yes	yes
7904A	yes	yes	yes
R7844	N.R.	yes	yes
7623B/R7623B	N.R.	yes	yes
7603/R7603	N.R.	no	yes

\*<sup>1</sup> N.R. = Not Recommended



## 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 oscilloscopes are also used extensively in 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

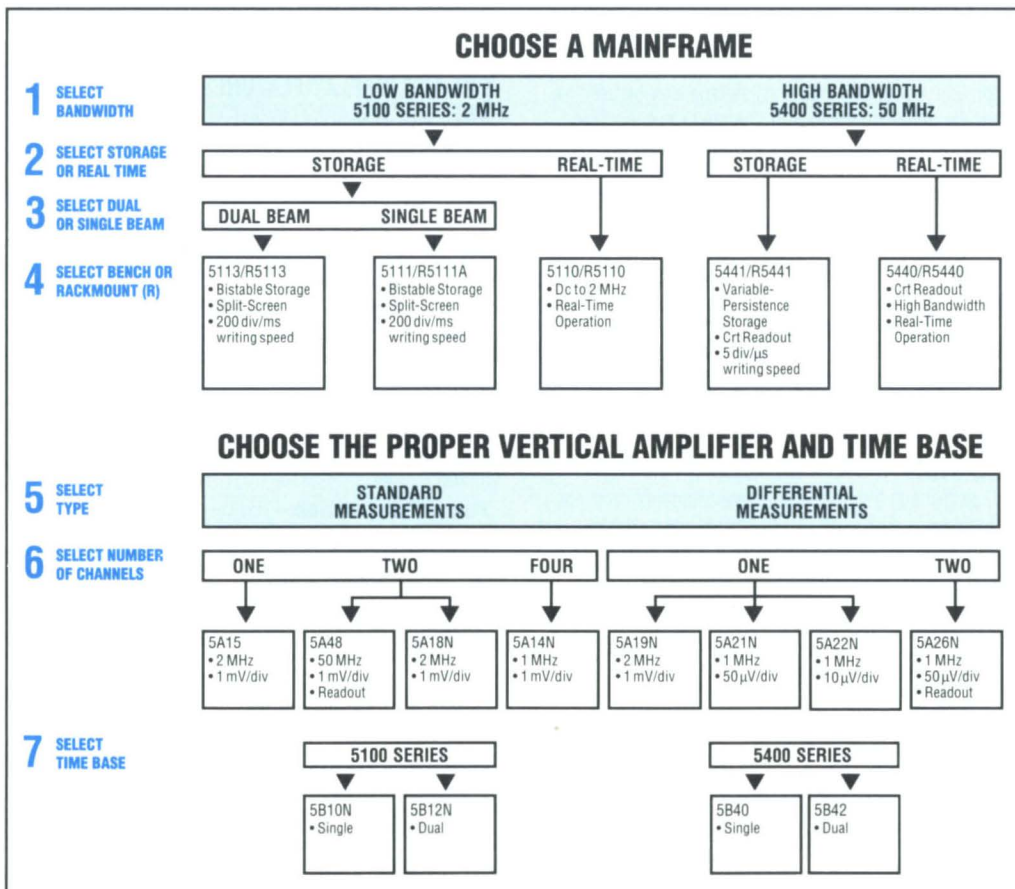
Choose a real-time scope for applications not requiring waveform storage, or when viewing repetitive signals greater than 50 Hz. Crt storage, on the other hand, is essential for displaying low repetition rate or slowly varying signals. Capturing transient or one-time events also requires a storage scope.

## VARIABLE PERSISTENCE OR BISTABLE STORAGE

The 5000 Series offers two types of crt storage: variable persistence or bistable. Variable persistence, provides a continuous gradation between the waveform and background. This is helpful when you want to suppress random noise or flicker, when you need to compare repetitive signals or produce bright, high contrast displays of fast signals occurring 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.

## 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  $\mu$ V/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 a Two-Gun CRT to eliminate 'dead time' between channels.



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5441/R5441  
5440/R5440

## 50 MHz MAINFRAME OSCILLOSCOPES

### High Bandwidth Real Time and Storage Mainframes.

- DC to 50 MHz Bandwidth
- CRT Readout
- 5 div/ $\mu$ s Stored Writing Speed
- Variable-Persistence Storage
- Dual X-Y Operation
- Wide Choice of Plug-Ins

### ORDERING INFORMATION

**5441/R5441** 50 MHz Storage Oscilloscope Mainframe\*<sup>1</sup>  
Includes: Instruction/Service manual (070-2140-01), 1 year warranty, Power cord (see page 78 for type).

**5441** \$7,995  
**R5441** \$7,995

**5440/R5440** 50 MHz Oscilloscope Mainframe\*<sup>1</sup>  
Includes: Instruction/Service manual (070-2139-01), 1 year warranty, Power cord (see page 78 for type).

**5440** \$5,275  
**R5440** \$5,395

Note: 'R' prefix indicates rack-mount version.

#### INSTRUMENT OPTIONS

**Opt. 01** – Without Crt Readout **NC**  
**Opt. 03** – User-Addressable Readout **+\$160**  
**Opt. 04** – Panel Cover (5440) **+\$45**

#### CONVERSION KITS

**CRT Readout** –  
Order 040-0691-02 <sup>2</sup>  
**Cabinet to Rack** –  
Order 040-0583-03 **\$315**  
**Rack to Cabinet** –  
Order 040-0584-04 **\$330**

#### INTERNATIONAL POWER PLUG OPTIONS

**Opt. A1** – **Opt. A5** – Power Plugs **NC**  
See page 78 for description.

#### ACCESSORIES

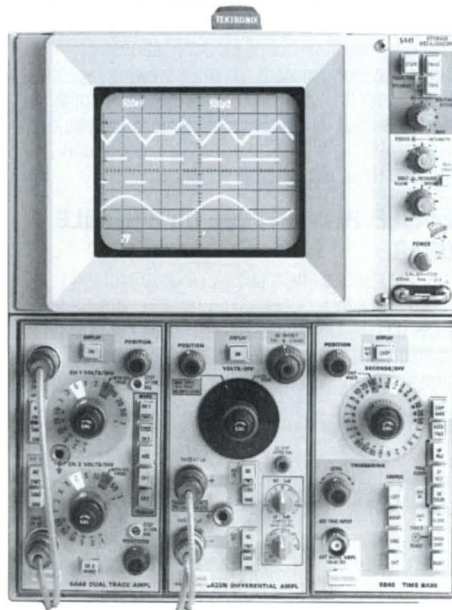
See page 78 for recommended accessories.

#### PHYSICAL CHARACTERISTICS

	Cabinet		Rackmount	
	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
<b>Weight</b>	<b>kg</b>	<b>lb</b>	<b>kg</b>	<b>lb</b>
Net	10.4	23.0	10.9	24.0
Shipping	14.5	32.0	19.5	43.0

\*<sup>1</sup> Plug-ins not included.

\*<sup>2</sup> Contact your local sales office.



5441

### 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\*, 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 needs.

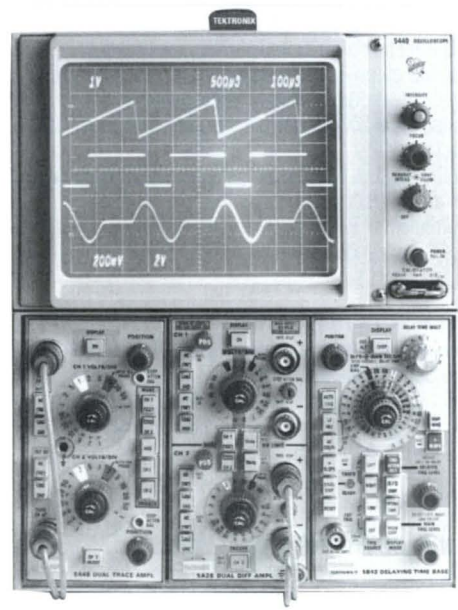
### CHARACTERISTICS

**VERTICAL SYSTEM** (Left and Center Compartments)

**Bandwidth and Rise Time (-3 dB)** – 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.



5440

**HORIZONTAL SYSTEM** (Right Compartment)

**Fastest Sweep Rate** – 10 ns/div (x10).

**X-Y Phase Shift** –  $\leq 2^\circ$  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/ $\mu$ s 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 Temperature** – 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

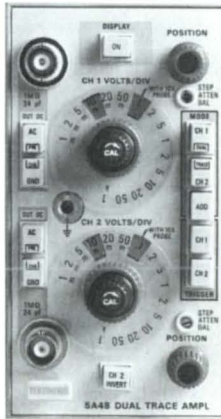
**User Addressable Readout** – Up to 20 characters, programmed by external resistors and switches.

**Warranty** – One year. See page 78 for Warranty-Plus options.

\*<sup>1</sup> 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.

# PLUG-IN AMPLIFIER AND TIME BASES FOR 5400 SERIES

**5A48**  
**5B42/5B40**



## 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** -  $\leq 3\%$  at 5 mV to 10 V/div, 15°C to 35°C;  $\leq 4\%$  at 5 mV to 10 V/div, 0°C to 50°C;  $\leq 5\%$  at 1 mV and 2 mV/div.

**Input R and C** - 1 M $\Omega$ ,  $\approx 24$  pF.

**Maximum Input Voltage** - Dc Coupled: 250 V (dc + peak ac). Ac Coupled: 500 V (dc + peak ac). 500 V p-p.

**Display Modes** - CH 1, CH 2, CH 2 Invert, Add, Alt, Chop.

## 5B42/5B40 HORIZONTAL TIME BASES

The 5B42/5B40 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 ( $\approx 1\%$ ) timing measurements to be made.

### CHARACTERISTICS

**Horizontal Sweep Rate** - 0.1  $\mu$ s to 0.5 s/div, 10 ns/div (X10).

**Sweep Accuracy** -

Time/Div	Unmagnified		Magnified	
	15°C to 35°C	0°C to 50°C	15°C to 35°C	0°C to 50°C
0.5 $\mu$ s to 1 s/div	3%	4%	4%	5.5%
0.1 $\mu$ s, 0.2 $\mu$ s, 2 s, and 5 s/div	4%	5%	5%	6.5%

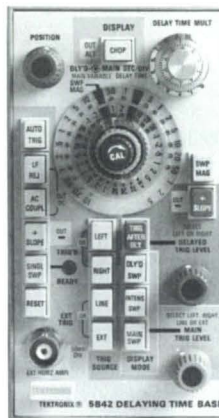
**Ext Horizontal Input** - Deflection Factor: 50 mV/div  $\pm 3\%$ . Input R and C: 1 M $\Omega$ ,  $\approx 24$  pF. Bandwidth: 2 MHz.

#### DELAYED SWEEP (5B42)

**Differential Time Measurement Accuracy** -  $\leq 1\% + 0.2\%$  of full scale from 1  $\mu$ s to 0.5 s delay time.

**Jitter** -  $\leq 0.05\%$  of one division of delayed sweep selected.

**Multiplier Range** - 0.2 to 10 times the time/div setting.



5B42



5B40

**Trigger Sensitivity** -

Mainframe	Frequency	Internal	External
5400	dc to 10 MHz	0.4 div <sup>*1</sup> 0.4 div <sup>*2</sup>	60 mV <sup>*1</sup> 100 mV <sup>*2</sup>
5400	10 MHz to 60 MHz	1.0 div <sup>*1</sup> 1.0 div <sup>*2</sup>	150 mV <sup>*1</sup> 400 mV <sup>*2</sup>
5100	dc to 2 MHz	0.4 div <sup>*2</sup>	100 mV <sup>*2</sup>

<sup>\*1</sup> 5B40 only.

<sup>\*2</sup> 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** -  $\pm 1.5$  V (5B40) and  $\pm 2.5$  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  
Includes: Instruction/Service manual (070-1450-00), 1 year warranty **\$1,595**

## 5B42/5B40

- 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  
Includes: Instruction/Service manual (070-1447-00), 1 year warranty **\$1,995**

**5B40**  
Single Time Base  
Includes: Instruction/Service manual (070-1742-00), 1 year warranty **\$1,195**

5113/5111A  
5110

## 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\*<sup>1</sup>  
Includes: Instruction/Service manual (070-2137-01).

**5113** \$5,995  
**R5113** \$5,995

**5111A/R5111A** 2 MHz Storage Oscilloscope Mainframe\*<sup>1</sup>  
Includes: Instruction/service manual (070-3934-00).

**5111A** \$4,195  
**R5111A** \$4,295

**5110A/R5110A** 2 MHz Oscilloscope Mainframe\*<sup>1</sup>  
Includes: Instruction/Service manual (070-2137-01).

**5110** \$2,895  
**R5110** \$2,995

#### INSTRUMENT OPTIONS

- Opt. 02** – Protective Cover (5113/5111A/5110) +\$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 78 for description.

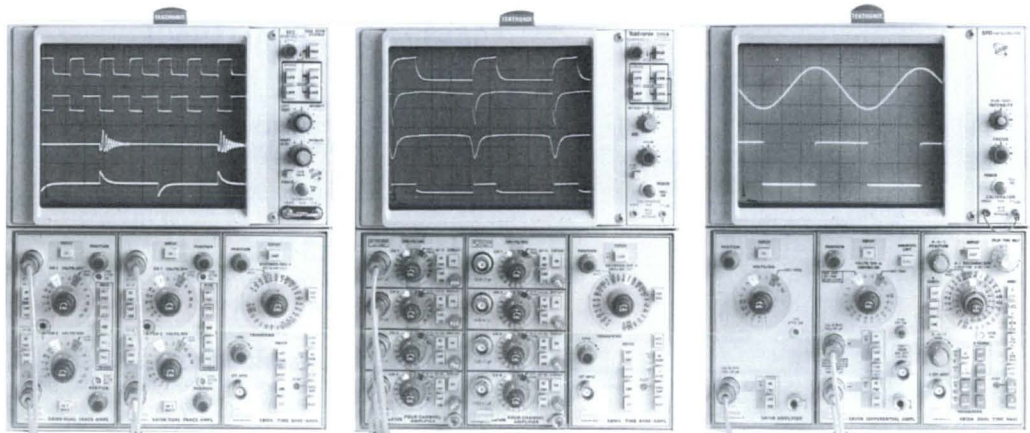
#### ACCESSORIES

See page 78 for recommended accessories.

#### PHYSICAL CHARACTERISTICS

	Cabinet		Rackmount	
	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
<b>Weight</b>	<b>kg</b>	<b>lb</b>	<b>kg</b>	<b>lb</b>
Net	10.4	23.0	10.9	24.0
Shipping	14.5	32.0	19.5	43.0

\*1 "R" prefix indicates rackmount version.



5113

5111A

5110

### 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  $\mu$ V/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.

### CHARACTERISTICS

**VERTICAL SYSTEM** (Left and Center Compartments)

**Bandwidth & Rise Time (-3 dB)** – 2 MHz and 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 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  $\mu$ s/div (x10).

**X-Y Phase Shift** –  $\leq 1^\circ$  from dc to 100 kHz.

### CRT AND DISPLAY FEATURES

**CRT** – 8 x 10 div, nonilluminated.

**Stored Writing Speed** – 5111A:  $\geq 20$  div/ms (Normal) and 50 div/ms (Enhanced). 5113:  $\geq 20$  div/ms.

**Opt. 03, Fast-Writing-Speed CRT** –  $\geq 200$  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

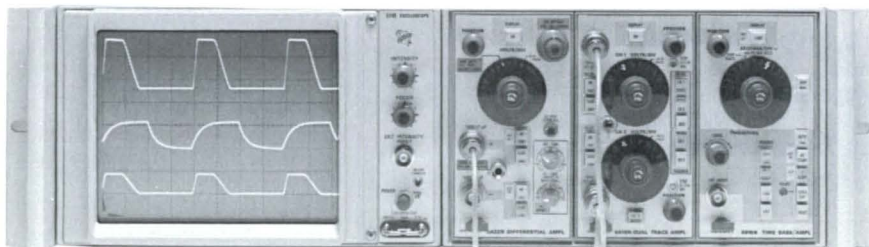
**Line Input** – 90 VAC to 250 VAC internally selected. 48 Hz to 440 Hz.

**Max Power Consumption** – 110 W.

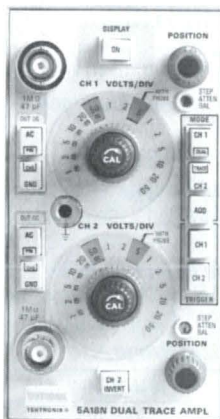
### ENVIRONMENTAL CHARACTERISTICS

**Ambient Temperature** – Operating: 0°C to +50°C; Nonoperating: -40°C to +70°C.

**Warranty** – One Year. See page 78 for Warranty-Plus options.



5000 Series mainframes also come in low-profile (5 1/4") rackmounts.



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

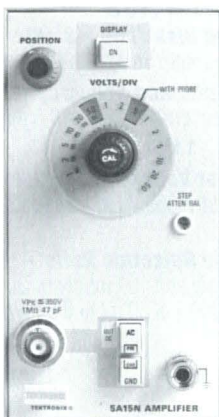
**Bandwidth and Rise Time (-3 dB)** – Dc to 2 MHz and 175 ns.

**Deflection Factor and Accuracy** –  $\leq 2\%$  at 1 mV to 5 V/div.

**Input R and C** –  $1\text{ M}\Omega$ ,  $\approx 47\text{ pF}$ .

**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.

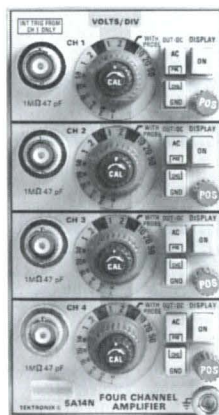
### CHARACTERISTICS

**Bandwidth and Rise Time (-3 dB)** – Dc to 2 MHz and 175 ns.

**Deflection Factor and Accuracy** –  $\leq 2\%$  at 1 mV to 5 V/div.

**Input R and C** –  $1\text{ M}\Omega$ ,  $\approx 47\text{ pF}$ .

**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** –  $\leq 2\%$  at 1 mV to 5 V/div.

**Input R and C** –  $1\text{ M}\Omega$ ,  $\approx 47\text{ pF}$ .

**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.

**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

<b>5A18N</b> Two-Channel Amplifier Includes: Instruction/Service manual (070-1137-00).	<b>\$1,095</b>
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### 5A15N

- DC to 2 MHz Bandwidth
- 1 mV to 5 V/div

### ORDERING INFORMATION

<b>5A15N</b> Single-Channel Amplifier Includes: Instruction/Service manual (070-1136-00).	<b>\$595</b>
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### 5A14N

- DC to 1 MHz Bandwidth
- Four Independent Channels
- 1 mV to 5 V/div

### ORDERING INFORMATION

<b>5A14N</b> Four-Channel Amplifier Includes: Instruction/Service manual (070-1229-00).	<b>\$2,195</b>
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# 5A22N/5A19N 5A21N

## DIFFERENTIAL AMPLIFIERS

**Wide Range of Differential Amplifiers Add Capability for Ultra Low-Level or Noisy Signal Applications.**

### 5A22N

- DC to 1 MHz Bandwidth
- 10  $\mu$ V to 5 V/Div
- 100,000:1 CMRR
- Selectable Bandwidth Limits
- Variable DC Offset

#### ORDERING INFORMATION

**5A22N**  
Differential Amplifier **\$1,595**  
Includes: Instruction/Service manual (070-1230-00).

### 5A21N

- DC to 1 MHz Bandwidth
- 10 kHz Bandwidth Limiter
- 50  $\mu$ V to 5 V/Div
- 100,000:1 CMRR
- Current-Probe Input

#### ORDERING INFORMATION

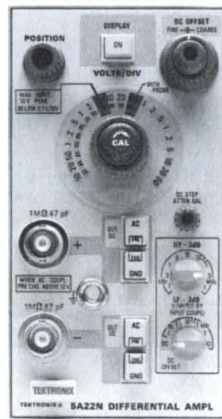
**5A21N**  
Differential Amplifier **\$895**  
Includes: Instruction/Service manual (070-1139-01),  
Opt. 01 - P6021 current probe. **+\$480**

### 5A19N

- DC to 2 MHz Bandwidth
- 1 mV to 20 V/Div
- 1,000:1 CMRR
- Variable DC Offset

#### ORDERING INFORMATION

**5A19N**  
Differential Amplifier **\$675**  
Includes: Instruction/Service manual (070-1328-00).



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** -  $\leq 3\%$  at 10  $\mu$ V to 5 V/div.

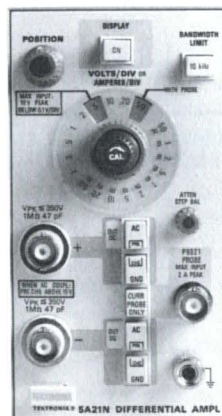
**Input R and C** - 1 M $\Omega$ ,  $\approx 47$  pF.

**Maximum Input Voltage** - 10 V (dc + peak ac) from 10  $\mu$ V 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  $\mu$ V to 100  $\mu$ V/div ( $\leq 30$  kHz). Ac Coupled: 10,000:1 at 10  $\mu$ V to 0.5 mV/div ( $\geq 5$  kHz).

**Signal and Offset Range** -

Deflection Factor	10 $\mu$ V to 50 mV/div	0.1 mV to 5 V/div
Common-Mode Range	$\pm 10$ V	$\pm 350$ V
Dc Offset Range	+0.5 to -0.5 V	+50 to -50 V



5A21N

### 5A21N

A dc to 1 MHz differential amplifier, the 5A21N provides a current-probe input. The voltage mode provides sensitivities to 50  $\mu$ V/div; with the optional P6021 current probe, sensitivities range from 0.5 mA to 0.5 A/div.

### CHARACTERISTICS

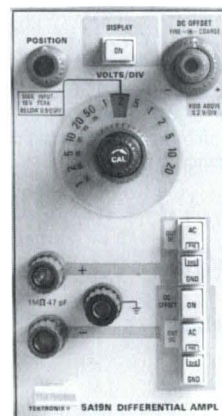
**Bandwidth and Rise Time (-3 dB)** - dc to 1 MHz and 350 ns. Bandwidth limit: 10 kHz.

**Deflection Factor and Accuracy** -  $\leq 2\%$  at 50  $\mu$ V to 5 V/div. Current probe:  $\leq 3\%$  at 0.5 mA to 0.5 A/div.

**Input R and C** - 1 M $\Omega$ ,  $\approx 47$  pF.

**Maximum Input Voltage** - 10 V (dc + peak ac) from 50  $\mu$ V 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  $\mu$ V and 100  $\mu$ V/div ( $\leq 30$  kHz). ac coupled: 10,000:1 at 50  $\mu$ V to 0.5 mV/div ( $\geq 5$  kHz).



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** -  $\leq 2\%$  at 1 mV to 20 V/div.

**Input R and C** - 1 M $\Omega$ ,  $\approx 47$  pF.

**Maximum Input Voltage** - 350 V (dc + peak ac).

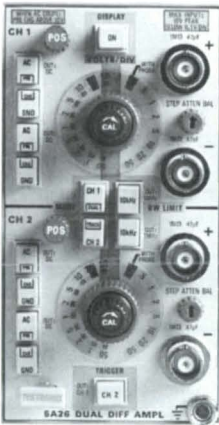
**Signal and Offset Range** -

Deflection Factor	1 mV to 200 mV/div	500 mV to 20 V/div
Common-Mode Range	$\pm 16$ V	$\pm 350$ V
Dc Offset Range	+15 to -15	+350 to -350 V

**Common-Mode Rejection Ratio** - 1,000:1 at 1 mV to 200 mV/div ( $\leq 10$  kHz), 100:1 at 0.5 V to 20 V/div.

# PLUG-IN DUAL DIFFERENTIAL AMPLIFIERS AND TIME BASES

**5A26/5B10N  
5B12N**



5A26

## 5A26

The 5A26 combines two independent differential amplifiers in one unit. It provides 50  $\mu\text{V}/\text{div}$  sensitivity at 1 MHz, high common-mode-rejection ratio, trigger-source selection and independent bandwidth limits.

With two 5A26s, up to four differential channels can be observed.

## CHARACTERISTICS

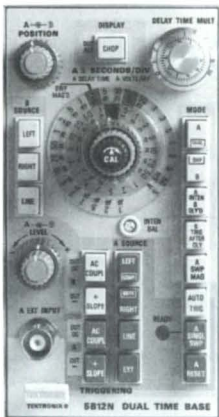
**Bandwidth and Rise Time (-3 dB)** - Dc to 1 MHz and 350 ns. Bandwidth limit: 10 kHz.

**Deflection Factor and Accuracy** -  $\leq 2\%$  at 50  $\mu\text{V}$  to 5 V/div.

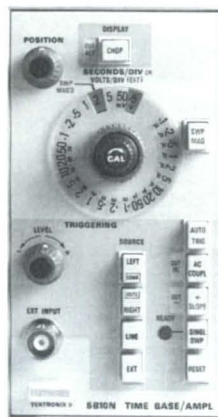
**Input R and C** - 1 M $\Omega$ ,  $\approx 47$  pF.

**Maximum Input Voltage** - 10 V (dc + peak ac) from 50  $\mu\text{V}$  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  $\mu\text{V}$  to 50 mV/div; 300:1 at 0.1 V to 5 V/div ( $\leq 30$  kHz). Ac Coupled: 20,000:1 at 50  $\mu\text{V}$  to 50 mV/div ( $\geq 5$  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  $\mu\text{s}$  to 5 s/div. 100 ns/div (X10); B Sweep: 0.2  $\mu\text{s}$  to 0.5 s/div.

**Sweep Accuracy** -  $\leq 3\%$  from 1  $\mu\text{s}$  to 1 s/div.  $\leq 4\%$  at 2 s and 5 s/div. Add 1% for X10 mag. B Sweep:  $\leq 3\%$  from 1  $\mu\text{s}$  to 0.1 s/div.  $\leq 4\%$  at 0.2  $\mu\text{s}$ , 0.5  $\mu\text{s}$ , 0.2 s, and 0.5 s/div.

### DELAYED SWEEP (5B12N)

**Delay Time** - Accuracy:  $\leq 1\%$  from 1  $\mu\text{s}$  to 1 s/div.  $\leq 2\%$  from 1 s to 5 s/div. Multiplier range: 0.2 to 10.2 times the time/div setting.

**Differential Time Measurement Accuracy** -  $\leq 1\% + 0.2\%$  of full-scale from 1  $\mu\text{s}$  to 0.5 s delay time.

**Jitter** -  $\leq 0.05\%$  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** -  $\pm 5$  V.

**External Horizontal Input** - Deflection Factor and Accuracy:  $\leq 3\%$  at 50 mV and 500 mV/div.

**Bandwidth (-3 dB)** - Dc to 1 MHz.

**Input R and C** - 1 M $\Omega$ ,  $\approx 70$  pF.

**Maximum Input Voltage** - 350 V (dc + peak ac).

## Dual Differential Amplifier and 5100 Series Time Bases.

### 5A26

- DC to 1 MHz Bandwidth
- 50  $\mu\text{V}$  to 5 V/div Sensitivity
- 100,000:1 CMRR
- CRT Readout (5400 Series)

## ORDERING INFORMATION

### 5A26

Dual Differential Amplifier \$1,895  
Includes: Instruction/Service manual (070-1947-00).

## 5B10N/5B12N

- 100 ns to 5 s/div Sweep Rates
- Alternate and Chopped Displays
- Dual and delayed sweep (5B12N)
- External horizontal amplifier

## ORDERING INFORMATION

### 5B10N

Single Time Base \$875  
Includes: Instruction/Service manual (070-1140-00).

### 5B12N

Dual Time Base \$1,795  
Includes: Instruction/Service manual (070-1141-00).

**Accessories and  
Options to Enhance  
Your 5000 Series Instru-  
ments.**

- *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-53P** – High Performance **\$2,560**  
(5441)  
**C-9** – General Purpose \*\*

**RECOMMENDED CART**

**K213** – Lab Instrument Cart  
For bench models. Plug-in  
storage available as Option 12. **\$700**

**OPTIONAL ACCESSORIES**

**Blank Plug-In Kit** – Order  
040-0818-04 **\$145**

**Blank Panel** – Order  
016-0452-01 **\$75**

**Viewing Hoods** –  
(Standard) Order 016-0154-00 **\$80**  
(Folding) Order 016-0260-00 **\$48**

**Protective Cover for Bench  
Version** – Order 016-0544-00 **\$18**

**Ground Isolation Monitor** –  
A6901 **\$1,200**

**Isolation Amplifier** – A6902B **\$2,200**

For more information on accessories see  
pages 294 to 341.

\*1 C4 should be used with  
illuminated graticule only.

\*\* Contact your local sales office.

**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
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

**PROBES**

Probe	Attenuation	Features
P6101A	1X	To 15 MHz bandwidth
P6006	10X	Rugged; monolithic
P6062B	1X/10X	Switchable; ground-reference button
P6015	1000X	High voltage
P6021		Current
P6007	100X	High voltage
P6202A	10X	FET (requires 1101A power supply)
P6135A	10X	Var Atten for high CMRR
P6102A	10X	To 60 MHz bandwidth
P6105A	10X	Full bandwidth

See pages 310-333 for additional information.

**WARRANTY-PLUS PACKAGES**

In addition to the one year product warranty, the following optional warranty packages are available:

- M7** – Additional 2 calibrations
- M9** – Additional 2 years service

Mainframes	M7	M9
5441	\$110	\$245
5440	\$100	\$235
5113	\$90	\$180
5111A	\$90	\$170
5110A	\$70	\$135
Vertical Plug-ins		
5A18N	\$ 55	\$ 65
5A15N	\$ 35	\$ 80
5A14N	\$ 70	\$110
5A26	\$ 70	\$100
5A22N	\$ 70	\$110
5A21N	\$ 65	\$ 90
5A19N	\$ 45	\$ 80
Time Base Plug-ins		
5B42	\$ 70	\$115
5B40	\$ 65	\$ 90
5B12N	\$ 70	\$110
5B10N	\$ 65	\$ 65

**INTERNATIONAL POWER PLUG OPTIONS**

Option	Type	Description	Part Number
Opt. A1	Universal Europe	220 V, 50 Hz	(020-0859-00)
Opt. A2	United Kingdom	240 V, 50 Hz	(020-0860-00)
Opt. A3	Australian	240 V, 50 Hz	(020-0861-00)
Opt. A4	North American	240 V, 60 Hz	(020-0862-00)
Opt. A5	Switzerland	220 V, 50 Hz	(020-0863-00)

**CUSTOM MODIFICATIONS**

In addition to the many standard and optional features available on the 5 K scopes, there are numerous custom modifications you can order to fit the instrument to your application.

This is a partial list of custom mods. They can be ordered with the help of your local field sales representative. Price and delivery are quoted for each custom order.

Mod #	Description
135J	Auto erase with variable view time and save
434A	135J + 710R
710R	XY/YT switching of center compartment signal
711C	Add control on 5B10N for switch in MOD 710R
768V	CH 1 and CH 2 signal to rear with MOD 768X
768X	6 signal output buffers to rear BNC's on mainframe
817B	6 rear BNC's on mainframe for signal input
817G	Input to rear of plug-in for use with mainframe mod
WT	IEC power con; delete chassis tracks
ZA	96 hr burn-in



### 2400 SERIES OSCILLOSCOPES

The Tektronix 2400 Series Portable Oscilloscopes represent the most widely used and accepted line in the industry:

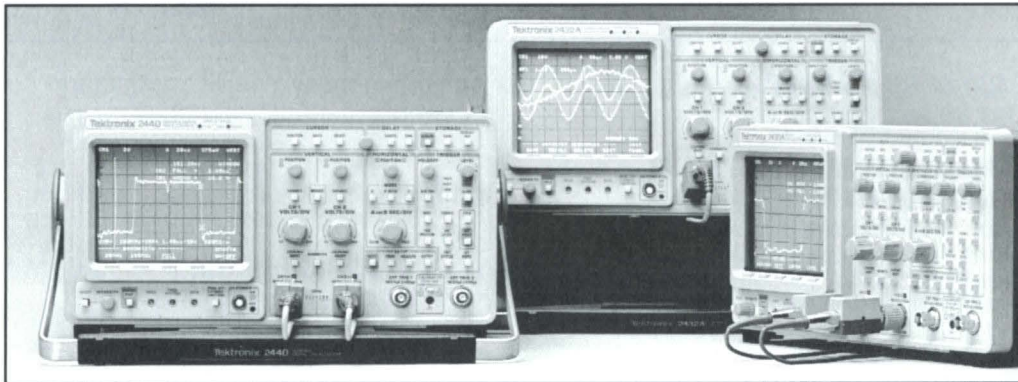
- The 2440 features the highest sample rate available in a portable scope.
- The 2467B "BrightEye" offers unsurpassed writing rate for the ultimate in fast event capture.
- The 2465B sets the standard against which other general-purpose portable scopes are measured.

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 2402A TekMate™ Instrument Extension expands 2400 Series digitizing oscilloscopes' capabilities for waveform storage, analysis, and pass/fail testing.



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2465BCT 400 MHz, Precision Timing .....	85

#### AUTOMATED DIGITIZING OSCILLOSCOPES

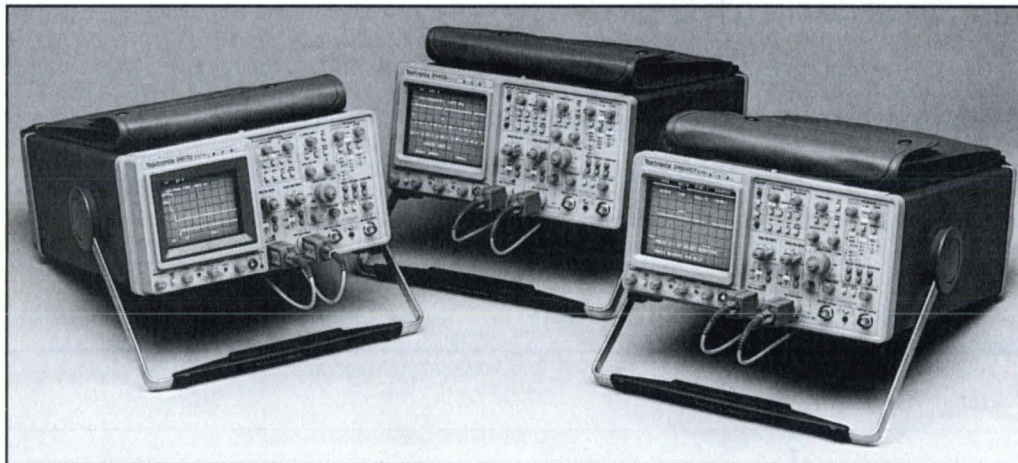
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**T**he Highest Performance and Automation Available in Portable Analog Scopes.

- 400 MHz Bandwidth (2467B/2465B)
- 500 ps/Div Time Base (2467B/2465B)
- Automatic Push-Button Setup and Measurements
- 4 Channels
- SAVE, RECALL, and SEQUENCE of Setups
- Lightweight and Rugged
- Cursor Measurements
- 1% Timing Accuracy



**2400 SERIES ANALOG  
OSCILLOSCOPES**

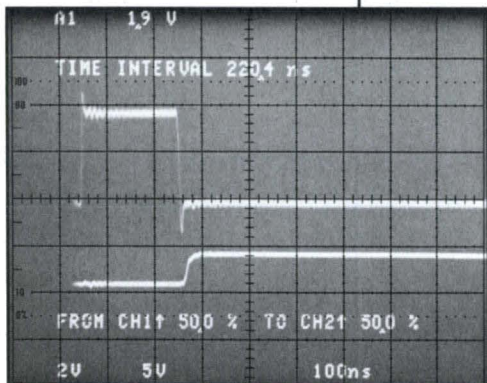
**CONVENIENCE, FAMILIARITY, AND  
STANDARD-SETTING PERFORMANCE**

The 2400 Series 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.

200 – 400 MHz 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, even as you make circuit adjustments and gives 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 2400 Series. Attach up to four probes to your signal points, press AUTOSETUP, 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.



*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.*

**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**

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.

**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.

**CUSTOMIZING THE 2400 SERIES**

Besides standard-setting performance features such as high signal fidelity, automatic setups and push-button measurements, advanced easy to use triggering and permanent memory for front-panel setups, the 2400 Series analog oscilloscopes can be configured to give you even more power. For demanding applications, a set of special options has been developed to customize these oscilloscopes. Whether you're doing dc troubleshooting, digital debugging, graphic display analysis or automating a manufacturing test system, the 2400 Series offers all the flexibility necessary to do the job. Choose the oscilloscope and option package that best fits your application. For your convenience Tektronix has bundled its most popular options into cost saving packages. For more information see page 85.

**AUTOMATING THE TEST PROCESS**

**Option 10** is a GPIB interface which provides remote programmability for your scope. 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 GPIB 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.

This option is recommended for use with DCS01.

**2400 Series 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 257-270.

**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 for developing procedures for Tektronix 2400 Series analog oscilloscopes and 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.

The DCS01 Digitizing Camera System can capture waveforms and digitize them for analysis and documentation on an IBM PC. See page 130.

**ADVANCED TROUBLESHOOTING**

**Option 01** provides an integral, fully programmable autoranging DMM. Features include averaging and smoothing of 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.

**Option 09** was designed to optimize the 2400 Series for a range of digital applications. The Counter/Timer/Trigger (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, providing isolation of complex events. The 17-bit parallel Word Recognizer (WR) 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 Option 06. Word Recognizer capability cannot be added to Option 06 later; it must be included at purchase.

**External Clock** (Option 1E, available only with Option 09 or Option 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.

**VIDEO MEASUREMENTS**

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.

**DMM (OPT 01)**

- 4.5 Digit Autoranging DMM
- True RMS AC Volts and Current from 20 Hz to 100 kHz
- 10  $\mu$ V Resolution on dc Volts
- Continuity Beeper
- Temperature Probe  $-62^{\circ}\text{C}$  to  $+230^{\circ}\text{C}$

**COUNTER/TIMER/TRIGGER/WORD RECOGNIZER (OPT 09)**

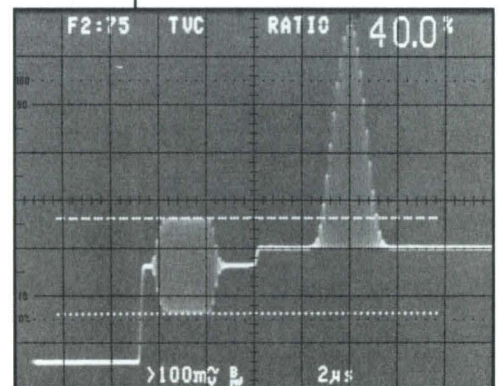
- 0.001% Crystal-Controlled Time Base
- Count up to 9,999,999 Events
- Delay-by-Events Triggering
- Boolean Logic Triggering
- 17-Bit Word Recognizer

**GPIB INTERFACE (OPT 10)**

- Front Panel Remote Control
- User-Generated and Controlled SRQ's
- Interface Parameters Selectable at Front Panel

**VIDEO MEASUREMENT (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)
- TV Waveform Monitors Type Vertical Response



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.

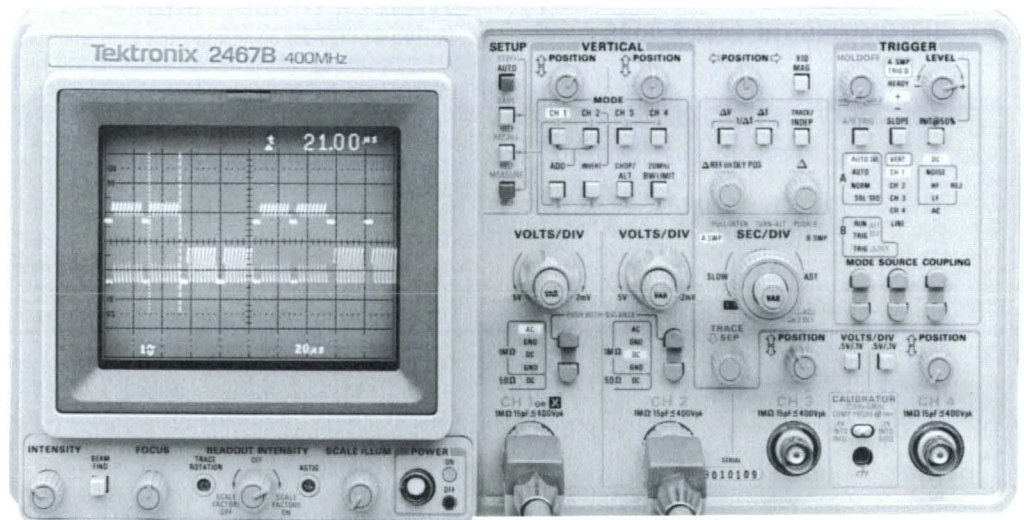
# 2467B HIGH WRITING-SPEED BRIGHT EYE™ OSCILLOSCOPE

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

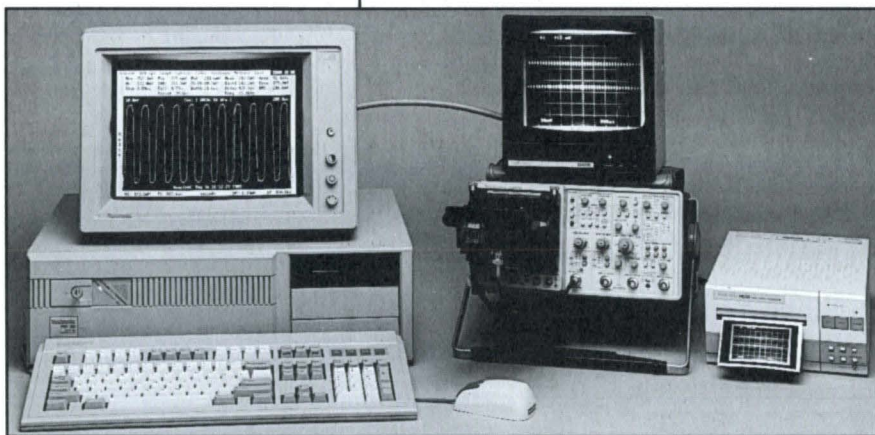
### A VISIBLE DIFFERENCE

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.

### 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 crt's. 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 also works with the DCS01 Digitizing Camera System. The result is a 400 MHz single-shot waveform digitizing system with up to 5 ps/point digitizing with 100 GS/s effective sampling rate.



The 2467B Option 10 and Tek Digitizing Camera System combine to give you 400 MHz single-shot capability with up to 10 ps/point digitizing. See page 130.

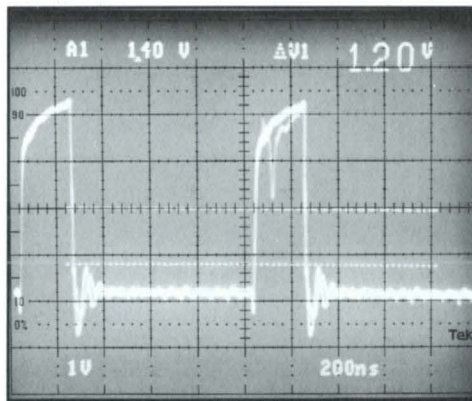
### WHAT IS VISIBLE WRITING SPEED?

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.

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. Thus, you can make circuit adjustments and see the change immediately. This gives you confidence that critical events are consistently captured and displayed, even if they occur intermittently.

## FAULT FINDING WITH THE 2467B

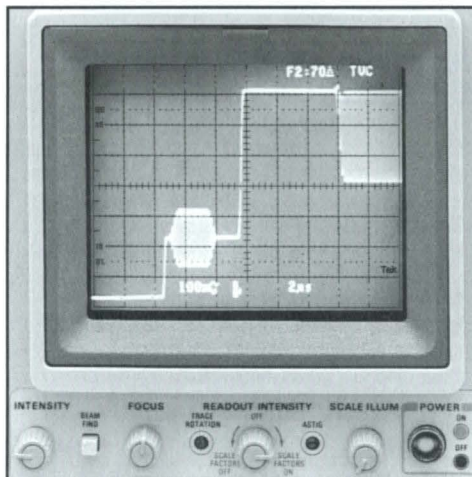
The 2467B is an effective tool for digital design and test engineers and a perfect companion for logic analyzers in troubleshooting a digital system. The 2467B's high writing rate MCP display immediately shows faults caused by asynchronous noise, crosstalk, bus contention, marginal timing, and metastability.



*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.



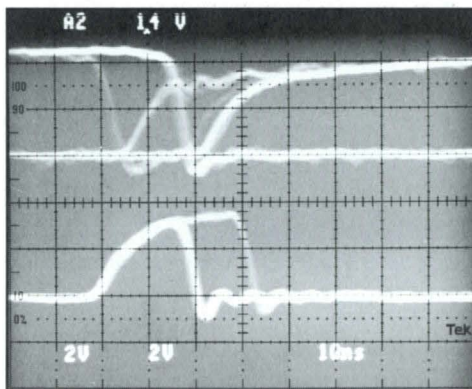
*At slower sweep speeds, viewing individual lines of a video signal is difficult with conventional crt's. This MCP crt displays the line brightly, even with its intensity control set to a low level.*

## 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.

## HDTV TROUBLE SHOOTING

The 2467BHD is a special 2467B which is ideal for trouble shooting HDTV signals. For complete details about this product, please refer to our Television Test Equipment products section in this catalog, page 348.



*This 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.*

## ORDERING INFORMATION

**2467B** 400 MHz, High Writing Speed Oscilloscope **\$12,950**  
Includes: four 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 (070-6861-00), and pocket guide (070-7148-01). See page 86 for detailed product specifications.

### INSTRUMENT OPTIONS

- Opt. 05** – Video Measurements **+\$1,295**  
Includes: same as standard instr., plus CCIR graticule filter, NTSC graticule filter, and polarized, collapsible viewing hood (016-0180-00).
- Opt. 06** – Counter/Timer/Trigger **+\$1,295**  
Includes: same as standard instr.
- Opt. 09** – CTT/Word Recognizer **+\$1,835**  
Includes: Opt. 06, plus Word Recognizer Probe P6407, SMT KlipChip™ Adapters (206-0364-00), and two ten-wide combs with 10-inch leads (012-0747-00).
- Opt. 1E** – External Clock for CTT **+\$225**  
only available with Opt. 06 or Opt. 09.
- Opt. 10** – GPIB Interface **+\$1,010**  
(IEEE-488)  
Includes: same as standard instr., plus Instrument Interfacing Guide (070-6859-00).
- Opt. 11** – Rear Panel Probe Power **+\$225**  
Not available if instr. is equipped with Opt. 09 Word Recognizer.
- Opt. B1** – Standard Service Manual (070-6863-00) **+\$55**
- Opt. B2** – Options Service Manual Includes: Information from Standard Service Manual + service information for all options listed above (070-6864-00). **+\$30**
- Opt. 1R** – Rackmount kit **+\$350**  
Includes: rackmount hardware and slide-out assemblies, deletes snap pouch.
- Opt. 1T** – Transit Case telescoping handle & retractable wheels. **+\$475**
- Opt. 5H** – HDTV measurements **+\$1,545**  
Includes: same as standard instr., plus CCIR graticule filter, NTSC graticule filter, and polarized, collapsible viewing hood (016-0180-00).  
*Note: Instrument options are not retrofittable after purchase.*

### INTERNATIONAL POWER PLUG OPTIONS

**Opt. A1-A5** – See page 374. **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** – 5 yrs warranty **+\$440**  
**Opt. M8** – 5 yrs calibration **+\$575**

**DIGITIZING CAMERA SYSTEM**  
**DCS01 Opt. 2A** **\$7,340**  
For addl. information, see pg 130.

**OPTIONAL ACCESSORIES** – See page 94

**SOFTWARE FOR 2400 SERIES**  
**EZ-Tek 2400** **\$500**  
For more information see pg 258.

## ORDERING INFORMATION

**2465B 400 MHz, Auto-Measuring Oscilloscope \$6,460**

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), and Pocket Guide (070-7148-01).

**2445B 200 MHz Auto-Measuring Oscilloscope \$4,395**

Includes: same as 2465B, except two P6136 Opt. 25 10X probes (1.3 m).

## INSTRUMENT OPTIONS

**Opt. 05 - Video Waveform Measurement System +\$1,295**

Includes: same as standard instr., plus CCIR graticule filter, NTSC graticule filter, and polarized, collapsible viewing hood (016-0180-00).

**Opt. 06 - Counter/Timer/Trigger +\$1,295**

Includes: same as standard instr.

**Opt. 09 - Counter/Timer/Trigger with Word Recognizer +\$1,825**

Includes: Opt 06, plus Word Recognizer Probe (010-6407-00) 20 SMT KlipChip™ Adapter (206-0364-00), and two ten-wide combs with 10-inch leads (012-0747-00).

**Opt. 1E - External Clock for Counter/Timer/Trigger +\$225**

Only available with Opt 06 or 09.

**Opt. 10 - GPIB Interface (IEEE 488) +\$1,010**

Includes: same as standard instruments, plus Instr. Interfacing Guide (070-6859-00).

**Opt. 11 - Rear Panel Probe Power Not available with Opt. 09.****Opt. 22 - Two additional matching probes (2445B) +\$250 (2465B) +\$350****Opt. B1 - Standard Service Manual 2465B: (070-6863-00) +\$55 2445B: (070-6862-00)****Opt. B2 - Options Service Manual +\$30**

Includes: All information from Standard Service Manual plus service information for options listed above (070-6864-00).

**Opt. 1R - Rackmount kit +\$350**

Includes rackmount hardware and slide-out assemblies, deletes snappouch.

**Opt. 1T - Transit Case +\$475**

Telescoping handle & retractable wheels.

Note: Instrument options are not retrofittable after purchase.

**INTERNATIONAL POWER PLUG OPTIONS Opt. A1-A5 - See pg 374. 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 - 5 yrs warranty 2465B +\$370 2445B +\$340****Opt. M8 - 5 yrs calibration 2465B +\$255 2445B +\$255**

## DIGITIZING CAMERA SYSTEM

**DCS01 Opt. 2A \$7,340**

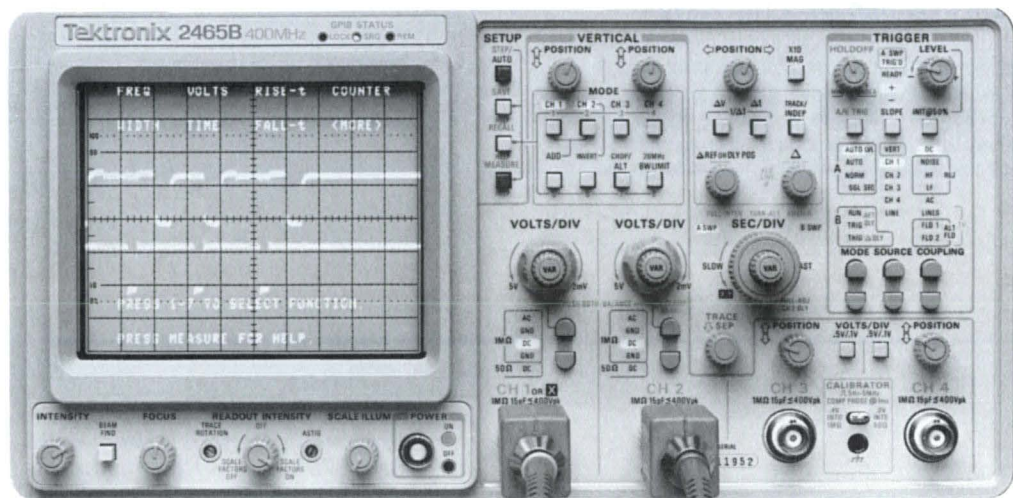
For additional information, see pg 130.

## OPTIONAL ACCESSORIES - See pg 94

## SOFTWARE FOR 2400 SERIES

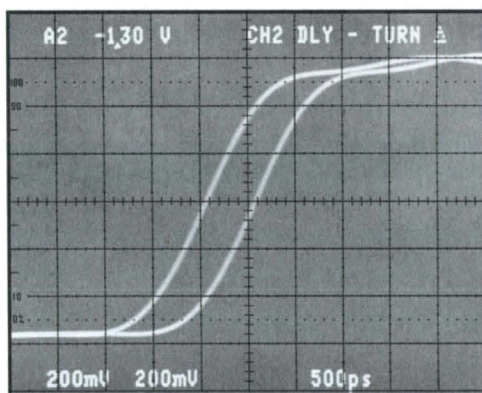
**EZ-Tek 2400. Order S38A101 \$550**

For more information see pg 258.

THE WORLD'S MOST POPULAR  
PORTABLES

Tek state-of-the-art technology makes possible the 2465B's 400 MHz bandwidth and pushes the limits again by increasing the 2445's bandwidth to 200 MHz. These scopes also provide pushbutton measurements never before seen in analog instruments. In addition, new pushbutton probes take the full bandwidth to the probe tip - where you really need it.

No other portable oscilloscopes answer so many diverse, demanding requirements in research and design, manufacturing and service. You can count on the 2465B and the 2445B for needs ranging from waveform observation and quality measurement to fully automated testing.

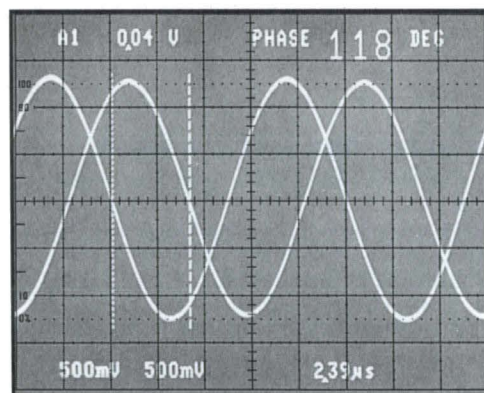


Adjustable delay increases accuracy. A front-panel knob adjusts the Channel 2 delay to exactly match the Channel 1 delay from the probe tip.

HIGH PERFORMANCE - THE FIRST  
PRIORITY

Both the 400 MHz 2465B and the 200 MHz 2445B achieve timing accuracies to 1%. You can make high-resolution timing measurements with sweep speeds to 500 ps/div in the 2465B, to 1 ns/div in the 2445B. And trigger on signals to 500 MHz and 250 MHz on the two instruments respectively - thus extending the usefulness of each scope well beyond its vertical bandwidth.

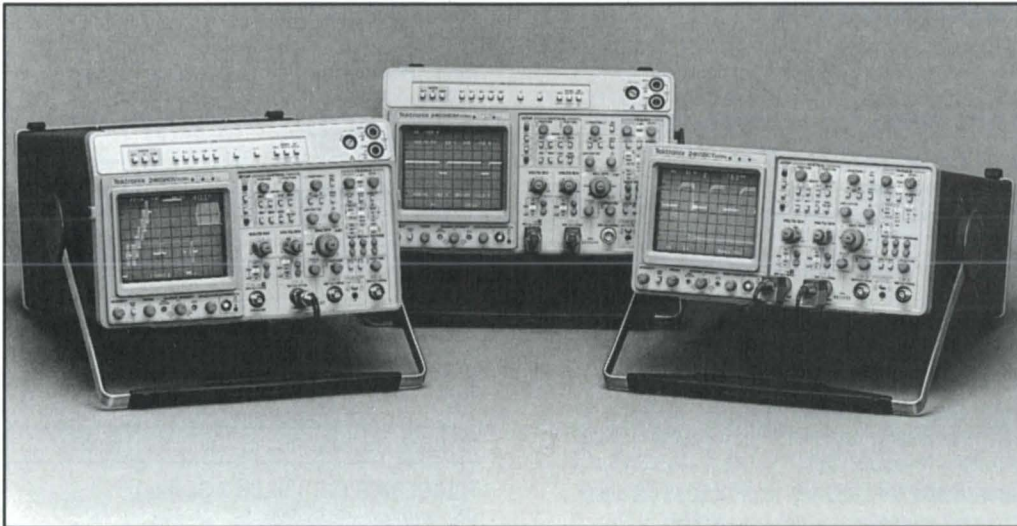
True four-channel capability includes two channels optimized for logic signals. You can also make three-channel X-Y comparisons such as multiple transducer measurements.



Measure phase shift in degrees or percent. The continuously-calibrated variable sec/div control sets one cycle (360° or 100%) to five horizontal divisions. The time cursors make phase and percentage measurements directly.

# 2400 SERIES ANALOG BEST VALUE PACKAGES

**2465BDV/2465BDM/  
2465BCT**



## 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 SCOPE

For 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

Features	Standard Models		Special Packages		
	2465B	2445B	2465BDV	2465BDM	2465BCT
Bandwidth	400 MHz	200 MHz	400 MHz	400 MHz	400 MHz
General Purpose Interface Bus	Opt. 10	Opt. 10	Included	Included	Included
Counter/Timer/Trigger Word Recognizer	Opt. 09	Opt. 09	Included	Included	Included
Digital Multimeter	Opt. 01	Opt. 01	Included	Included	—
Video Measurement System	Opt. 05	Opt. 05	Included	—	—
Two additional probes	Opt. 22	Opt. 22	Included	Included	Included
Rackmount	Opt. 1R*1	Opt. 1R*1	Opt. 2R	Opt. 2R	Opt. 1R
Probe Power	Opt. 11	Opt. 11	—	—	—
Warranty	3 years, parts and labor		3 years, parts and labor		

\*1Specify Opt 2R if Opt 01 (DMM) is ordered.

## ORDERING INFORMATION

**2465BCT** 400 MHz Precision Timing Oscilloscope **\$8,715**

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 **\$10,185**

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 **\$11,200**

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.

### INSTRUMENT OPTIONS

**Opt. 1R** – Rackmount kit **+\$350**

Includes rackmount hardware and slide-out assemblies, deletes snap pouch.

**Opt. 1T** – Transit Case **+\$475**

Telescoping handle & retractable wheels.

Note: Instrument options are not retrofittable after purchase.

### INTERNATIONAL POWER PLUG OPTIONS

**Opt. A1 – A5** see page 374. **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** – 5 yrs warranty

2465BCT **+\$395**

2465BDM **+\$405**

2465BDV **+\$405**

**Opt. M8** – 5 yrs calibration

2465BCT **+\$360**

2465BDM **+\$395**

2465BDV **+\$395**

### DIGITIZING CAMERA SYSTEM

**DCS01 Opt. 2A** **\$7,340**

For additional information, see page 130.

### OPTIONAL ACCESSORIES

See page 94.

### SOFTWARE FOR 2400 SERIES

**EZ-Tek 2400**. Order S38A101. **\$550**

For more information see page 258.

**CHARACTERISTICS**

Characteristics are common to all 2400 Series analog scopes except where indicated. For complete specifications, call your local Tektronix sales office or the Tek National Marketing Center: 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/CH 2); ±10% (CH 3/CH 4).

**Bandwidth Limit** – 20 MHz

**AC-Coupled Lower (-3 dB Point)** – 10 Hz or less.

**Input Coupling and Max Voltage** – (1 MΩ) ac, dc, GND; Max input voltage: 400 V (dc + peak ac) (50 Ω); Max input voltage: 5 Vrms.

**Input R and C** – 1 MΩ and 15 pF or 50 Ω (nominal).

**Channel Isolation** – ≥ 100:1 at 100 MHz, ≥ 50:1 at nominal BW (CH 1/CH 2), ≥ 50:1 at 100 MHz (CH 3/CH 4).

**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)	—
2445B	200 MHz	150 MHz

Standard accessory probe or internal 50 Ω termination used.

**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** – 2465/67B: 500 ms/div to 5 ns/div (to 500 ps/div with X10 mag); 2445B: 500 ms/div to 10 ns/div (to 1 ns/div with X10 mag).

**B Sweep Time Base Range** – 2465/67B: 50 ms/div to 5 ns/div (to 500 ps/div with X10 mag); 2445B: 50 ms/div to 10 ns/div (to 1 ns/div with X10 mag).

**Continuously Variable Timing Control** – calibrated between sec/div settings. Extends A Sweep to 1.5 s/div.

**AUTOMATIC MEASUREMENTS ACCURACY**

+15°C to +35°C, Specifications based on noise < 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 MHz.

**Rise Time, Fall Time** – 5% + 3 ns (for transition times >10 ns). These rise & fall times 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 from CH 1 to CH 2) + 5% of start and stop event transition times. Voltages < 10% of either peak.

**Time A-B (from % to %)** – 0.9% (+ 3 ns if from CH 1 to CH 2) + 5% of start and 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)
100 ms/div and faster; +15°C to + 35°C; X 10 mag off	

**TRIGGERING (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 5 div. of 350 MHz at 500 ps/div.

2465B: ≤ 50 ps with 5 div. of 300 MHz at 500 ps/div.

2445B: ≤ 100 ps with 5 div. of 150 MHz at 1 ns/div.

**OTHER SIGNAL INPUTS AND OUTPUTS**

**Z-Axis Input, CH 2 Signal Out, A & B Gate Out**

**DISPLAY**

**Graticule Size** – 8 x 10 cm; 6.8 x 8.5 cm for 2467B.

**Writing Speed** – **2467B 2465B**

Visual (room light)	20 div/μs	≥ 4 div/ns
Photographic w/o preflashing (C30 camera; f1.9, ASA 3000 film)	50 div/μs	≥ 10 div/ns

**Cursors** – Volts, Time, 1/Time.

**POWER REQUIREMENTS**

**Line Voltage Ranges** – 115 V: 90 to 132 VAC; 230 V: 180 to 250 VAC.

**Line Frequency** – 48 to 440 Hz.

**Maximum Power Consumption** – 120 W (180 VA) for fully-optional instrument.

**ENVIRONMENTAL AND SAFETY**

See page 90.

**EFFECTIVE SAMPLING RATE**

24678 Opt. 10 with DCS01 = 100 GS/s.

PHYSICAL CHARACTERISTICS				
	2467B		Rackmount	
Dimensions	mm	in	mm	in
Width				
w/handle	338	13.3	483	19.0
Height				
w/feet, pouch	190	7.5		
w/o pouch	160	6.3	178	7.0
Depth				
w/front cover	472	18.6	419	16.5
handle extended	533	21.0		
Weight ≈	kg	lb	kg	lb
Net w/accessories and pouch	10.9	24.0		
w/o accessories or pouch	9.7	21.3	4.0 <sup>1</sup>	8.8 <sup>1</sup>
Shipping	14.6	32.1	6.3 <sup>1</sup>	13.8 <sup>1</sup>
2465B/2445B Rackmount				
Dimensions	mm	in	mm	in
Width				
w/handle	338	13.3	483	19.0
Height				
w/feet, pouch	190	7.5		
w/o pouch	160	6.3	178	7.0
Depth				
w/front cover	434	17.1	419	16.5
handle extended	508	20.0		
Weight ≈	kg	lb	kg	lb
Net w/accessories and pouch	10.2	22.4		
w/o accessories or pouch	9.3	20.5	4.0 <sup>1</sup>	8.8 <sup>1</sup>
Shipping	12.8	28.2	6.3 <sup>1</sup>	13.8 <sup>1</sup>

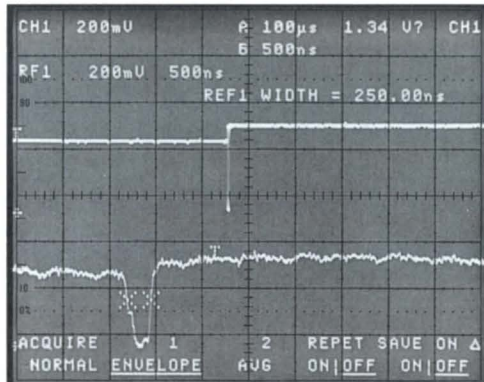
<sup>1</sup> Weight of conversion kit only. Rear support kit





## COMPACT DIGITIZING OSCILLOSCOPES

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.

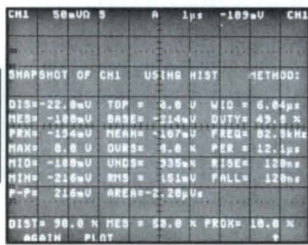
## SAVE TIME AND REDUCE COST IN SYSTEMS OF ALL SIZES

In large systems, 2400 Series Digitizing Oscilloscopes 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.

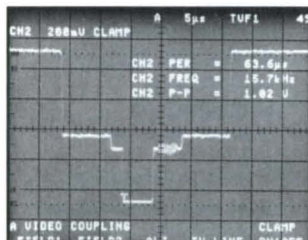
Compatible software is described in "Test and Measurement Software," pages 257-270.

The 2400 Series Digitizing Scopes Offer a Well-Balanced Combination of Performance, Automation, and Convenience Features.

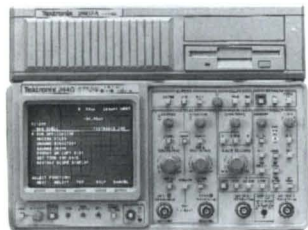
- 500 MS/s Digitizing 2440 and 2439. (250 MS/s: 2432A and 2431L, 100 MS/s: 2430A)
- 300 MHz Bandwidth (150 MHz: 2430A)
- 2 ns Glitch Capture (except 2439 and 2431L)
- 8-Bit Vertical Resolution (Single-shot and Repetitive)
- 0.0015% Crystal-Controlled Time Base
- Simultaneous Two-Channel Sampling
- Auto Pass/Fail Testing
- Fast, Reliable Automatic Measurements
- Fast Update Rate
- Extensive Triggering Capabilities
- Direct Printer/Plotter Output
- Disk Storage Available with 2402A TekMate
- On-Screen "HELP" for All Functions
- MATE/CIL Versions Available – 2440M, 2432M, 2430M



**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 **2402A TekMate** enhances 2400 Series digitizing scopes with extended capabilities:

- Waveform Storage to PC compatible 3.5" floppy.
- Automatic Data Logging
- FFT - Waveform Processing
- Advanced Hardcopy features

### STAND-ALONE OPERATION IN LOW-VOLUME OR SHORT-RUN TESTS

The 2402A TekMate™ Instrument Extension extends the capabilities of the 2440, 2439, 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. 2402A TekMate functions, specifications, and ordering information are located on pages 92-93.

### TEK SECURE MEMORY ERASE

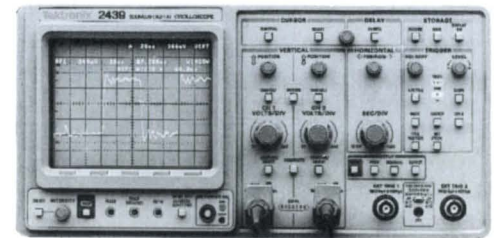
2400 Series Digitizing Oscilloscopes can be instantly declassified for removal from secure areas. Invoking the TekSecure™ feature completely erases waveform, front-panel, and sequence memories, restarts the instrument with factory settings, then gives positive indication that erasure has been accomplished.

### SOFTWARE FOR 2400-SERIES DIGITIZING OSCILLOSCOPES

Powerful, off-the-shelf software packages that run on the IBM PC, XT, AT or compatibles.

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 355. **WaveWriter**, specific to 2400 Series Digitizing Scopes, is described on page 262. Other **Test and Measurement Software** is located on pages 257-270.

### NEW 2439 AND 2431L



### LOW-COST SOLUTION TO HIGH-PERFORMANCE REQUIREMENTS

The 2439 and 2431L, with 300 MHz, 500 MS/s and 250 MS/s respectively, built in automation features answer the need for lower costs and faster measurements. These products offer entry-level performance to the 2400 Series Digitizing Oscilloscope family.

Software written for the 2439 and 2431L is fully compatible with other, higher performance 2400 Series Digitizing Oscilloscopes: 2440, 2432A, and 2430A.

### MATE/CIL 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
2439	500 MS/s	300 MHz	100 MHz	8 bits	No	Main <sup>2</sup>
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 MS/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.

\*2 Delay Time base, available on GPIB bus.

### 2400 Series Digitizing Oscilloscopes Features

	Auto Setup	Auto Measure	Auto Pass/Fail	Auto Sequencing	Auto Probe
2439	View Only	Live and Snapshot	Yes	200 steps (typical)	No
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.

## 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 exercises, and procedures for calibration and diagnostics.

The QuickStart videotape previews measurement exercises 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, page 91.

## CHARACTERISTICS

### 2400-SERIES DIGITIZING OSCILLOSCOPES

Characteristics are common to the 2440, (2440M), 2439, 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 and 2439), 20 MHz or 50 MHz (2432A, 2431L, 2430A).

**Vertical Sensitivity** - 2 mV/div (200  $\mu$ V/div with expansion or averaging) to 5 V/div, continuously variable between ranges.

**Vertical Accuracy** -  $\pm 2\% + 1$  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, 2439, 2432A, 2431L	300 MHz	reduce bandwidth by 2.5 MHz for each °C above +30°C
2430A	dc to 150 MHz	

Measured with standard accessory probe or internal 50  $\Omega$  termination.

**Input Coupling and Max Voltage** - (1 M $\Omega$ ) ac, dc, GND; Max input voltage: 400 V (dc + peak ac) (50  $\Omega$ ); Max input voltage: 5 V rms.

**Input R and C** - 1 M $\Omega$  and 15 pF or 50  $\Omega$  (nominal).

**Vertical Position Range** -  $\pm 10$  div (nominal).

### HORIZONTAL SYSTEM

**Display Modes** - A, A INTENSified, B (A only for 2439 and 2431L).

**Time Base Accuracy** - 0.0015%.

**Maximum Time Base Resolution** - 40 ps (2440, 2439, 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, 2439), 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, 2439), 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  $\mu$ s/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).

### 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, CH 1, CH 2, 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 1 and Ext 2 Inputs** - Resistance: 1 M $\Omega$   $\pm$  1%. Capacitance: 15 pF  $\pm$  3 pF.

Maximum Input Voltage: 400 V (dc + peak ac), 800 V p-p ac at 10 kHz or less.

**Trigger Level Control Range** -

CH 1 and CH 2 Source:  $\pm 18$  div x V/div.  
Ext 1 and Ext 2 Source Gain +1:  $\pm 0.9$  V.

## QuickStart Operator's Training Package

- Basic Training for First-Time Users
- Advanced Techniques for Experienced Operators
- Refresher for Occasional Users

\*Not available on 2439 and 2431L.

**OTHER SIGNAL OUTPUTS**

**CH 2 Signal Out, A Trigger, Record Trigger, Word Recognizer Trigger** – (signal outputs not available on 2439 and 2431L).

**POWER REQUIREMENTS**

**Line Voltage Ranges** – 115 V: 90 V to 132 VAC; 230 V: 180 V to 250 VAC.

**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, peak-to-peak, 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.

**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 4500 m (max operating temperature decreases above 1500 m), Nonoperating: to 15,000 m.

**Shock** – 50 g's.

**Transit Drop** – Meets MIL-T-28800D, paragraph 4.5.5.4.2.

**Bench Handling** – Meets MIL-STR-810E, Method 516.4, Procedure VI (MIL-T-28800D, 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-28800D 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.

**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 3.7.2.2, 3.7.2.3, and 3.7.2.4.

**Electromagnetic Interference (EMI) –**

- Meets MIL-T-28800D.
- Meets MIL-STD-461C, 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.

**PHYSICAL CHARACTERISTICS**

Dimensions	Cabinet		Rackmount	
	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		
<b>Weights</b>	<b>kg</b>	<b>lb</b>	<b>kg</b>	<b>lb</b>
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

<b>2440</b> 500 MS/s Digitizing Oscilloscope 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.	<b>\$12,390</b>
<b>2439</b> 500 MS/s Digitizing Oscilloscope Includes: two P6136 10 x probe (1.3 m) with accessories, fuse, power cord, Operators' Manual (070-8232-00), Users' Reference Guide (070-8230-00), Programmers Reference Guide (070-8231-00), GPIB Pocket Guide (070-8229-00).	<b>\$9,995</b>
<b>2432A</b> 250 MS/s Digitizing Oscilloscope Includes: same as 2440.	<b>\$10,900</b>
<b>2431L</b> 250 MS/s Digitizing Oscilloscope Includes: same as 2439.	<b>\$7,990</b>
<b>2430A</b> 100 MS/s Digitizing Oscilloscope Includes: same as 2440, except 2 P6133 Opt. 25 10X (1.3 m) probes.	<b>\$6,950</b>
<b>MATE/CIIL VERSIONS</b>	
<b>2440M</b> 500 MS/s MATE/CIIL Digitizing Oscilloscope Includes: same as 2440, plus MATE/CIIL Operators' Manual (070-6828-00) and 2440 Service Manual (070-6603-00).	<b>\$22,625</b>
<b>2432M</b> 250 MS/s MATE/CIIL Digitizing Oscilloscope Includes: same as 2440, plus MATE/CIIL Operators' Manual (070-6287-01) and 2432 Service Manual (070-7273-00).	<b>\$19,685</b>
<b>2430M</b> 100 MS/s MATE/CIIL Digitizing Oscilloscope Includes: same as 2430A, plus MATE/CIIL Operators' Manual (070-6042-01) and 2430A Service Manual (070-6330-01).	<b>\$18,080</b>
<b>INSTRUMENT OPTIONS</b>	
<b>Opt. 03</b> - Word Recognizer Probe Pod (P6407) (Not available for 2431L or 2439)	<b>+\$495</b>
<b>Opt. 05</b> - Video Waveform Trigger System	<b>+\$1,295</b>
<b>Opt. 11</b> - Probe Power (not available for 2431L, 2439)	<b>+\$225</b>
<b>Opt. 22</b> - Two Additional Matching Probes	<b>+\$350</b>
<b>Opt. 29</b> - 2402A TekMate (Not available for 'M' Versions)	<b>+\$3,195</b>
<b>Opt. 46</b> - Commercial Version of ARMY OS-291/G (National Stock Number 6625-01-258-0022)	<b>*1</b>
<b>Opt. 2C</b> - FeedThrough Cable Kit (Included with Opt. 1R for 'M' Versions)	<b>+\$225</b>
<b>Opt. 2F</b> - QuickStart Training Package (U.S. power) (2440/2430A/2432A only)	<b>+\$205</b>
<b>Opt. 3F</b> - QuickStart Training Package (Euro power) (2440/2430A/2432A only)	<b>+\$205</b>
<b>Opt. 1P</b> - HC100 Color Plotter (U.S. power 110V) (Includes GPIB cable) (Not available for 'M' Versions)	<b>+\$1,020</b>
<b>Opt. 2P</b> - HC100 Color Plotter (Euro power 220V) (Includes GPIB cable) (Not available for 'M' Versions)	<b>+\$1,020</b>
<b>Opt. 1R</b> - Rackmount	<b>+\$330</b>
<b>Opt. 1T</b> - Transit Case (telescoping handle, retractable wheels) (2440/2430A/2432A only)	<b>+\$465</b>
<b>Opt. 4F</b> - French HELP Text (2440/2430A/2432A only)	<b>NC</b>
<b>Opt. 4G</b> - German HELP Text (2440/2430A/2432A only)	<b>NC</b>
<b>Opt. 4H</b> - Italian HELP Text (2440/2430A/2432A only)	<b>NC</b>
<b>Opt. 4S</b> - Spanish HELP Text (2440/2430A/2432A only)	<b>NC</b>
<b>Opt. B1</b> - Service Manual (Not required for 'M' Versions) (2440/2432A/2431L/2430A)	<b>+\$55</b>
	<b>+\$75</b>

### SOFTWARE FOR 2400 SERIES DIGITIZING OSCILLOSCOPES

For additional software packages, see the 'Test and Measurement Software' section, pages 257-270.  
**Wave Writer** -  
 S37T100 or \$285  
 S37T100 Opt. 28 (U.S. only) \$470

### INTERNATIONAL POWER PLUG OPTIONS

<b>Opt. A1</b> - Universal Euro 220 V, 50 Hz	<b>NC</b>
<b>Opt. A2</b> - UK 240 V, 50 Hz	<b>NC</b>
<b>Opt. A3</b> - Australian 240 V, 50 Hz	<b>NC</b>
<b>Opt. A4</b> - North American 240 V, 50 Hz	<b>NC</b>
<b>Opt. A5</b> - Switzerland 220 V, 50 Hz	<b>NC</b>

### 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

<b>Opt. M2</b> - Remedial Coverage in years 4 and 5.	
2440	<b>+\$380</b>
2440M	<b>+\$415</b>
2432A/2439	<b>+\$380</b>
2431L	<b>+\$340</b>
2432M	<b>+\$415</b>
2430A	<b>+\$325</b>
2430M	<b>+\$385</b>
<b>Opt. M3</b> - 4 calibrations (in years 2 through 5), Remedial Coverage for years 4 and 5.	
2440	<b>+\$826</b>
2440M	<b>+\$864</b>
2432A/2431L	<b>+\$768</b>
2439	<b>*1</b>
2432M	<b>+\$779</b>
2430A/2430M	<b>+\$903</b>
<b>Opt. M4</b> - 5 calibrations (in years 1 through 3).	
2440	<b>+\$523</b>
2440M	<b>+\$523</b>
2432A/2431L	<b>+\$501</b>
2439	<b>*1</b>
2432M	<b>+\$501</b>
2430A/2430M	<b>+\$608</b>
<b>Opt. M5</b> - 9 calibrations (in years 1 through 5), Remedial Coverage for years 4 and 5.	
2440	<b>+\$1,316</b>
2440M	<b>+\$1,354</b>
2432A/2431L	<b>+\$1,235</b>
2439	<b>*1</b>
2432M	<b>+\$1,246</b>
2430A/2430M	<b>+\$1,472</b>
<b>Opt. M7</b> - 2 calibrations (in years 2 and 3).	
2440	<b>+\$223</b>
2440M	<b>+\$223</b>
2432A	<b>+\$214</b>
2431L/2439	<b>*1</b>
2432M	<b>+\$214</b>
2430A/2430M	<b>+\$259</b>
<b>Opt. M8</b> - 4 calibrations (in years 2 through 5).	
2440	<b>+\$435</b>
2440M	<b>+\$495</b>
2432A/2431L	<b>+\$435</b>
2439	<b>*1</b>
2432M/2430M	<b>+\$495</b>
2430A	<b>+\$435</b>

\*1 Contact your local sales representative.

### MANUALS

	2440/2440M	Price	2439	Price	2432A/2432M	Price	2431L	Price	2430A/2430M	Price
<b>Operators' Manual</b>	070-6599-00	<b>\$55</b>	070-8232-00	<b>\$55</b>	070-7272-00	<b>\$48</b>	070-7701-00	<b>\$48</b>	070-6286-02	<b>\$55</b>
<b>Programmers' Reference</b>	070-6601-00	<b>\$21</b>	070-8231-00	<b>\$21</b>	070-7271-00	<b>\$21</b>	070-7700-00	<b>\$21</b>	070-6338-01	<b>\$24</b>
<b>GPIB Pocket Guide</b>	070-6602-00	<b>\$6.75</b>	070-8229-00	<b>\$6.75</b>	070-7270-00	<b>\$6.75</b>	070-7699-00	<b>\$6.75</b>	070-6604-01	<b>\$6.75</b>
<b>Users' Reference Guide</b>	070-6600-00	<b>\$6.75</b>	070-8230-00	<b>\$6.75</b>	070-7269-00	<b>\$6.75</b>	070-7698-00	<b>\$6.75</b>	070-6339-02	<b>\$6.75</b>
<b>Service Manual</b>	070-6603-00	<b>\$125</b>	070-8233-00	<b>\$125</b>	070-7273-00	<b>\$110</b>	070-7702-00	<b>\$100</b>	070-6330-01	<b>\$100</b>

# 2402A TekMate™ INSTRUMENT CONTROLLER

## GPB controller or DSO functional extension.

- Full performance IBM® - compatible GPIB controller
- Environmentally rugged, compact in size
- Instrument extension for 2400 Series DSO's
- Powerful DSO utility software for data logging, pass/fail testing, complex waveform analysis
- Flexible DSO development system for custom solutions



## RUGGED FULL PERFORMANCE GPIB CONTROLLER

The TekMate™ instrument controller satisfies many GPIB bus control needs. It is a compact, low power, environmentally rugged IBM-compatible GPIB controller equally suited for rack or benchtop applications.

Because of its compact size and ruggedness, TekMate attaches to any 2400 Series Digital Storage Oscilloscope (DSO). Coupled with powerful DSO extension software, the TekMate/DSO combination is a flexible and portable waveform storage, processing and measurement functional extension.

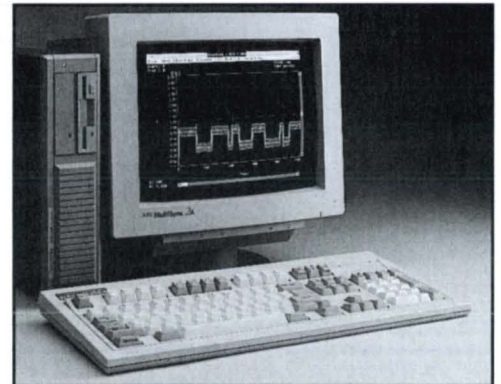
Options are available to satisfy a variety of application needs including 44 Mbyte hard disk, VGA graphics card, additional RAM memory and math coprocessor.

### SOFTWARE SOLUTIONS

There are many IBM compatible software packages available from Tektronix that support broad requirements and individual instrument capabilities. Here are some examples:

**DSO Utility Software adds capability** to a 2400 Series DSO including:

- Waveform and instrument settings storage/recall on IBM® PC compatible 3.5" floppies or optional hard disk.
- Keyboard and monitor are not required because software uses the DSO front panel and display for the operator interface.
- Complex waveform analysis including FFT, Correlation, Differentiation, and Integration.
- Creation and storage of templates for waveshape tests.
- Automatic Pass/Fail decisions.
- Data logging with time/date stamp for unattended data collection and remote site monitoring.



2402A with Option 35 makes a rugged instrument controller.

**DSO Program Development System** saves time and cuts program development costs. It runs on IBM-compatible computers and includes:

- Menu development system, waveform math and GPIB control function libraries
- Disk, directory and file-management functions
- Template generation tools

The program development system (Opt. 41) includes Microsoft® Quick C and QuickBASIC programming languages and over 250 example programs.

### EZ-TEST Test Procedure Generator Software

Adding EZ-TEST TPG allows creating GPIB test procedures quickly and easily without programming. These procedures can be executed using just the TekMate/DSO combination—without the need for keyboard or monitor. EZ-TEST provides a quick, low-cost entry into automated testing.

## CHARACTERISTICS

**Processor** – 80286 at 16 MHz.

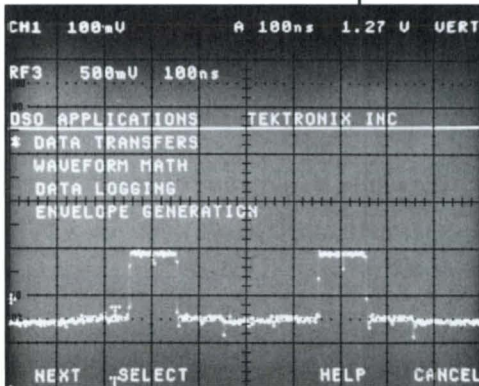
**Disk Drives** – Two 3.5" IBM-compatible 720 kilobyte floppy drives standard. Optional 44 Mbyte hard disk replaces one floppy drive.

**Monitor support** – With optional VGA graphics card. Card can be software configured for analog video VGA, EGA, CGA and monochrome monitors. Does not support TTL video monitors.

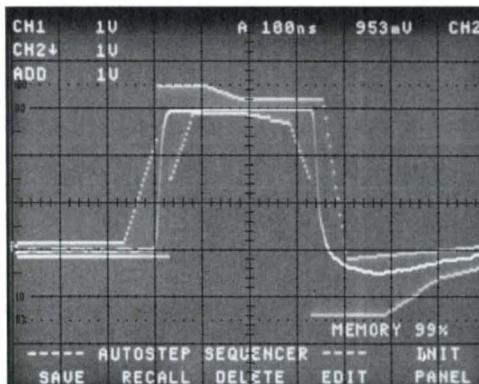
**Power requirements** – 90 to 250 VAC line voltage range, 48 to 440 Hz line frequency range, consumes 70 watts.

**Environmental** – MIL-T-28800D, class 5 (limited by floppy and hard disk).

**For complete specifications** – Refer to product data sheets available from your local Tektronix sales office or the Tek National Marketing Center – call toll free: 1-800-426-2200, ext. 99.



TekMate displays easy-to-use DSO utility software on 2400 Series DSO.



TekMate transfers templates from disk to the scope for template testing. A DS1 signal is shown here with a DS1 test template.

**ORDERING INFORMATION**

**2402A TEKIMATE OPTIONS**

**2402A TekMate Instrument Extension** **\$2,795**  
Includes: power cord, MS-DOS software, diagnostic software, 2402A hardware manual and MS-DOS manual. See recommended configurations below.

**RECOMMENDED CONFIGURATIONS**

**Opt. 01 – 2400 DSO Utility Kit –** **+\$400**  
Includes: 2402A TekMate base unit, DSO utility software, DSO utility manual, GPIB cable and 2400 DSO mounting kit and instructions.  
**Opt. 35 – Instrument Controller –** **+\$2,200**  
Adds VGA graphics card, VGA monitor (U.S. power only), keyboard and 44 Mbyte hard disk.

**2402A TEKIMATE OPTIONS**

**Hardware options**

**Opt. 21 – 44 Mbyte Hard Disk** **+\$995**  
**Opt. 34 – Add VGA Graphics Card** **+\$495**  
**Opt. 39 – Add math co-processor (80287)** **+\$645**  
**Opt. 45 – 2 Mbyte total RAM expansion** **+\$500**  
(for 4 Mbytes, order two option 45)  
**Opt. 1R – Rackmount** **+\$350**  
**Opt. 1C – Transit Cart** **+\$115**

**Software options**

**Opt. 41 – 2400 DSO Program Development System** **+\$995**  
**Opt. 4X – Delete Microsoft DOS** **-\$25**  
(where international licensing limitations require)  
**Opt. S9 – Software subscription for Opt. 01 DSO Utility Software.** Extends software upgrades and product support to one full year for U.S. customers. **NC**  
**Opt. 42 – S9 Software subscription for Opt. 41 DSO Program Development System.** Extends software upgrades and product support to one full year for U.S. customers. **1**  
**Opt. 1S – Software subscription for Opt. 01 DSO Utility Software.** Extends software upgrades and product support to one full year for international customers. **NC**  
**Opt. 42 – 1S Software subscription for Opt. 41 DSO Program Development System.** Extends software upgrades and product support to one full year for international customers. **1**

**Training options**

**Opt. 2F – QuickStart Operators Training Package** **+\$205**  
(U.S. power, 020-1747-01)  
**Opt. 3F – QuickStart Operators Training Package** **+\$205**  
(Euro power, 020-1748-01)

**INTERNATIONAL POWER PLUG OPTIONS**

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

**OTHER ACCESSORIES FOR 2402A TEKIMATE**

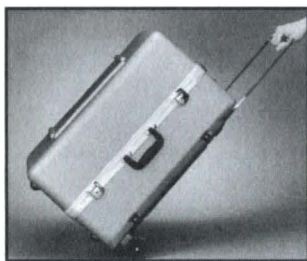
**Hardware accessories**

**GPIB cable – 1/2 meter, Order 012-1282-00** **\$135**  
**GPIB cable – 1 meter, Order 012-0991-01** **\$140**  
**Keyboard – Order 119-3772-00** **\$190**  
**VGA Color Monitor (U.S. power only) –** **\$700**  
Order 119-3798-00  
**VGA Graphics Board field upgrade –** **\$550**  
Order 040-1332-00  
**44 MByte Hard Disk field upgrade –** **\$1,050**  
Order 040-1331-00  
**2 Mbyte RAM (Total) Expansion field upgrade –** **\$550**  
Order 040-1333-00  
**Math Coprocessor field upgrade –** **\$690**  
Order 040-1334-00  
**2400 DSO Mechanical Compatibility Kit –** **\$55**  
Order 016-0978-00  
**2712 Spectrum Analyzer Mechanical Compatibility Kit –** **\$70**  
Order 016-1109-00

**Software accessories**

**2400 DSO Program Development Software –** **\$1,295**  
Order S37UD01  
**2400 DSO Utility Software and Manual –** **\$775**  
Order S37UT01  
**EZ-Test Test Program Generation Software –** **\$1,995**  
Order S45F030  
**Wavewriter Arbitrary Waveform Generator Software –** **\$1,795**  
Order S75VWVR  
**Microsoft Quick C – (5.25" media with manual),** **1**  
Order 062-8832-00  
**Microsoft Quick BASIC – (5.25" media with manual,** **\$99**  
Order 062-9352-02  
**Lap Link Software – (3.5" and 5.25" media, manual,** **\$150**  
RS-232 cable), Order 062-9976-00  
**Training accessories**  
**Quickstart Operators Guide – (manual only),** **\$34**  
Order 070-7447-01

*1 Contact your local sales office.*



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
<b>Passive Probes (1 M<math>\Omega</math>)</b>	10X, 400 MHz, compact tip, (incl. with 2467B, 2465B, 2440, 2432A)	322	P6137	<b>\$180</b>
	10X, 350 MHz, subminiature tip	322	P6136	<b>\$175</b>
	10X, 350 MHz, compact tip (incl. with 2455B, 2431L)	322	P6136 Opt. 25	<b>\$175</b>
	10X, 150 MHz, subminiature tip	322	P6133	<b>\$140</b>
	10X, 150 MHz, compact tip (incl. with 2430A, 2445B)	322	P6133 Opt. 25	<b>\$140</b>
	Rugged 10X, 150 MHz	312	P6109	<b>\$70</b>
<b>Active Probe</b>	10X FET Probe, 500 MHz	320	P6202A	<b>\$825</b>
<b>Bias/Offset Probe</b>	10X Bias/Offset Probe, 1.5 GHz	320	P6230	<b>\$525</b>
<b>Low Impedance Probe (50 <math>\Omega</math>)</b>	10X Low Impedance, 3.5 GHz	321	P6156*1	<b>\$255</b>
<b>Current Probes</b>	50 MHz, 20 Amps (dc + pk ac)	325	AM 503S	<b>\$2,400</b>
	15 MHz, 100 Amps (dc + pk ac)	325	AM 503S Opt. 03	<b>\$3,030</b>
<b>High Voltage Probes</b>	120 MHz, 1500 V pk	323	P6009	<b>\$250</b>
	75 MHz, 40 kV pk	323	P6015	<b>\$840</b>
<b>Optical to Electrical Converters</b>	450-1050 nanometers, 700 MHz (requires 1103 Probe Power Supply)	287	P6701A	*2
	450-1050 nanometers, 250 MHz, High Gain, (requires 1103 Probe Power Supply).	287	P6711	*2
	1000-1700 nanometers, 500 MHz (requires 1103 Probe Power Supply)	287	P6703A	*2
	1100 to 1700 nanometers, 300 MHz, High Gain, (requires 1103 Probe Power Supply).	287	P6713	*2
<b>Power Supply Isolator</b>	Power Supply for up to two probes	323	1103	<b>\$415</b>
	Two independently-isolated channels, 20 MHz, 3000 VAC	328	A6902B Opt. 02	<b>\$2,830</b>
<b>SMT Interconnects</b>	SMT KlipChip™ for surface-mount devices (requires 013-0202-02)	317	SMG50	<b>\$89</b>
	SOIC Twin Pack for Small Outline Integrated Circuits (8,14,16, 20, 24 pins)	317		
	PLCC Twin Pack for Plastic Leader Chip Carriers (20, 28, 44, 52, 68 pins)	317		
<b>Cameras</b>	Low-cost, mountable film back camera	302	C-5C Opt. 01	<b>\$580</b>
	High Performance	303	C-30 BP Opt. 01	<b>\$2,135</b>
	Digitizing	172	DCS01 Opt. 2A	<b>\$7,340</b>
<b>Carts</b>	Portable Instrument Cart	307	K212	<b>\$385</b>
	Cart with Plotter Shelf	307	K212 Opt. 22	<b>\$530</b>
<b>Carrying Cases</b>	Telescoping handle, retractable wheels	339	202-0302-00	<b>\$495</b>
	Low-cost suitcase style	339	016-0792-01	<b>\$345</b>
<b>Carrying Strap</b>	Over-the-shoulder	339	346-0119-00	*2
<b>Swivel Base</b>	Adjustable scope stand	309	K501	<b>\$60</b>
<b>Color Plotter</b>	HC100 4-Pen Plotter	295	HC100 Opt. 01	<b>\$1,050</b>
<b>Printer</b>	Dot Matrix, 9 pin	296	HC200	<b>\$275</b>

\*1 Optional 1X, 20X, and 100X tips available, see page 332.

\*2 Contact your local sales representative.



### HOW TO CHOOSE THE RIGHT PORTABLE SCOPE FOR YOUR MEASUREMENT NEEDS

The Tek 2200 Series digital and analog scopes span a performance range from 20 MHz to 100 MHz.

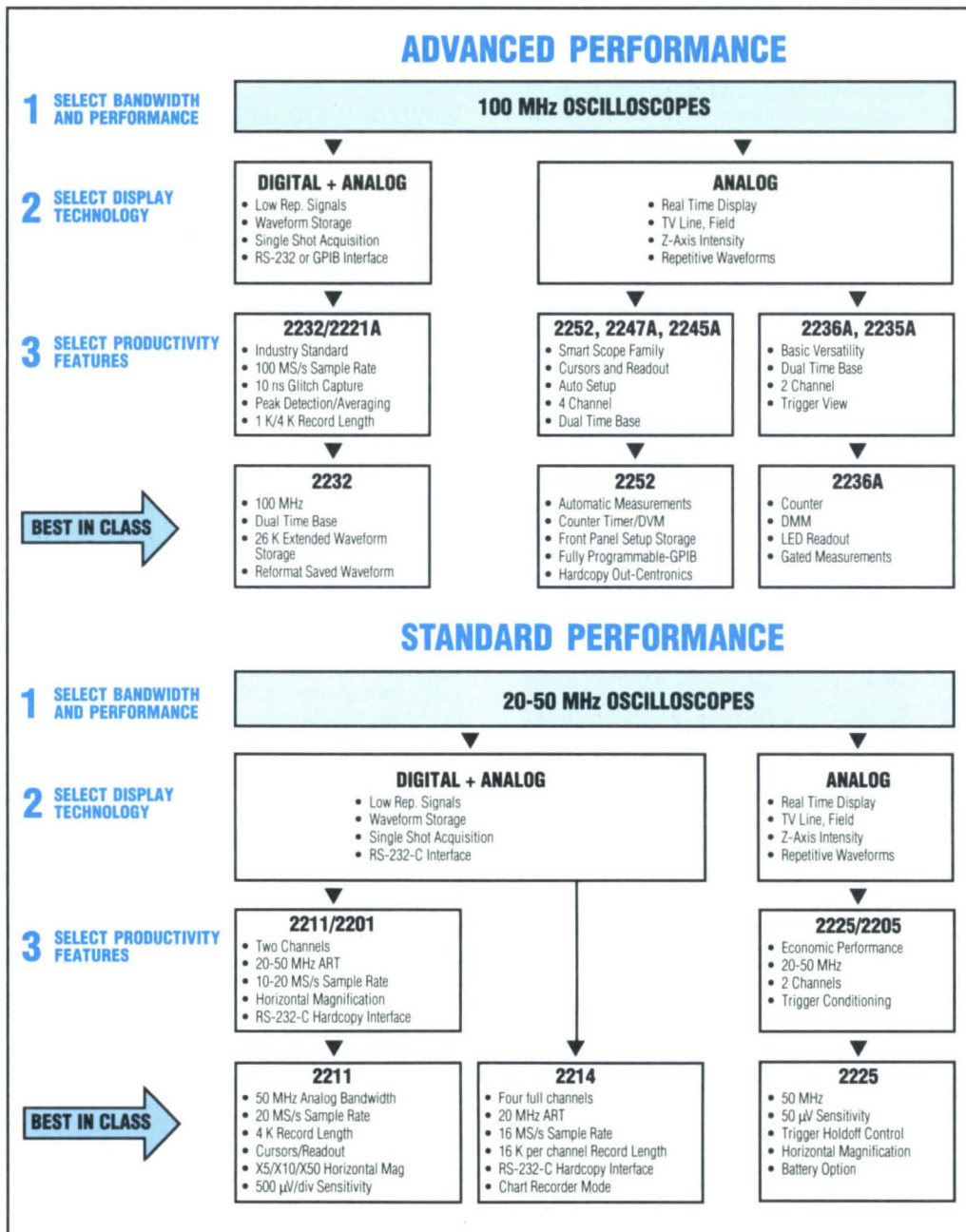
To choose the right scope, first characterize your signal and decide if you need full-featured advanced performance or economical standard performance. An advanced 100 MHz oscilloscope is the most popular choice for most service and repair needs. The second step is to decide on either digital plus analog 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.

### A Family of Economical Portable Oscilloscopes Engineered With the Capability to Satisfy Diverse Measurement Situations.

- Wide Range of Models for Diverse Signal Measurement Needs
- Familiar Operation
- Advanced Design Features for Productivity, Performance and Reliability
- Rugged, Safe, Lightweight and Portable



### Contents

**DIGITAL STORAGE (DSO) + ANALOG REAL TIME (ART)**

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NEW 2214	100

**ANALOG REAL-TIME (ART)**

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### ACCESSORIES

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2200 Series Probe Information ..... 310

2200 Series Rackmounts, Travel Accessories, Viewing Hoods ..... 339-341

External Battery Power w/Internal ac to dc Inverter: (see 2211, 2214 or 2225 with option 07 or 30) ..... 99,100,106

## Waveform Confidence and Versatility Unmatched at the Price.

- 100 MHz Analog and Digital Storage Bandwidth
- 100 MS/s Per Channel Sampling Rate
- 10 ns Glitch Capture, Any Sweep Speed
- Selectable 1 K or 4 K Record Length
- 8-bit Vertical Resolution
- Time and Voltage Waveform Cursors
- Trigger-Level Readout
- GPIB or RS-232-C Communications Options

## 2232

- Dual Time Base
- 26 K Added Battery-Backed Waveform Storage



\*The 2232 and 2221A oscilloscopes comply with IEEE Standard 488.1-1987 with Option 10, RS-232-C with Option 12, and Tektronix Standard Codes and Formats.

## 2232/NEW 2221A OSCILLOSCOPES

### UNMATCHED VERSATILITY

The 2232 and 2221A deliver high-end performance at the lowest price in their class. These 100 MHz oscilloscopes have advanced capabilities not found in comparable scopes. For single-shot and low repetition-rate signals, they offer simultaneous 100 MS/s sampling on each channel, 10 ns glitch capture, 1 K and 4 K record length, and battery-backed memory. When your signal is best viewed in real-time, a single push of a button makes each operate as familiar analog oscilloscope. This dual performance capability assures you the right solution is always at your fingertips.

The 2221A is an improved version of our popular 2221, offering the same digitizing performance as the 2232 in a single time base oscilloscope. The fast sample rate and long 4 K record length provide plenty of signal capturing capability; its horizontal and vertical expansion of stopped waveforms facilitate the signal analysis.

### HIGH-SPEED GLITCH CAPTURE

With innovative sampling technologies, these oscilloscopes are capable of catching random signal variations that are often missed with other digitizing oscilloscopes. In *Peak Detect* sampling mode, these scopes always sample at 100 MS/s, continuously observing your signal every 10 ns, regardless of sweep speed. This "glitch-finding" capability helps you quickly isolate problems such as power line spikes or false clock pulses that would otherwise be hidden between samples.

### EXCELLENT WAVEFORM RESOLUTION

Both oscilloscopes acquire 1 K or 4 K records with 8-bit vertical resolution. They can display between 100 and 4096 points on-screen for precise analysis. Events as slow as 20 seconds (and slower with external clocking) or as fast as several nanoseconds can be captured and analyzed with confidence.

The 2232 adds a powerful dual time base system, allowing you to zoom in on any portion of your waveform and acquire a full record of information. A period of delay from the initial (A) trigger is set scrolling a "B-delay" intensified window to the point of interest. The 2232 can then immediately start acquiring samples at the new sweep speed, or await a trigger event to lock onto the point of interest.

### WAVEFORM STORAGE AND ANALYSIS

Digital storage provides the opportunity to freeze events on-screen for analysis. But unlike many digital oscilloscopes, the 2232 and 2221A allow you to expand, compress, reposition, and measure a waveform after it has been captured. These capabilities apply to any stored waveform with the 2232, including non-volatile reference memories. The 2232 also adds an additional 26 K of extended memory for waveform storage on-board. Thus, a reference library of up to 26 known-good waveform sets can be recalled at any time for performance verification. Or unknown signals can be captured and recalled later for analysis.

### TIME-SAVING FEATURES

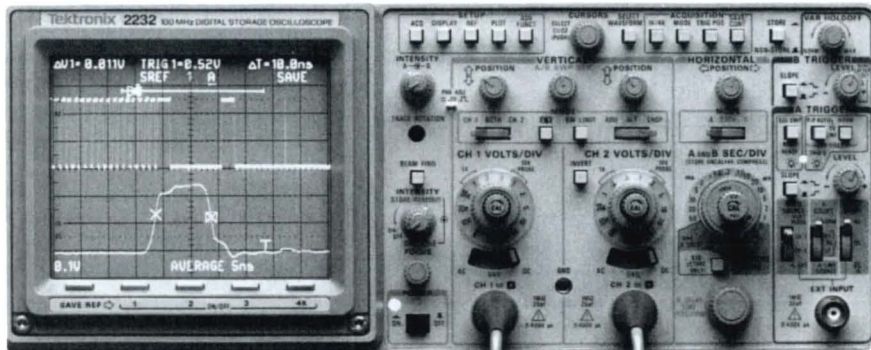
Bezel buttons, measurement cursors and on-screen readouts reduce analysis time and measurement error. Conveniently located bezel buttons let you easily select advanced menu functions. These functions include adjusting average weighting and sweep limits, point-selectable trigger position, and display modes.

Measurement cursors further simplify scope operation by calculating and displaying delta time and voltage. The cursors are tied to a selected waveform and can be positioned anywhere in a record (including off-screen over greater than 10 divisions) for detailed timing analysis. Scale factors automatically track the selected waveform.

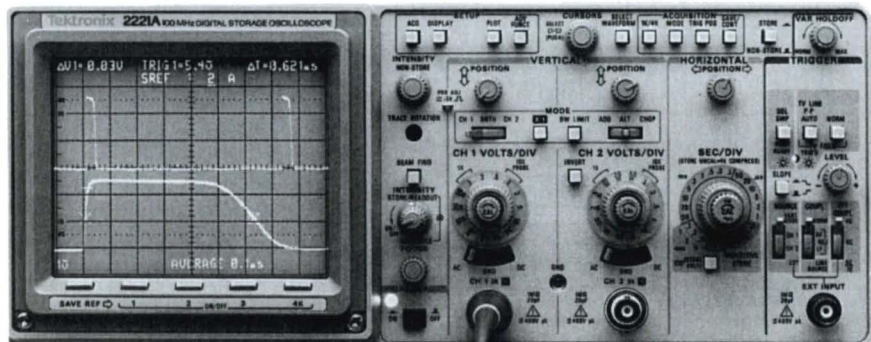
### INTERFACING ALTERNATIVES

The 2232 and 2221A offer a choice of interfaces: GPIB and RS-232-C. Both allow you to transmit and receive waveform data, query front-panel settings, control menu functions, and reset single-sweep trigger. In addition, you can connect the oscilloscope directly to a compatible printer or plotter for hardcopy output at the push of a button.

Tektronix makes interfacing with your personal computer easy. For example, Tek's "WaveSaver" package makes easy work of waveform transfer, documentation, and data archiving on your pc. For remote data transfer over commercial telephone lines, "TeleServicing" software adds modem control capabilities for a turn-key field service and remote-monitoring solution. See the T&M Software section of this catalog for more information on these and other software solutions.



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 characterize the glitch.



The 2221A offers the same powerful digitizing capabilities in a single time base scope, making it an attractive lower cost alternative for many troubleshooting needs.

# 100 MHz, 100 MS/s DIGITAL STORAGE PLUS ANALOG OSCILLOSCOPES

2232/2221A

NEW

## CHARACTERISTICS

Characteristics are common to the 2232 and 2221A except where noted.

### DIGITAL STORAGE SYSTEM

**Sample Rate** – 100 MS/s per channel. Effective sample rates up to 2 GS/s in repetitive storage mode (0.5  $\mu$ s/div and faster in single-channel mode, 0.2  $\mu$ s/div and faster dual-channel).

**Resolution** – Vertical: 8 bits (25 levels per div.), up to 12 bits in average mode. Horizontal: 10 bits (100 points per div.), 9 bits per channel in dual channel mode.

**Record Length** – 4 K or 1 K selectable. 2 K or 512 per channel in dual channel mode.

**Pre/Post Trigger** – 1/8, 1/2, or 7/8 trigger position selectable, selectable to any point in record 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); and Sample.

**Save Reference Memory** – One 4 K or three 1 K acquisitions battery-backed. 2232: adds 26 K 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  $\pm 2\%$  (+15°C to +35°C);  $\pm 3\%$  (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 M $\Omega$ , 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  $\mu$ s/div, extended to 5 ns/div with X10 magnification. Store mode: 5 s/div to 0.05  $\mu$ s/div (5 ns/div with X10 MAG). 2232: B sweep: 50 ms/div to 0.05  $\mu$ s/div.

**Accuracy** – Nonstore Mode: X1:  $\pm 2\%$ ; X10:  $\pm 3\%$  (+15°C to +35°C). X1:  $\pm 3\%$ ; X10:  $\pm 4\%$  (0°C to +50°C). Store Mode:  $\pm 0.1\%$  over full 10.24 divisions.

**Horizontal Operating Modes** – 2232: Nonstore Mode: A, ALT (A intensified by B and B), B. Store Mode: A, A intensified by B, B, 4 K COMPRESS. 2221A: A; 4 K COMPRESS in store mode.

**Delay Jitter** – 5000:1 (2232).

**Delay Time Accuracy** –  $\pm 1\%$  (+15°C to +35°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. 2232 B-Mode: Runs-After-Delay, Triggered-After-Delay.

**Trigger Source** – A Trigger: VERT MODE, CH 1, CH 2, LINE, EXT. 2232 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: Nonstore mode 2.5 MHz; Store mode same as vertical system. Y-Axis: same as vertical system.

**Phase Difference** –  $\pm 3^\circ$  from dc to 150 kHz.

### ADVANCED FUNCTIONS

**Cursor Function and Accuracy** –  $\Delta$ Volts:  $\pm 3\%$  of reading.  $\Delta$ Time:  $\pm 1$  display interval (5 s/div to 1  $\mu$ s/div);  $\pm 2$  display intervals + 500 ps (0.5  $\mu$ s/div to 0.05  $\mu$ s/div).

**X-Y Plotter Output** – Plots all displayed waveforms, crt readout, and graticule (selectable).

**External Clock Input** – Dc to 1 kHz (roll mode), dc to 100 kHz (record mode).

### 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, GRATI-CULE ILLUMINATION.

**Z-Axis** – 5 V causes 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 108.

### OTHER CHARACTERISTICS

**Safety** – UL 1244 listed, CSA certification.

**Warranty** – 3 years.

### INSTRUMENT OPTIONS

**ANSI/IEEE-488.1 GPIB Interface (Option 10)** – Function Subsets Implemented: SH1, AH1, T5, L3, SR1, RL2, PPO, DC1, DT0, C0, E2. Plotter Devices: HPGL (single-color), Epson FX-Series, HP ThinkJet. Data Transfer Rate: approximately 1 kilobyte/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: HPGL (single-color), 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.

**Rackmount Kit (Option 3R)** – Provides rackmount kit for 5.25" rack height.

## ORDERING INFORMATION

**2232 100 MHz Dual Time Base, Digital + Analog Oscilloscope** **\$4,995**

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.

**2221A 100 MHz Single Time Base Digital + Analog Oscilloscope** **\$3,995**

Includes: same as above except:  
Operator's Manual (070-8156-00),  
User's Ref. Guide (070-8158-00)

### INSTRUMENT OPTIONS

**Opt. 10** – GPIB Interface **+\$300**  
**Opt. 12** – RS-232-C Interface (with pc/plotter cable) **+\$300**  
**Opt. 2F** – QuickStart Package<sup>1</sup> **+\$199**  
**Opt. 3R** – Rackmount Kit **+\$250**

### ACCESSORY OPTIONS

**Opt. 1C** – C-9 Camera **+\$580**  
**Opt. 1K** – K212 Instrument Cart **+\$385**  
**Opt. 1P** – HC100 Plotter w/GPIB cable (requires Opt. 10) **+\$1050**  
**Opt. 3P** – HC100 Plotter w/RS-232-C Cable (req. Opt. 12) **+\$950**  
**Opt. 1T** – Transit Carrying Case **+\$345**  
**Opt. 17** – P6408 Logic Probe **+\$375**  
**Opt. 33** – Travel Line Package **+\$295**

### INTERNATIONAL POWER PLUG OPTIONS

**Opt. A1-A5** – Available **NC**  
See page 108 for descriptions.

### WARRANTY-PLUS SERVICE PLANS

**2232:**  
**Opt. M2** – +2 yrs service **+\$335**  
**Opt. M8** – +4 calibrations **+\$530**  
**2221A:**  
**Opt. M2** – +2 yrs service **+\$318**  
**Opt. M8** – +4 calibrations **+\$495**

### RECOMMENDED ACCESSORIES/ FIELD KITS

**Service Manual** –  
2232: (070-7067-00) **\$85**  
2221A: (070-8157-00) **\$35**  
**2232F10** – GPIB Field Upgrade Kit **\$300**  
**2232F12** – RS-232-C Upgrade Kit **\$300**  
**Rackmount Kit** – (016-0833-01) **\$250**  
**QuickStart Training Package** – (020-1812-04) **\$199**  
(See page 108 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

<sup>1</sup>See page 274 in Education section for information on Quick Start Packages.

**T** Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

**H**ere's Digital Storage and Analog Familiarity Plus Documentation at an Affordable Price.

## 2211

- 50 MHz Analog Bandwidth
- 20 MS/s Per Channel Sampling
- 500  $\mu$ V/div Vertical Sensitivity
- 4 K Per Channel Record Length
- CRT Readout, Including Trigger Level Voltage
- Cursors Operate in Storage and Non-Storage Modes
- Hardcopy Interface (RS-232-C)
- External Clock Inputs from DC to 10 MHz

## 2201

- 20 MHz Analog Bandwidth
- 10 MS/s Per Channel Sampling
- 2 K per Channel Record Length
- Hardcopy Interface Optional (RS-232-C)

## 2211/2201 OSCILLOSCOPES

### FAMILIAR ANALOG CONVENIENCE

Tek brings you familiar analog operation, plus crt readout, on-screen cursors, and an RS-232-C hardcopy interface in a portable package. Now, with a 2211 or 2201, you can have an inexpensive yet versatile oscilloscope with modern digital storage, without giving up the familiarity of analog operation.

With a friendly and familiar control panel, these scopes make it easy to switch between conventional analog and digital storage operation. Just select storage or non-storage with the push of a button and the crt switches between digital dot display and real-time mode.

### POWERFUL FEATURES FOR THE NOVICE OR EXPERT

In the digital storage mode, you can capture and display single-shot events and view low repetition rate signals without the usual flicker of an analog display. With digital pre-trigger you can view events that occurred before the trigger point, making it easy to identify trigger conditions.

The 2211's crt 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 predetermined voltage spike, store the waveform and see pretrigger events while babysitting a process control application.

By automatically calculating time and voltage differentials, waveform cursors increase accuracy and repeatability. 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.

With the RS-232-C hardcopy interface (optional on the 2201), you can send your results to a printer or plotter for convenient hardcopy documentation. Using this same interface you can transfer waveforms to a PC for further study.

These features make the 2211 and 2201 the right instruments for a wide variety of applications. They are ideal for first-time users and seasoned operators.

### PREMIUM SPECIFICATIONS

The 2211 provides 50 MHz analog bandwidth, two-channel sampling at 20 MS/s per channel, a 4 K record length per channel, and excellent vertical sensitivity. The 2201 provides 20 MHz analog bandwidth, two-channel sampling at 10 MS/s per channel, and a 2 K record length per channel. Since both instruments have dual digitizers, you don't sacrifice sampling speed or record length in two channel measurements.

With the 500  $\mu$ V vertical sensitivity of the 2211 you can evaluate 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.

A time base multiplier on both instruments 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.

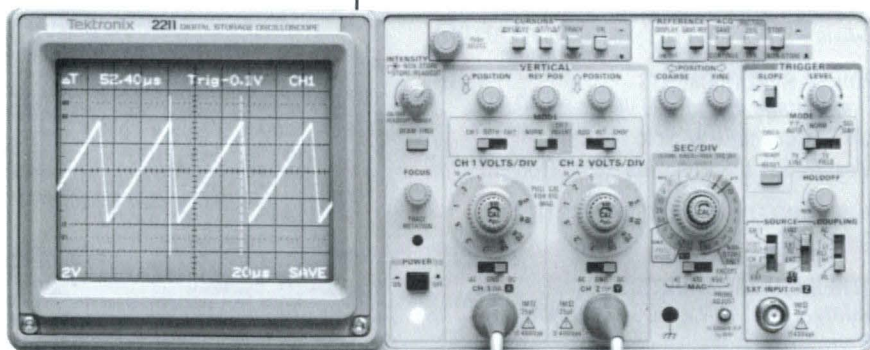
### PUSH BUTTON DOCUMENTATION

An RS-232-C hardcopy output serial interface is standard on the 2211, optional on the 2201. Hardcopy documentation with HPGL and EPSON compatible plotters and printers, simply by pressing a button. Recommended Hardcopy devices are: Tek HC100 (4-color plots), HC200 (black and white prints).

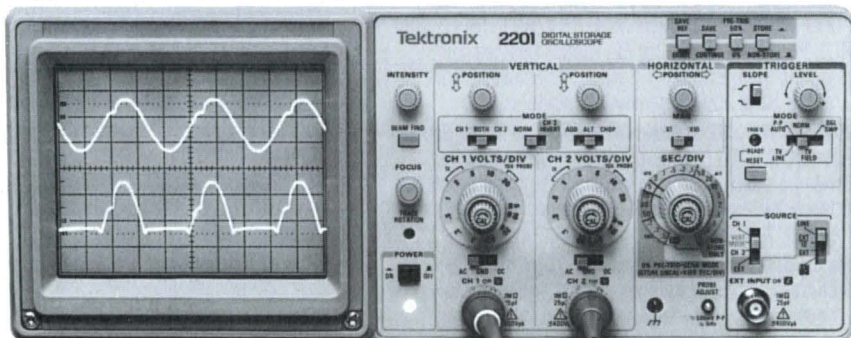
Plus, Tek's GRABBER 2 software lets you transfer waveform data from the scope to an IBM PC/XT/AT (or compatible) for display, mass storage, or evaluation. This software creates an HPGL plot file which can be archived, converted to other formats or printed out for documentation. By using a word processor which accepts HPGL files you can even import stored waveforms to your documents. No complex communication protocols or cabling are required.

### USEFUL BATTERY POWER OPERATION

With the optional internal 12 VDC inverter and a power source like the 1104A battery pack (mounts on rear of scope) the 2211 can be used in remote locations or when a floating measurement is required as in automotive testing. Order option 07 to get the internal inverter and option 30 to get the inverter plus an 1104A battery pack.



The 2211 is ideally suited for applications such as physical measurements, production testing process control, service, or repair.



The 2201 provides the power of digital storage, the familiarity of analog operation, and the affordability of Tek's lowest priced DSO.

# 50 MHz, 20 MS/s & 20 MHz, 10 MS/s DIGITAL PLUS ANALOG OSCILLOSCOPES

2211/2201

## CHARACTERISTICS

### DIGITAL STORAGE SYSTEM

**Sample Rate** – 2211: 20 MS/s max. per channel.  
2201: 10 MS/s max. per channel.

**Resolution** – Vertical: 8 bits (25 levels per division).  
Horizontal: 2211: 12 bits (400 points per division).  
2201: 11 bits (200 points per division).

**Record Length** – 2211: 4 K per channel.  
2201: 2 K per channel.

**Pre/Post Trigger** – 2211: 25% or 75% trigger position  
selectable. 2201: 0% or 50% trigger position selectable.

**Acquisition Mode** – Sample.

**Save Reference Memory** – One acquisition.

### VERTICAL SYSTEM (2 Identical Channels)

**Bandwidth (-3 dB) and Rise Time** – 2211: 50 MHz  
and 7.0 ns (+5°C to +35°C); 40 MHz and 8.8 ns (0°C to  
+40°C). 2201: 20 MHz and 17.5 ns

**Deflection Factor and Accuracy** – 5 mV/div to  
5 V/div, ±3%. 2211: 500 µV/div, ±5% with X10 vertical  
mag.

**Vertical Operating Modes** – CH 1, CH 2, CH 2 IN-  
VERT, ADD, ALT, CHOP (500 kHz), X10 vertical mag  
(2211 only).

**CMRR** – 2211: At least 10:1 at 20 MHz.  
2201: 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 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 (2211  
only), X-Y (non-store).

### TRIGGER SYSTEM

**Trigger Sensitivity** – Internal: 0.35 div at 5 MHz,  
1.0 div at 50 MHz. External: 40 mV at 5 MHz, 150 mV at  
50 MHz.

**Trigger Operating Modes** – Peak-Peak AUTO (also  
TV LINE), NORM, TV FIELD, SGL SWP.

**Trigger Source** – VERT MODE, CH 1, CH 2, LINE, EXT,  
EXT/10.

**Trigger Coupling** – 2211: ac, dc, HF REJ, (attenuates  
above 30 kHz), LF REJ (attenuates below 30 kHz).  
2201: dc.

**Variable Holdoff** – At least 8:1 (2211 only).

### X-Y OPERATION

**Deflection Factors** – Same as vertical system.

**Bandwidth** – X-Axis: 2 MHz. Y-Axis: same as vertical

**Phase Difference** – 2211: ±3° from dc to 150 kHz.  
2201: ±3° from dc to 50 kHz.

### ADVANCED FUNCTIONS

**Cursor Function and Accuracy** – 2211: 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 (2211 only).

**Hardcopy Interface (RS-232-C)** – Plots all displayed  
records (X1 MAG), crt readout and graticule (selectable).  
Baud rate: 300 to 9600. Plotter Devices: HPGL, Epson  
FX-Series. Connector: 9-pin DTE (male).

**Communication Software (Grabber 2)** – Comes  
with the instrument and transfers waveform data from the  
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 modulation, usable to 5 MHz.

### POWER REQUIREMENTS

**Line Voltage Range** – Low: 95 VAC to 128 VAC.  
High: 185 VAC to 250 VAC.

**Line Frequency** – 48 Hz to 440 Hz.

**Maximum Power Consumption** – 2211: 85 W  
(95 VA). 2201: 70 W (80 VA).

**Opt. 07** – 2211 Inverter Input Volts: 11.8 VDC to  
30 VDC (not retrofitable).

**1104A Battery Pack** – 2211 only. Couples to rear of  
scope. For use with opt. 07; Output: 12 V, 8 amps;  
Input: 95 VAC to 128 VAC or 185 VAC to 250 VAC  
(48 Hz to 440 Hz); Operating time: 2 hrs; Charge time:  
Approx. 16 hrs (longer when scope is operating);  
Weight: 14 lbs/6.5 kg.

**Warranty** – 3 years (Opt. 07); 1 year (1104A).

### ENVIRONMENTAL CHARACTERISTICS

See page 108.

### PHYSICAL CHARACTERISTICS

**Dimensions** – Width (with handles): 15.0 in; Height:  
5.4 in; Depth (without cover): 17.2 in; Weight: 16.8 lbs/  
7.6 kg.

### OTHER CHARACTERISTICS

**Safety** – UL 1244 listed, CSA certification.

**Warranty** – 3 years.

## ORDERING INFORMATION

2211 50 MHz Digital Plus  
Analog Oscilloscope **\$2,795**

Includes:  
Two 10X Voltage Probes (P6109),  
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 2 software,  
3 Year Warranty, Power Cord.

2201 20 MHz Digital Plus  
Analog Oscilloscope **\$1,695**

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. 07 – Internal 12 VDC  
Inverter (2211) **+\$445**  
Opt. 30 – 1104A Battery + Opt. 07  
(option 07, 30 for 2211 only) **+\$845**  
Opt. 12 – RS-232-C (2201) **+\$300**  
Opt. 3R – Rackmount Kit **+\$250**  
Opt. 2V – 2201 Training Package **+\$60**  
Opt. 2F – 2211 QuickStart (US) **+\$199**

### ACCESSORY OPTIONS

Opt. 1C – C-9 Opt. 01 Camera **+\$610**  
Opt. 1K – K212 Instrument Cart **+\$385**  
Opt. 1P – HC 100 Plotter (120V) **1**  
Opt. 1T – Transit Carrying Case **+\$345**  
Opt. 02 – Pouch and Front Cover **+\$60**

### INTERNATIONAL POWER PLUG OPTIONS

Opt. A1-A5 – Available **NC**  
See page 108 for description.

### WARRANTY-PLUS SERVICE PLANS

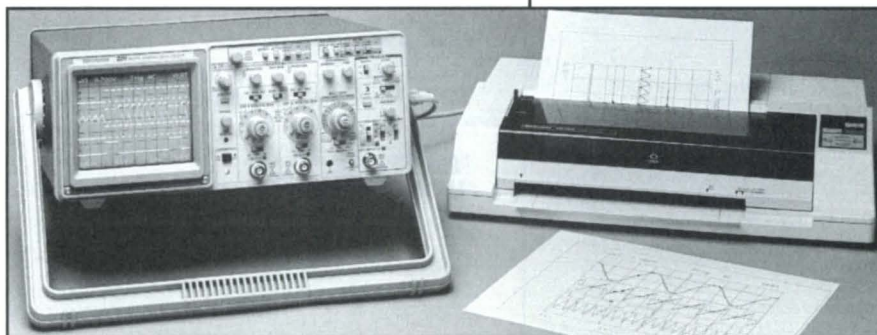
2211:  
Opt. M2 – +2 yrs service **+\$285**  
Opt. M8 – +4 annual calibrations **+\$195**  
2201:  
Opt. M2 – +2 yrs service **+\$170**  
Opt. M8 – +4 annual calibrations **+\$190**

### RECOMMENDED ACCESSORIES

Service Manuals –  
2211: Order 070-7234-00 **\$95**  
2201: Order 070-7189-00 **\$95**  
RS-232-C Interface Cable –  
Order 012-1298-00 **\$35**  
Rackmount Kit – 016-0819-03 **\$250**  
Battery Pack for Opt. 07 – 1104A **\$450**  
(See page 108 for more accessories.)

☎ Product available within 24 hours  
through Tek Direct. Call 1-800-426-2200.

\*1Contact your local sales office.



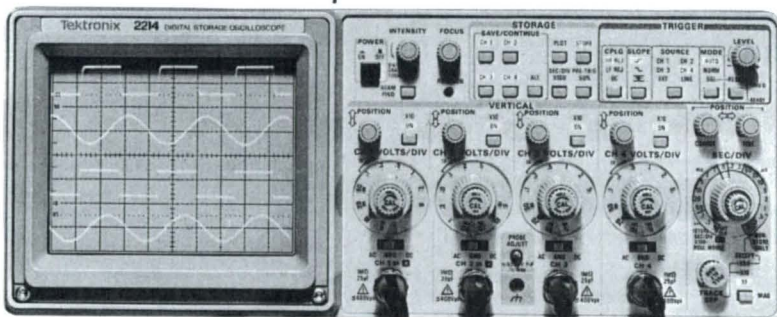
For convenient documentation you can link the 2211 or 2201 to a 4-color plotter such as the HC100, to print the waveform record.

2214

# 20 MHz, 16 MS/s DIGITAL PLUS ANALOG OSCILLOSCOPE

## Four Channel DSO with 16 K Record Length for Physical Signal Investigation.

- 20 MHz Analog Bandwidth
- 16 MS/s Per Channel Concurrent Sampling
- 8-Bit Vertical Resolution
- 16 K Per Channel Records
- 500  $\mu$ V/div Sensitivity
- Hardcopy Out Interface with Chart Record (RS-232-C)



The 2214 has unique capabilities for Electromechanical, Biophysical and Process Control applications where data acquisition and multi-channel monitoring is needed.

## NEW 2214 OSCILLOSCOPE

The new 2214 Four Channel Digital/Analog Oscilloscope is the ideal tool for research, service and maintenance people who need to troubleshoot or monitor Physical Systems. With its advanced design, the 2214 can acquire 16 K records on each of four fully attenuated channels and concurrently sample at a rate of 16 MS/s per channel. This allows users to capture long bursts of information and view it with fine resolution. With unique features like a continuously variable timebase, bi-slope triggering, chart record output and dual differential measurements the 2214 meets a wide variety of needs.

**Accuracy**— X1:  $\pm 3\%$ ; X10:  $\pm 4\%$ ; X50:  $\pm 5\%$  ( $+15^\circ\text{C}$  to  $+35^\circ\text{C}$ ). X1:  $\pm 4\%$ ; X10:  $\pm 5\%$ ; X50:  $\pm 8\%$  ( $0^\circ\text{C}$  to  $40^\circ\text{C}$ ).

**Horizontal Operating Modes**— X1, X10, X50, ROLL, X-Y (NON-STORE, CH 1 & 2 only), Continuously Variable Mode in STORE & NON-STORE (to 1 ms/div in STORE).

### TRIGGER SYSTEM

**Trigger Sensitivity**— Internal: 0.4 div at 5 MHz, 1.5 div at 20 MHz. External: 50 mV at 5 MHz, 250 mV at 20 MHz.

**Trigger Operating Modes**— Peak-Peak AUTO, NORM, SGL SWP.

**Trigger Source**— CH 1, CH 2, CH 3, CH 4, LINE, EXT.

**Trigger Coupling**— Dc, HF REJ (attenuates above 30 kHz), LF REJ (attenuates below 30 kHz).

### X-Y OPERATION

**Mode**— X1 mag. and NONSTORE, CH 1 & 2 only.

**Deflection Factors**— Same as vertical system.

**Bandwidth**— X-Axis: 2 MHz. Y-Axis: same as vertical.

**Phase Difference**—  $\pm 3^\circ$  from dc to 50 kHz.

### ADVANCED FUNCTIONS

**Trigger Level Output**— Selects the amplitude point on the trigger signal that produces triggering. A side panel BNC provides the interface for the trigger level so it can be input to an external meter or a scope channel.

**External Clock Input**— Dc to 8 MHz. ROLL Mode: dc to 16 kHz.

**Hardcopy Interface (RS-232-C)**— Prints or Plots all 16K records (X1 MAG only), ROLL mode output for continuous printout of data like a CHART RECORDER (from 10 s/div to 2500 s/div). Baud rate: 300, 1200, 4800, 9600. Plotter/Printer Devices: HPGL, Epson FX-Series, Laserjet (100 dpi), Thinkjet. (9-pin DTE (male)).

**Communication Software (Grabber 2)**— Comes with the instrument and transfers waveform data from the 2214 to an IBM PC/XT/AT (or compatible) via RS-232. Can be used to convert files for use by other software.

### CRT SYSTEM

**Display**— 8 cm x 10 cm, 12.6 kV nominal voltage.

**Controls**— INTENSITY, TRACE ROTATION, BEAM FIND, FOCUS.

### POWER REQUIREMENTS

**Line Voltage Range**— Low: 95 VAC to 128 VAC. High: 185 VAC to 250 VAC.

**Line Frequency**— 48 Hz to 440 Hz.

**Maximum Power Consumption**— 85 W (95 VA).

**Opt. 07**— Inverter Input Voltage: 11.8 VDC to 30 VDC.

**1104A Battery Pack**— Couples to rear of scope. For use with opt. 07; Output: 12 V, 8 amps; Input: 95 VAC to 128 VAC or 185 VAC to 250 VAC (48 Hz to 440 Hz); Operating time: 2 Hrs; Charge time: Approx. 16 Hrs (longer when scope is operating); Weight: 14 lbs/6.5 kg.

### PHYSICAL CHARACTERISTICS

**Dimensions**— Width (with handles): 15.0 in; Height: 5.4 in; Depth (without cover): 17.2 in; Weight: 17.4 lbs.

**Safety**— UL 1244 listed, CSA certification.

**Warranty**— 3 years (1 year 1104A).

## ORDERING INFORMATION

2214 20 MHz Oscilloscope \$3,995

Includes:  
Two 10X Probes (P6103),  
Operators Manual (070-7781-00),  
9-pin to 25-pin RS-232  
Interface Cable (012-1197-00),  
GRABBER 2 software,  
3 Year Warranty, Power Cord.

### INSTRUMENT OPTIONS

Opt. 3R — Rackmount Kit +\$250  
Opt. 07 — 12 VDC internal inverter +\$445  
Opt. 30 — Opt. 07 + 1104A battery +\$895

### ACCESSORY OPTIONS

Opt. 1C — C-9 Camera +\$610  
Opt. 1K — K212 Instrument Cart +\$385  
Opt. 3P — HC100 Plotter (120V) +\$950  
Opt. 3H — HC200 Printer (110V) +\$420  
(RS-232-C) w/ Chart Roll Adapter  
Opt. 1T — Transit Carrying Case +\$345  
Opt. 02 — Pouch and Front Cover +\$60  
Opt. 22 — 2 P6103 10X Probes +\$80  
Opt. 23 — 2 P6119 1/10X Probes +\$130

### INTERNATIONAL POWER PLUG OPTIONS

Opt. A1-A5 — See page 108. NC

### WARRANTY-PLUS SERVICE PLANS

Opt. M2 — +2 yrs service +\$245  
Opt. M8 — +4 calibrations +\$280

### RECOMMENDED ACCESSORIES

Service Manual — 070-7783-00 \$95  
RS-232 Cable — 012-1298-00 \$35  
Rackmount Kit — 016-0819-03 \$250  
Battery Pack for Opt. 07 — 1104A \$450  
(See page 108 for more accessories.)

## CHARACTERISTICS

### DIGITAL STORAGE SYSTEM

**Sample Rate**— 16 MS/s per channel. (Quad Digitizers)

**Resolution**— Vertical: 8 bits (25 levels per division). Horizontal: 14 bits (1600 points per division, on screen).

**Record Length**— 16 K per channel.

**Pre/Post Trigger**— 0% or 50% position selectable.

**Acquisition Mode**— Sample, Roll.

**Save/Continue Memory**— Freeze waveform record on any or all channels (16 K/CH). Non-Volatile. Front-panel settings non-volatile at power down.

### VERTICAL SYSTEM (4 Identical Channels)

**Bandwidth ( $-3$  dB) and Rise Time**— 20 MHz and 17.5 ns ( $0^\circ\text{C}$  to  $+40^\circ\text{C}$ ).

**Deflection Factor and Accuracy**— 5 mV/div to 5 V/div,  $\pm 3\%$ . 500  $\mu$ V/div to .5 V/div,  $\pm 3\%$ , limited to 1 MHz with X10 vertical mag.

**Vertical Operating Modes**— CH 1, CH 2, CH 3, CH 4, CH 1 INVERT, CH 3 INVERT, ADD CH 1 + CH 2, ADD CH 3 + CH 4 (dual differential), X10 vertical mag.

**CMRR**— At least 50:1 at 100 kHz.

**Input R and C**— 1 M $\Omega$ , 25 pF.

**Max Input Voltage**— 400 V (dc + peak ac), 800 V p-p.

**Channel Isolation**— 100:1 at 5 MHz.

### HORIZONTAL SYSTEM

**Sweep Speeds**— In NON-STORE: 0.5 s/div to 0.1  $\mu$ s/div, extended to 10 ns/div with X10 ALT MAG. In STORE, 0.5 s/div to 0.1 ms/div, extended to 2  $\mu$ s/div with X50 ALT MAG and 50 s/div with X100 ROLL MODE.



For convenient documentation and analysis, off-the-shelf software packages are available to link many 2200 Series oscilloscopes to printers, plotters, and computers (such as Tek's TeleServicing solution).

Many of the 2200 Series instruments can be configured with a variety of interfaces to provide added functionality. These interfaces can provide a means to collect data into a computer, to control the oscilloscope with the computer, or to provide hardcopy output of the waveform data. In addition, through the use of specialized software, advanced functions (such as modem communications) are available.

### GPIB INTERFACE

Several oscilloscopes can be configured with a GPIB interface. The new 2252 is Tek's lowest-cost, fully programmable portable oscilloscope. With its standard GPIB interface (IEEE-488.2-1988 Standard), you can control all scope controls remotely. Waveform and measurement data can be transmitted to a personal computer for storage and analysis. Test routines can be developed with the help of development software from Tektronix that can quickly automate many repetitive test applications.

The 2232 and 2221A Digital Storage Oscilloscopes can also be ordered with a GPIB interface (Option 10). With the interface installed, you can transmit and receive waveform data from the scope to personal computers and other peripherals. Most front-panel settings and menu states can be queried and many functions controlled via the interface, for example, single-sweep trigger reset. In

addition, the instruments can provide hardcopy output when connected directly to a compatible printer or plotter. Devices supported include HPGL digital plotters, such as the Tektronix HC100, or the HP Thinkjet printer.

### RS-232-C INTERFACE

All of the 2200-series DSO's can be ordered with an RS-232-C serial interface. The 2232 and 2221A can be ordered with an RS-232-C interface (Option 12) that provides all the functions described above for GPIB. The RS-232-C interface has both DCE and DTE connectors, selectable with baud rate, parity, and line termination using switches located on the oscilloscope side panel. Hardcopy output is also available, and includes support for Epson FX-Series printers with a serial interface, such as the Tektronix HC200.

The 2214 and 2211 offer RS-232-C standard, while the 2201 can be ordered with Option 12 to include the interface. On these oscilloscopes, the interface is designed as a talker-only interface. Hardcopy output is available using a number of devices, including HPGL serial plotters and Epson-compatible (FX Series) serial printers. The 2214 also supports HP Laserjet and Thinkjet printers. A special software program included with each of these oscilloscopes, called Grabber 2, permits waveform transfer to a personal computer for long term storage or analysis.

### CENTRONICS INTERFACE

The 2252 also comes equipped with a Centronics interface which provides hardcopy output for the HC200 and Epson FX-series printers. A push of the hardcopy button on the front panel causes all displayed waveforms and measurements to be sent to the printer for documentation.

### INTEGRATED SOFTWARE PACKAGES

To keep you focused on solving your problems, rather than software coding chores, Tektronix offers a variety of off-the-shelf software programs. Numerous packages are available for waveform acquisition, signal analysis, and instrument control. A partial listing is provided on this page as an example of solutions available.

*For more information on utility and application software, see the Test and Measurement Software Section of this catalog.*

**T**ektronix offers the complete solution to your test and measurement needs, from hardware to software and accessories.

- *Printers and Plotters for Hardcopy Documentation*
- *Software for Instrument Control*
- *Software for Waveform Data Acquisition and Analysis*

Some examples of software packages from Tektronix:

#### WaveSaver (S41SAVE):

Waveform transfer, display, and storage with 2232-series oscilloscopes, utilizing easy-to-use pop-up menus and color EGA graphics.

**TeleServicing (S41TSS1):** Adds to WaveSaver the ability for remote instrument communication over modems. Includes integrated dialing directory and modem control software.

**GURU II+ (S3FG100):** GPIB User's Resource Utility software for instrument control, waveform acquisition, and display.

**SPD (S3FG130):** Signal Processing and Display software to simplify the acquisition, processing, and measurement of digitized waveforms.

**EZ-Test PC (S45F030):** A software productivity tool used to create and run automated test programs without the need for programming.

### INTERFACES AND PRINTER/PLOTTER DEVICES SUPPORTED

Scope	GPIB	RS-232	Centronics	HPGL	Epson FX	Thinkjet	Laserjet	Programmability
2252	Std	—	Std	—	Yes	—	—	Full
2232	Opt	Opt	—	Yes	Yes	Yes	—	Partial
2221A	Opt	Opt	—	Yes	Yes	Yes	—	Partial
2214	—	Std	—	Yes	Yes	Yes	Yes	—
2211	—	Std	—	Yes	Yes	—	—	—
2201	—	Opt	—	Yes	Yes	—	—	—
222	—	Std	—	—	—	—	—	Full

2252/2247A  
2245A100 MHz, DUAL TIME BASE  
OSCILLOSCOPES

**S**mart Scopes with 100 MHz, Four Channels, and Advanced Features like Auto Setup, Tracking Cursors, Voltmeter, Integrated Counter/Timer, and Store/Recall of Front Panel Setups.

- Four Independent Channels
- Auto Setup of Instrument Front Panel
- Dual Time Base with Delayed Sweep
- Cursor Time/Voltage Measurements
- On-Screen Scale Factor Readouts

## 2247A

- Hands-Off Voltmeter Measurements
- SmartCursor™ Track Voltmeter Measurements
- Integrated Counter/Timer
- Phase Measurements
- Automatic Rise/Fall Time and Propagation Delay Time Measurements
- Store/Recall of 20 Front Panel Setups

## DUAL TIME BASE OSCILLOSCOPES

## HIGHER PERFORMANCE, LOWER PRICE

When productivity, performance, and low cost really count, nothing beats the 2245A, 2247A, and new 2252 line of portable oscilloscopes. These four-channel, dual time base oscilloscopes are top-of-their-class in automation and versatility, becoming the industry standard in 100 MHz real-time performance. Such capabilities as 2 ns/division time base, 2 mV/division vertical sensitivity, and advanced trigger modes assure you solutions for your design, testing, and service tasks.

## AUTOMATIC FRONT PANEL SETUP

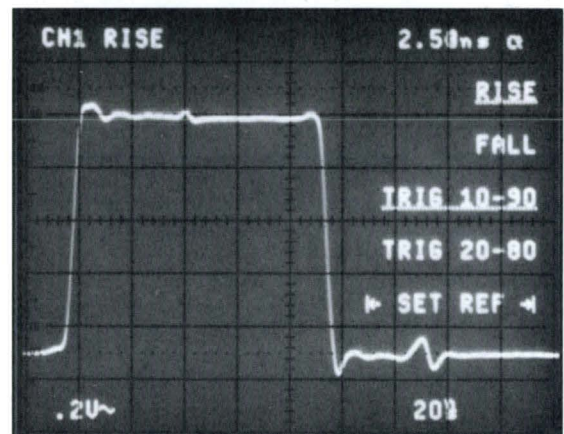
All these oscilloscopes offer single button setup. Just press the AutoSet key and vertical, horizontal, triggering and display controls are automatically adjusted to display a waveform. In seconds, a stable, triggered display of your waveform appears on-screen, ready to measure.

## STORE/RECALL MEMORY

For even greater versatility in setup, the 2247A and 2252 offer store/recall of 20 front panel setups. Current front panel settings can be stored in non-volatile memory, then recalled when and where they are needed. Switching between setups is easy – just two buttons recall a complete setup, including selected measurements and operator prompts. For repetitive testing or service diagnostics, store/recall settings can even be used in sequence to step through a predetermined series of tasks.

## ADVANCED REAL-TIME MEASUREMENTS

Each have cursors for making 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.



*Make difficult measurements faster and more accurately. Rise time measurements are made automatically with the integrated 200 MHz counter/timer on the 2247A and 2252.*

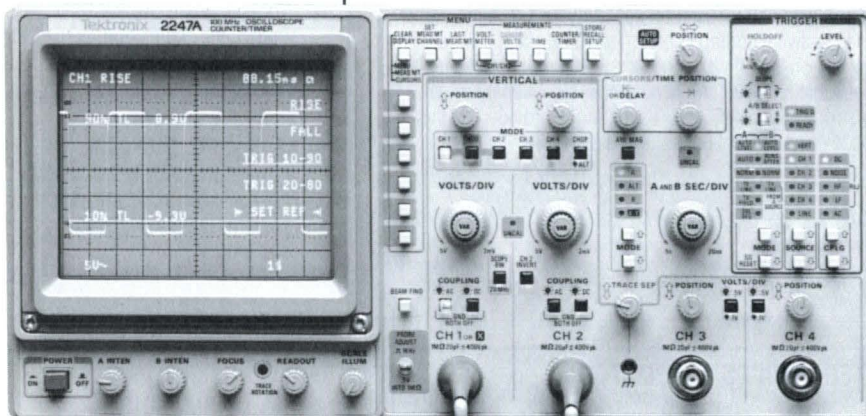
The 2247A and 2252 further integrate advanced measurement capability with a built-in digital voltmeter and a precision counter/timer. These integrated tools provide a complement of automatic measurements at your fingertips.

## DIGITAL VOLTMETER BUILT-IN

The voltmeter measurement system 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 SmartCursors™ delivers instant answers.

## INTEGRATED PRECISION TIMER/COUNTER

The 200 MHz counter/timer delivers crystal-controlled accuracy for your timing measurements. You can measure frequency, width, period, and totalized events directly from your input channels. Rise and fall time can be made automatically at predefined thresholds (10-90%, 20-80%) or user-set reference levels. Propagation delay measurements between channels are push-button simple. And all measurements can be made using gated time intervals simply by adjusting an intensified zone to any size and position on your waveform.



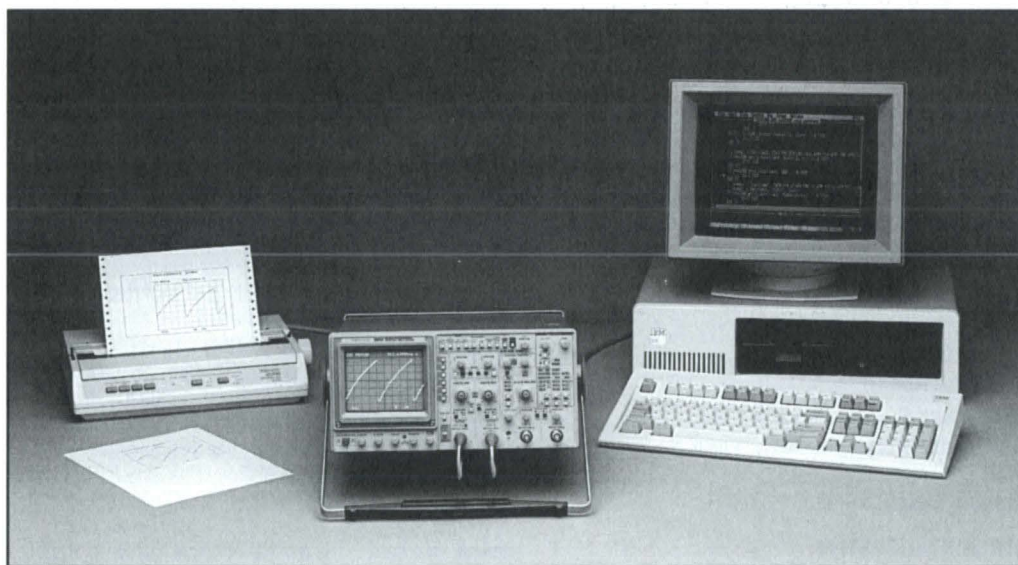
2247A: Packed with time saving automation like front panel auto setup and store/recall. Automatic measurements are push-button simple using the integrated digital voltmeter and precision counter/timer.



# 100 MHz, DUAL TIME BASE OSCILLOSCOPES

2252/2247A  
2245A

NEW



**NEW 2252:** The only oscilloscope that combines the versatility of analog display with the power of precision measurement tools, full programmability and push-button waveform hardcopy. Ideal for manufacturing test, depot repair, service documentation, and bench-top ATE.

## HARDCOPY DOCUMENTATION

With the introduction of the 2252, Tektronix combines the precision and versatility of analog real-time with the power of waveform digitizing. At the push of a button, repetitive waveforms are quickly digitized using a proprietary sequential sampling technique. With this innovation, an Epson-compatible printer (such as our HC200 printer) replaces the traditional crt camera for waveform documentation. Each channel is acquired using 500-point record length and up to 12-bit vertical resolution, then transferred via the Centronics interface to your printer. Active measurements and scale factors are also documented. An exclusive peak detection process further ensures anti-aliasing, and is capable of detecting repetitive events as narrow as 10 ns at any sweep speed.

## FULL GPIB PROGRAMMABILITY

The 2252 extends its power of automation to include full programmability of all front panel and menu controls. The standard GPIB (IEEE 488.2) interface allows access to all scope functions, including instrument setup, signal acquisition, and measurement control. Digitized waveforms can be acquired and transferred to a personal computer for analysis, documentation, and archiving. Measurements can be queried, and test routines easily created for go/no-go testing.

The 2252 is as easy to program as it is to use. In addition to specific command variables, the operator can learn an entire front-panel setting simply by querying the current instrument setup. The response can be stored in a file, then downloaded to the scope when needed at a later time. To support automated test development, a 2252 instrument driver is also available for Tek's popular EZ-Test PC software program. See the Test and

Measurement Software section of this catalog for more information on this complete development and test routine software system.

## UNMATCHED PERFORMANCE AND INNOVATION

The 2245A, 2247A, and 2252 are packed with performance capabilities and innovation to meet your automation needs. Whether you're looking for automation in the field, on the design bench, or an entire production line, these scopes can meet the challenge.

**A**utomation made easy with full programmability, digitized waveform hardcopy, and push-button measurements.

## NEW 2252

All the features of 2247A, plus:

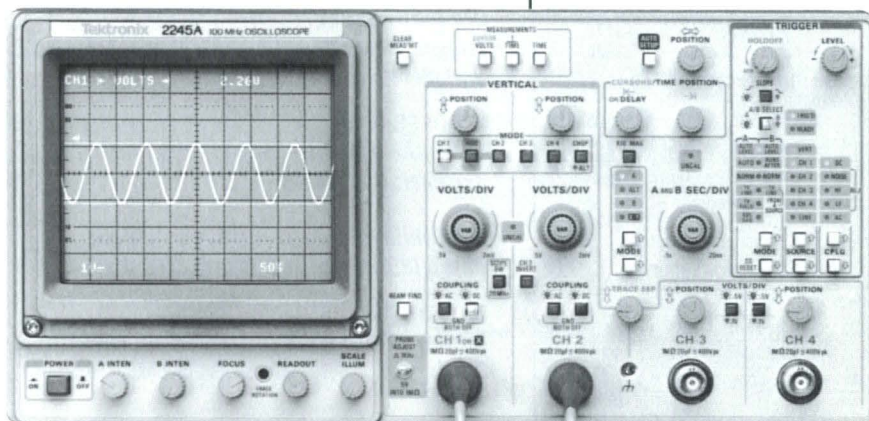
- Push-Button Hardcopy Output
- Centronics Interface
- Fully GPIB Programmable

**GPIB\***  
IEEE-488.2

\*The 2252 oscilloscope complies with IEEE Standard 488.2-1988, and Tektronix Standard Codes and Formats.

## SELECTION GUIDE

Features	2245A	2247A	2252
Bandwidth	100 MHz	100 MHz	100 MHz
Channels	4	4	4
Time Base	Dual	Dual	Dual
Auto Setup	Yes	Yes	Yes
Cursors	Yes	Yes	Yes
Store/Recall	No	Yes	Yes
Digital Voltmeter	No	Yes	Yes
Counter/Timer	No	Yes	Yes
Programmability	No	No	Yes
Hardcopy Output	No	No	Yes



**2245A:** Ideal for troubleshooting, general repair, and design where basic measurements are often needed. Time and voltage cursors make short work of signal time and amplitude analysis.

## ORDERING INFORMATION

2252 100 MHz Programmable Oscilloscope with Hardcopy Output **\$3,495**  
Includes:

Two 10X Voltage Probes (P6109)  
Opt. 01, Operators Manual (070-7837-00), Users Reference Guide (070-7839-00), 3 Year Warranty, Power Cord.

2247A 100 MHz Oscilloscope with Voltmeter/Counter/Timer **\$2,995**  
Includes:

Two 10X Voltage Probes (P6109), Operators Manual (070-6373-00), Users Reference Guide (070-6688-00), 3 Year Warranty, Power Cord.

2245A 100 MHz Oscilloscope with Cursors **\$2,995**  
Includes:

Two 10X Voltage Probes (P6109), Operators Manual (070-6558-00), Users Reference Guide (070-6718-00), 3 Year Warranty, Power Cord.

## INSTRUMENT OPTIONS

Opt. 1R - Rackmounted Instr. **+\$350**  
Opt. 15 - CH2 & A Gate Output **+\$100**  
Opt. 2F - QuickStart Training <sup>1</sup> **+\$199**

## ACCESSORY OPTIONS

Opt. 02 - Acc. Pouch and Cover (2252) **+\$55**  
2247A/2245A **+\$60**  
Opt. 1C - C-9 Camera (2252) <sup>2</sup>  
2247A/2245A **+\$580**  
Opt. 1H - HC200 Printer (2252) **+\$295**  
Opt. 1K - K212 Instrument Cart **+\$385**  
Opt. 1T - Transit Carrying Case (2252) **+\$280**  
2247A/2245A **+\$345**  
Opt. 17 - P6408 Logic Probe **+\$375**  
Opt. 22 - Add two P6109 probes **+\$140**  
Opt. 23 - Add 2 P6062B 1X/10X Probes **+\$440**

INTERNATIONAL POWER PLUG OPTIONS  
Opt. A1 - A5 - Available (see pg. 108) **NC**

## WARRANTY-PLUS SERVICE OPTIONS

2252:  
Opt. M2 - +2 yrs service **+\$235**  
Opt. M8 - +4 annual calibrations **+\$455**

2247A:  
Opt. M2 - +2 yrs service **+\$205**  
Opt. M8 - +4 annual calibrations **+\$395**

2245A:  
Opt. M2 - +2 yrs service **+\$176**  
Opt. M8 - +4 annual calibrations **+\$320**

## RECOMMENDED ACCESS./FIELD KITS

Service Manuals -  
2252 (070-7838-00) **\$95**  
2247A (070-6367-00) **\$95**  
2245A (070-6557-00) **\$95**  
Rackmount Kit - Order 2240F1R **\$350**

QuickStart Training Package - (020-1864-04) <sup>1</sup> **\$199**  
See page 108 for more accessories.

## 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	8.7	17.9

<sup>1</sup> See page 274 for additional educational information.

Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

## CHARACTERISTICS

Characteristics are common to the 2252, 2247A, and 2245A except where noted.<sup>1</sup>

## VERTICAL SYSTEM (4 Channels)

**Bandwidth (-3 dB) and Rise Time** - 100 MHz and 3.5 ns (-10°C to +35°C); 90 MHz and 3.9 ns (2 mV/div or +35°C to +55°C). Bandwidth limit: 20 MHz.

**Deflection Factor and Accuracy** - CH 1 & 2: 2 mV/div to 5 V/div; CH 3 & 4: 0.1 V/div and 0.5 V/div; all at ±2% (±3% outside +15°C to +35°C). CH 1 & 2 variable at least 2.5:1.

**Vertical Operating Modes** - CH 1, 2, 3, 4, CH 2 INVERT, ADD, ALT, CHOP (625 kHz).

**CMRR** - At least 10:1 at 50 MHz.

**Input R and C** - 1 MΩ, 20 pF.

**Max Input Voltage** - 400 V (dc + peak ac) or 800 V p-p.

**Channel Isolation** - 50:1 at 100 MHz.

## HORIZONTAL SYSTEM

**Sweep Speeds** - A Time Base: 0.5 s/div to 20 ns/div; B Time Base: 5 ms/div to 20 ns/div (X10 MAG to 2 ns/div).

**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.

**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: 100 MHz.

**Phase Difference** - ±3° from dc to 50 kHz.

## CRT SYSTEM

**Display** - 8 cm x 10 cm, 16.5 kV nominal voltage.

**Z-Axis** - 3.8 V causes noticeable modulation. Usable to 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 108.

## ADVANCED FUNCTIONS

**Cursors** - Time, 1/Time: ±0.5% + 2% of one div; Delta Time, 1/Delta Time, Delta Phase (2247A/2252): ±0.5% + 1% of one div; Volts: ±0.5% + 2% of one vertical div.

**Voltmeter (2252 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). Channels 1 and 2.

**Counter/Timer (2252 and 2247A)** - Time Base and Accuracy: 200 MHz and 10 ppm (0.001%). Frequency: 0.01 Hz to 100 MHz. Max resolution: 0.00000001 Hz. Max accuracy same as time base. Period: 100 s to 5 ns. Max resolution: 0.1 fs. Max accuracy same as time base. Width: 100 s to 5 ns. Max resolution: 1 ps. Max accuracy same as time base ± 2 ns. Totalize: 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 VDC + peak ac. Frequencies: 1, 5, and 10 MHz.

**Centronics Interface (2252)** - Printers: Epson FX-Series (9 or 24 pin).

**ANSI/IEEE-488.2 GPIB Interface (2252)** - Function Subsets: SH1, AH1, T6, L4, SR1, RL1, DC1, DT, PPO, E1, and CO.

## DIGITIZER SYSTEM (2252)

**Type** - Sequential (10 ns peak detection).

**Resolution** - Vertical: 12 Bits (250 levels/div) (25 pts/div for hardcopies). Horizontal: 9 Bits (50 pts/div).

**Record length** - 500 points per channel (four channels).

**Useable Sweep Speeds** - (A Horizontal Mode only) 0.5 s to 20 ns/div.

## INSTRUMENT OPTIONS

**Channel 2 And A-Gate Output (Opt. 15)** - Channel 2 Output - Bandwidth: Dc to 25 MHz; Deflection factor: 10 mV/div into 50 Ω, 20 mV/div into 1 MΩ; Dynamic Range: ±7 divisions; DC Offset: < 0.5 divisions. A-Gate Output Level - TTL compatible; Drive: 4 mA (high state), 20 mA (low state).

## OTHER CHARACTERISTICS

**Safety** - UL 1244 listed, CSA certification.

**Warranty** - 3 years.

<sup>1</sup> Military Versions 22461Y/2R/Mod A also available. See page 109.

## 2235A AND 2236A OSCILLOSCOPES

The 2235A and 2236A offer reliability and easy operation with 100 MHz, dual time base performance. The 2236A's Counter/Timer and DMM provide additional measurement versatility.

### PROVEN STANDARD IN 100 MHz TWO-CHANNEL OSCILLOSCOPES

The 2235A and 2236A offer advanced 100 MHz, dual time base performance with simple operation. Innovative architecture, advanced circuit design and a large bright crt make these scopes accurate, reliable and serviceable.

The 2235A and 2236A scopes ideal for digital and high-speed analog circuit troubleshooting. Both offer the needed sensitivity for reliable low-level signal measurements with 5 ns/div sweep speed and 2% vertical and horizontal accuracy. The 2236A integrated counter/timer and multimeter permits quick measurements of critical circuit parameters at the touch of a button.

## CHARACTERISTICS

### VERTICAL SYSTEM

**Bandwidth (-3 dB) and Rise Time** - 100 MHz and 3.5 ns (0°C to 15°C).

**Deflection Factor and Accuracy** - 2 mV/div to 5 V/div  $\pm 2\%$  (15°C to 35°C);  $\pm 3\%$  (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** - 1 M $\Omega$ ; 2235A: 20 pF, 2236A: 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 sweep: 0.5 s/div to 0.05  $\mu$ s/div. B sweep: 50 ms/div to 0.05  $\mu$ s/div. Both extended to 5 ns/div with X10 magnifier.

**Accuracy** -  $\pm 2\%$ , Magnified  $\pm 3\%$ .

**Horizontal Operating Modes** - A, ALT and B.

**Delay Jitter** - 2235A: 20,000:1. 2236A: 10,000:1.

**Delay Accuracy** - 2235A:  $\pm 1\%$ . 2236A: Same as counter/timer time base  $\pm 20$  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).

**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

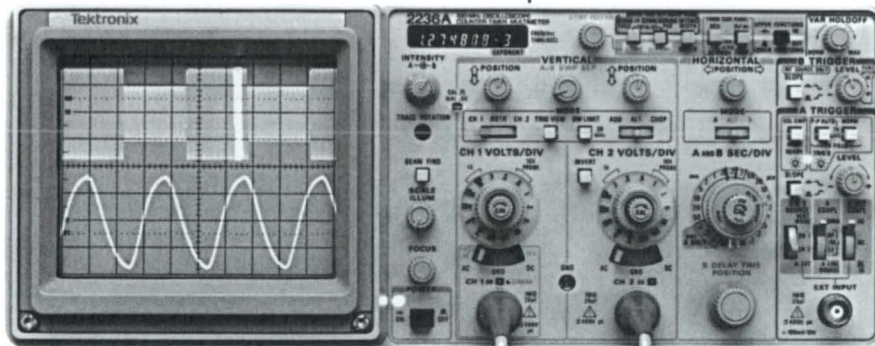
**Deflection Factors** - Same as vertical system.

**Bandwidth** - X-Axis: 3 MHz. Y-Axis: same as vertical.

**Phase Difference** -  $\pm 3^\circ$  from dc to 150 kHz.

### CRT SYSTEM

**Display** - 8 cm x 10 cm, 14 kV nominal voltage.



The 2236A offers all the features, reliability, and performance of the popular 2235A plus the added versatility of a counter/timer and digital multimeter.

**Controls** - A, B INTENSITY, TRACE ROTATION, BEAM FIND, SCALE ILLUM, FOCUS.

**Z-Axis** - 5 V causes noticeable modulation, to 20 MHz.

### POWER REQUIREMENTS

**Line Voltage Range** - 90 VAC to 250 VAC.

**Line Frequency** - 48 Hz to 440 Hz.

**Maximum Power Consumption** - 2235A: 40 W (70 VA). 2236A: 60 W (110 VA).

### 2236A ADVANCED FUNCTIONS

**Counter/Timer** - Time Base and Accuracy: 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/Width: 5 s to 5 ns. Max resolution: 10 ps. Max accuracy same as time base  $\pm 10$  ns. Totalize: 8,000,000 counts. Delay Time: 2.5 s to 500 ns. Max resolution: 10 ps. Max accuracy same as time base  $\pm 20$  ps. Delta Time: 1 ns to 2.5 s. Max resolution: 10 ps. Max accuracy same as time base  $\pm 50$  ps.

**Digital Multimeter** - Dc Volts: 0 to 500 V. Max resolution: 100  $\mu$ V. Accuracy  $\pm 1\%$ . Input: side DMM leads. RMS AC Volts: 0 to 350 V (20 Hz to 20 kHz). Max resolution: 100  $\mu$ V. Accuracy  $\pm 1\%$ . Input: side DMM leads. CH 1 VDC: 0 to 500 V. Resolution: 1 mV. Accuracy  $\pm 5\%$ . CH 1 Vrms ac: 0 to 350 V (50 Hz to 20 kHz). Max resolution: 1 mV. Accuracy  $\pm 2\%$ . Resistance: 0 to 20 G $\Omega$ . Max resolution: 0.01  $\Omega$ . Max accuracy 0.15%  $\pm 2$  LSD's. Diode Detect: 0.15 V to 2.0 V. Max resolution: 1 mV. Max accuracy 0.15%  $\pm 2$  LSD's. Continuity: 0 to 5  $\Omega$ . Accuracy  $\pm 1 \Omega$ . Temperature: -62°C to +230°C. Accuracy  $\pm 2\% \pm 1.5^\circ$ C.

### ENVIRONMENTAL CHARACTERISTICS

See page 108.

### OTHER CHARACTERISTICS

**Safety** - UL 1244 listed, CSA certification.

**Warranty** - 3 years.

## 2236A

- Built-in Counter/Timer/DMM
- Voltage, resistance, and temperature measurements
- Crystal-controlled precision C/T accuracy

## ORDERING INFORMATION

**2236A 100 MHz Oscilloscope with Counter/Timer/ Multi-meter** **\$3,595**

Includes: Two 10X Probes (P6109) Opt. 01, DMM Leads (012-0941-01), Operators/Service Manual (070-7685-00), 3 Year Warranty, Power Cord.

**2235A 100 MHz Oscilloscope** **\$1,995**  
Includes: Two 10X Probes (P6109) Opt. 01, Operators/Service Manual (070-7683-00), 3 Year Warranty, Power Cord.

### INSTRUMENT OPTIONS

**Opt. 14** - (2236A only) - TCXO Temperature Compensated Crystal Oscillator (0.5 ppm) **+\$315**

**INTERNATIONAL POWER PLUG OPTIONS**  
Opt. A1-A5 (see page 108) **NC**

### WARRANTY-PLUS SERVICE OPTIONS

**2236A:**  
**Opt. M2** - +2 yrs service **+\$200**  
**Opt. M8** - +4 calibrations **+\$320**  
**2235A:**  
**Opt. M2** - +2 yrs service **+\$169**  
**Opt. M8** - +4 calibrations **+\$259**

### RECOMMENDED ACCESSORIES

**Rackmount Kits** -  
2236A Order 016-0015-03 **\$300**  
2235A Order 016-0833-01 **\$250**  
**Temperature Compensated Crystal Oscillator (TCXO) Retrofit Kit** - (2236A only) Order 040-1136-00 **\$370**

### PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Height	137	5.4
Width (w/ handle)	360	14.2
Depth (w/o front cover)	445	17.3
Weight	kg	lb
2236A Net	7.3	16.2
2235A Net	6.1	13.5

Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

- 500  $\mu$ V/div Vertical Sensitivity
- HF/LF Reject Trigger Filters
- X5, X10, X50 Magnification
- Peak-to-Peak Auto Triggering
- Opt. Battery Power Operation



The 2225 offers simplified but precise operation for such applications as field service, design, education, and production test.

## 2225 OSCILLOSCOPE

Real economy coupled with unique real-time performance.

### ECONOMICAL WITH HIGH-END FEATURES

The two-channel 2225 contains features usually found in more expensive instruments. For example, the new low-noise vertical system operates at 500  $\mu$ V/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. The single-sweep function is very useful for babysitting waveforms and waveform photography.

### DC OPERATION

Two 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 external, rear-mounted 1104A battery pack. This provides at least three hours of operation under battery power. The integrated charger allows operation during the charging cycle. These options are also available on the 2211 and 2214.

## 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,  $\pm 3\%$ . 500  $\mu$ V/div,  $\pm 5\%$  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 M $\Omega$ , 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  $\mu$ s/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: 0.3 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 (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 causes noticeable modulation. Usable to 5 MHz.

### POWER REQUIREMENTS

**Line Voltage Range** - Low: 95 VAC to 128 VAC. High: 185 VAC to 250 VAC.

**Line Frequency** - 48 Hz to 440 Hz.

**Maximum Power Consumption** - 70 W (80 VA).

**Opt. 07** - Inverter Input Voltage: 11.8 VDC to 30 VDC (not retrofittable).

**1104A Battery Pack** - Couples to rear of scope. For use with opt. 07; Output: 12 V, 8 amps; Input: 95 VAC to 128 VAC or 185 VAC to 250 VAC (48 Hz to 440 Hz); Operating time: 3 Hrs; Charge time: Approx. 16 Hrs (longer when scope is operating); Weight: 14 lbs/6.5 kg.

**Warranty** - 3 years (Opt. 07); 1 year (1104A).

### ENVIRONMENTAL CHARACTERISTICS

See page 108.

### OTHER CHARACTERISTICS

**Safety** - UL 1244 listed, CSA certification.

**Warranty** - 3 years.

## ORDERING INFORMATION

2225 50 MHz Oscilloscope  $\$1,195$

Includes:

2 10X Voltage probes (P6103),  
Operators Manual (070-6298-00),  
3 Year Warranty, Power Cord.

### INSTRUMENT OPTIONS

Opt. 3R - Rackmount Kit **+\$250**  
Opt. 1V - Operators Tape **+\$60**  
Opt. 07 - Internal 12VDC Inverter **+\$445**  
Opt. 30 - External Battery Pack **+\$845**  
(1104A battery plus Option 07)

### ACCESSORY OPTIONS

Opt. 1C - C-9 Camera Opt. 01 **+\$610**  
Opt. 1K - K212 Instrument Cart **+\$385**  
Opt. 1T - Transit Carrying Case **+\$345**  
Opt. 02 - Pouch and Panel Cover **+\$60**  
Opt. 17 - P6408 Logic Probe **+\$375**  
Opt. 23 - Add 2 P6119 1X/10X Probes **+\$130**

### INTERNATIONAL POWER PLUG OPTIONS

Opt. A1- A5 - Available **NC**  
See page 108 for description.

### WARRANTY-PLUS SERVICE PLANS

Opt. M2 - +2 yrs service **+\$126**  
Opt. M8 - +4 annual calibrations **+\$212**

### RECOMMENDED ACCESSORIES

Service Manual - (070-6299-00) **\$95**  
Self-Study Package <sup>1</sup> -  
(068-0279-XX) **\$115**  
Battery Pack for Opt. 07 - 1104A **\$450**  
Rackmount Kit - (016-0819-03) **\$250**  
See page 108 for more accessories.

### 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

<sup>1</sup> See the Educational section, page 274 for more information.

Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

## 2205 OSCILLOSCOPE

Everything you need for basic scope measurements to 20 MHz.

### 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 20 MHz 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 245-248 for TM 250 products). These configurations are ideal for use in applications such as field service, production testing and classroom lab stations.

## CHARACTERISTICS

### VERTICAL SYSTEM (2 Identical Channels)

**Bandwidth (-3 dB) and Rise Time** - 20 MHz and 17.5 ns (5°C to 35°C). 15 MHz and 23.3 ns (0°C to 40°C).

**Deflection Factor and Accuracy** - 5 mV/div to 5 V/div  $\pm 3\%$ , (15°C to 35°C);  $\pm 5\%$ , (0°C to 40°C).

**Vertical Operating Modes** - CH 1, CH 2, CH 2 IN-VERT, ADD, ALT, CHOP.

**CMRR** - At least 10:1 at 10 MHz.

**Input R and C** - 1 M $\Omega$ , 25 pF.

**Max Input Voltage** - 400 V (dc + peak ac), 800 V p-p.

**Channel Isolation** - 100:1 at 20 MHz.

### HORIZONTAL SYSTEM

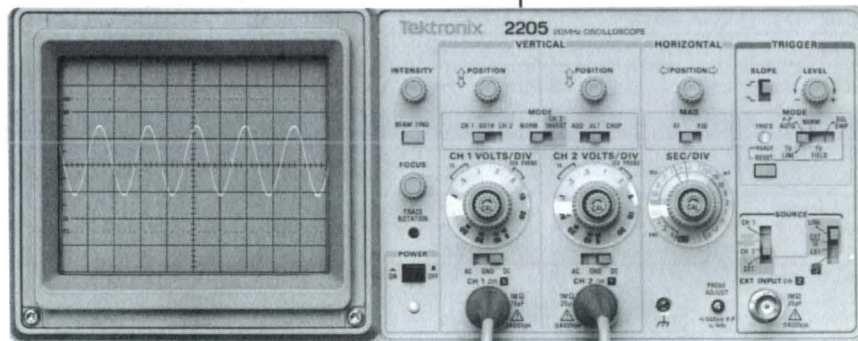
**Sweep Speeds** - 0.5 s/div to 0.1  $\mu$ s/div. (X10 MAG to 10 ns/div).

**Accuracy** -  $\pm 3\%$ ; Magnified  $\pm 4\%$  (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.



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.

**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** -  $\pm 3^\circ$  from dc to 50 kHz.

### CRT SYSTEM

**Display** - 8 cm x 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 250 VAC.

**Line Frequency** - 48 Hz to 440 Hz.

**Maximum Power Consumption** - 40 W (60 VA).

### ENVIRONMENTAL CHARACTERISTICS

See page 108.

### OTHER CHARACTERISTICS

**Safety** - UL 1244 listed, CSA certification.

**Warranty** - 1 year; 3 years optional.

- Peak-to-Peak Auto Triggering
- 0.3 div Trigger Sensitivity
- Front Panel Z-Axis Input
- 10 ns/div Max. Sweep Rate

## 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. 3R - Rackmount Kit +\$250

### ACCESSORY OPTIONS

Opt. 1C - C-9 Camera Opt. 01 +\$610  
Opt. 1K - K212 Instrument Cart +\$385  
Opt. 1T - Transit Carrying Case +\$345  
Opt. 02 - Pouch and Front Cover +\$60  
Opt. 17 - P6408 Logic Probe +\$375  
Opt. 22 - Add 24 test leads +\$60  
Opt. 23 - Add 2 P6119 1X/10X Probes +\$130  
Opt. 24 - Add 2 P6103 10X Probes +\$80

### INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 - A5 Available NC  
See page 108 for descriptions.

### WARRANTY-PLUS SERVICE OPTIONS

Opt. M7 - +2 yrs service +\$83  
Opt. M9 - +2 calibrations +\$166

### RECOMMENDED ACCESSORIES/ FIELD KITS

Service Manual - (070-6716-00) \$95  
Rackmount Kit - (016-0819-03) \$250  
Self Study Package Video <sup>1</sup> - (068-0289-xx) \$115  
See page 108 for more accessories.

### 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

<sup>1</sup> See the educational section, page 274 for more information.

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

**INTERNATIONAL POWER PLUG OPTIONS**

Option*	Type	Description	Part Number	Option	Type	Description	Part Number
Opt. A1	Universal Europe	220 V, 50 Hz	(020-0859-00)	Opt. A4	North American	240 V, 60 Hz	(020-0862-00)
Opt. A2	United Kingdom	240 V, 50 Hz	(020-0860-00)	Opt. A5	Switzerland	220 V, 50 Hz	(020-0863-00)
Opt. A3	Australian	240 V, 50 Hz	(020-0861-00)	Standard	North American	120 V, 60 Hz	(161-0104-00)

(\*No charge when ordering as an option to an instrument)

**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.

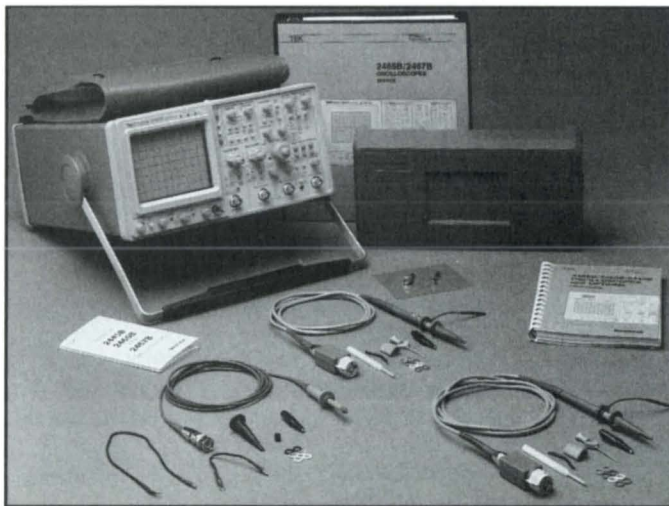
Oscilloscope Model	2232 2221A	2214 2211 2201	2252 2247A 2245A	2235A	2236A	2225	2205
<b>Ambient Temp</b>							
Operating	0°C to +50°C	0°C to +40°C	-10°C to +55°C	0°C to +50°C	0°C to +50°C	0°C to +40°C	0°C to +40°C
Nonoperating	-40°C to +71°C	-55°C to +75°C	-51°C to +71°C	-50°C to +75°C	-55°C to +75°C	-55°C to +75°C	-55°C to +75°C
<b>Humidity</b>							
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
<b>Altitude</b>							
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)						
<b>EMC</b>	Meets Class B requirements per VDE 0871-B for radiated and conducted emissions and FCC requirements.						
<b>Vibration</b>							
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	0.025	0.015	0.015	0.015	0.015
<b>Shock</b>							
Operating	30 g, 1/2 sine, 11ms duration, 3 shocks per axis along each major axis. Total of 18 shocks.						

**2200 SERIES RECOMMENDED ACCESSORIES\*1**

DESCRIPTION	PAGE	ITEM	PRICE (EA)	DESCRIPTION	PAGE	ITEM	PRICE (EA)
<b>PROBES</b>				<b>DC POWER</b>			
<i>PASSIVE VOLTAGE</i>				Battery pack (for 2225, 2211, 2214)	---	1104A	\$450
8 MHz/100 MHz, 1X/10X, switchable, with readout	323	P6062B	\$220	Battery pack	---	1106	\$2,030
8 MHz/100 MHz, 1X/10X, switchable, w/o readout	323	P6119	\$65	12 VDC to 110 VAC Inverter	---	1107	\$1,530
150 MHz, 10X, ruggedized, w/readout	322	P6109 Opt. 01	\$65	Mounting bracket for 1107 to 2221A, 2232, 2235A, 2236A	---	016-0785-00	\$60
100 MHz, 10X, miniature, w/readout	322	P6121	\$155	<b>TRAVEL ACCESSORIES</b>			
100 MHz, 10X, miniature, w/o readout	322	P6122	\$80	Carrying strap	339	346-0199-00	\$20
50 MHz, 10X, ruggedized, w/o readout	322	P6103	\$40	Transit carrying case	339	016-0792-01	\$345
34 MHz, 1X, modular w/o readout	322	P6101A Opt. 01	\$75	Front panel cover (2235A, 2236A, 2232, 2221A) (2245A, 2247A, 2252)	339	200-2520-00	\$10
<i>CURRENT</i>				(2201, 2205, 2211, 2214, 2225)	339	200-3232-00	\$10
20 Amp max, dc to 50 MHz, w/A6302 current probe	325	AM503S	\$2,400	Accessory pouch (2201, 2205, 2211, 2214, 2225, 2235A, 2236A, 2232, 2221A) (2245A, 2246A, 2247A, 2252)	---	016-0677-02	\$50
100 Amp max, dc to 15 MHz, w/A6303 current probe	325	AM503S Opt 03	\$3,030	(2245A, 2246A, 2247A, 2252)	---	016-0857-00	\$50
<i>HIGH VOLTAGE</i>				Rain cover (2245A, 2247A, 2252)	339	016-0848-00	\$18
1.5 kV 100X, 120 MHz with readout	323	P6009	\$250	<b>VIEWING HOODS</b>			
40 kV 1000X, 75 MHz with readout	323	P6015	\$840	Collapsible	341	016-0592-00	\$15
<i>SPECIALTY</i>				Binocular	341	016-0566-00	\$21
100 MHz, 1X/10X differential probe, FET	327	P6046 w/pwr	\$2,150	Polarized	341	016-0180-00	\$70
Temperature probe, 230°C max (2236A only)	315	P6602	\$320	<b>CRT SHIELDS</b>			
Logic probe, 16 channel word recognizer/Trigger-TTL	329	P6408	\$375	Blue	341	337-2775-00	\$4.20
<b>INTERFACE CABLES</b>				Clear	341	337-2775-01	\$1.95
GPIB 2221A/2232/2252	334	012-0991-00	\$160	<b>RACKMOUNT KITS</b>			
RS-232 2221A/2232 to PC (25 pin)	334	012-0911-00	\$100	(2245A, 2246A, 2247A, 2252)	340	2240F1R	\$350
RS-232 2221A/2232 to plotter (25 pin)	334	012-1285-00	\$40	(2225, 2201, 2205, 2211, 2815, 2214)	340	016-0819-03	\$250
RS-232 2201/2211/2214 to plotter (25 pin)	334	012-1298-00	\$35	(2235A, 2221A, 2224, 2230, 2232)	340	016-0833-01	\$250
Centronics 2252 to printer (25 pin)	334	012-1250-00	\$50	(2236A only)	340	016-0015-03	\$300
<b>CAMERAS</b>				<b>CARTS</b>	307	K212	\$385
Scopes with graticule illum. (no flash required on camera) (2221A, 2232, 2235A, 2236A, 2245A, 2247A, 2252)	302	C-9	2	*1 See the Accessories section pages 294-341 for detailed information.			
Scopes without graticule illum. (flash required on camera) (2201, 2205, 2211, 2214, 2225, 2815)	302	C-9 Opt. 01	2	*2 Contact your local sales office.			
<b>PRINTERS/PLOTTERS</b>							
GPIB (2232, 2221A with Opt 10)	295	HC100 Opt 01	\$1,050				
RS-232-C (2232, 2221A, 2201 w/Opt. 12) (2211, 2214)	295	HC100 Opt 03	\$950				
Centronics (2252 only)	296	HC200	\$275				
RS-232-C (2232, 2221A, 2201 w/Opt. 12) (2211, 2214)	296	HC200 Opt 03	\$365				

# MILITARY AND SPECIAL SERVICE ANALOG AND DIGITAL OSCILLOSCOPES

**MILITARY**



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 86.



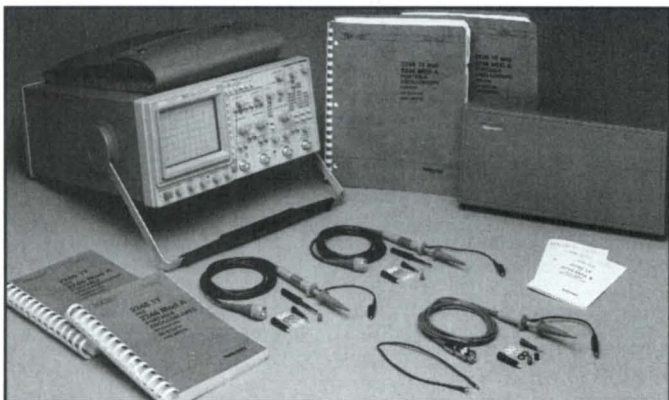
2430A Option 46

## 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 89.



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
- Includes pouch/cover

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 104.

## 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

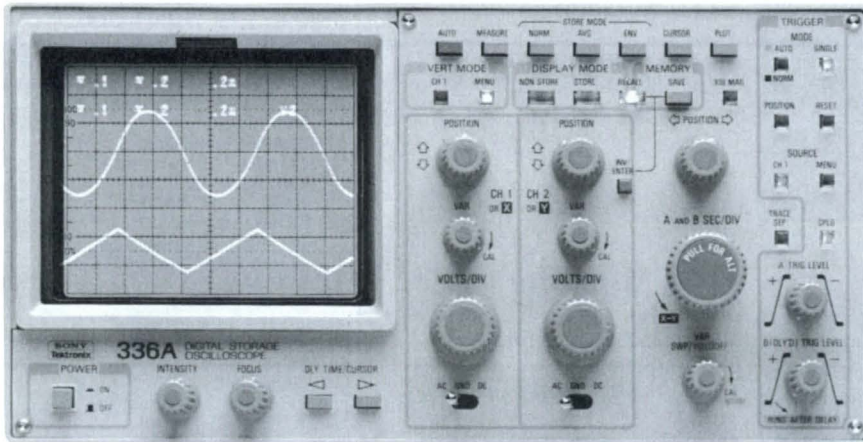
OVER 100 MHz ANALOG	
2465B Opt. 46	\$7,820
US Air Force preferred	
400 MHz, 4 CH analog scope	
NSN 6625-01-272-8054	
2465B Opt. 11, Mod WB	\$6,685
US Navy preferred	
400 MHz, 4 CH analog scope	
NSN 6625-01-273-8156	
F3801A2 Mod YE	\$10,275
US Navy preferred	
400 MHz battery powered scope	
NSN 6625-01-271-9845	
2445B	\$4,395
DOD preferred	
150 MHz, 4 CH analog scope	
NSN 6625-01-178-9491	
OVER 100 MHz DIGITAL	
2430A Opt. 46	\$7,035
US Army preferred	
150 MHz, 2 CH DSO	
NSN 6625-01-258-0022	
2430A	\$6,950
US Marine Corp preferred	
150 MHz, 2 CH DSO	
NSN 6625-01-257-2868	
2430A Opt. 1R	\$8,280
US Marine Corp preferred	
150 MHz, rackmounted DSO	
NSN 6625-01-252-0344	
2430M	\$18,080
Air Force MATE/CIL compatible	
150 MHz, rackmounted DSO	
NSN 6625-01-266-8763	
100 MHz ANALOG	
2246 Mod A	\$3,490
US Air Force preferred	
100 MHz, 4 CH analog scope	
NSN 6625-01-275-4766	
Order # 2246 Opt 2Y	
2246 1Y	\$3,490
US Navy preferred	
100 MHz, 4 CH analog scope	
NSN 7Z 6625-01-260-6908	
Order # 2246 Opt. 1Y	
2246 2R	\$3,840
Rackmount version of 2246 1Y	
NSN 7Z 6625-01-263-5932	
Order # 2246 opt 2R	
2235L	\$2,895
US Army preferred	
100 MHz, 2 CH analog scope	
NSN 6625-01-187-7847	
Order # 2235L	

# 50 MHz, 20 MS/s, DIGITAL PLUS ANALOG ULTRA-PORTABLE OSCILLOSCOPE

- AutoSetup of Time & Voltage
- Save Setup/Recall
- 50 MHz Digital/Analog BW
- 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 OSCILLOSCOPE

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.



## HORIZONTAL SYSTEM (Nonstore Mode Only)

**Sweep Speeds** – A Sweep: 0.2 s to 0.1 ms/div. Extended to 10 ns/div with X10 Mag. B Sweep: 50 ms to 0.1 ms/div.

**Accuracy** – X1:  $\pm 2\%$ ; X10:  $\pm 3\%$  (+20°C to +30°C). X1:  $\pm 3\%$ ; X10:  $\pm 4\%$  (0°C to +50°C).

**Delay Time Jitter** – 10,000:1.

**Delay Time Accuracy (Nonstore mode)** –  $\pm 1\%$  (+25°C to +35°C);  $\pm 2.5\%$  (0°C to 25°C).

## TRIGGER SYSTEM

**Trigger Operating Modes** – Normal, Automatic, Single Sweep.

**Trigger Source** – CH 1, CH 2, or external.

**Trigger Sensitivity** – Internal: 0.3 div at 10 MHz, 1.5 div at 50 MHz. External: 250 mV at 10 MHz, 350 mV at 50 MHz.

**Trigger Coupling** – Dc, ac, HF REJ (attenuates above 50 kHz), LF REJ (attenuates below 50 kHz).

## X-Y OPERATION

**Deflection Factors** – Same as vertical system.

**Bandwidth** – 1 MHz in nonstore mode, up to 50 MHz in store mode.

**Phase Difference** –  $\pm 3^\circ$  from dc to 50 kHz.

## ADVANCED FUNCTIONS

**Cursor Function and Accuracy** –  $\Delta$ Volts:  $\pm 3\%$  of reading + 4% of Volts/div switch setting.  $\Delta$ Time:  $\pm 0.1\%$  of full scale (real time);  $\pm 4\%$  (equivalent time).

## CRT SYSTEM

**Display** – 10 div (0.6 cm/div). 12 kV nominal voltage.

**Z-Axis** – 5 V causes noticeable modulation. Usable to 1 MHz.

## POWER REQUIREMENTS

**Line Voltage Ranges** – 90-132 VAC, 180-250 VAC.

**Line Frequency** – 48 Hz to 440 Hz.

**Power Consumption** – 50 W maximum.

## ENVIRONMENTAL

**Ambient Temperature** – Operating:  $-15^\circ\text{C}$  to  $+55^\circ\text{C}$ . Nonoperating:  $-25^\circ\text{C}$  to  $+75^\circ\text{C}$ .

**Altitude** – Operating: To 9000 m (30,000 ft) maximum, decrease maximum temperature by  $1^\circ\text{C}/1000$  ft from 5,000 to 30,000 ft. Nonoperating: To 15,000 m (50,000 ft) maximum.

**Vibration** – 15 minutes along each of the 3 major axes, 0.025 in. (0.06 cm) p-p displacement (4 g's at 55 Hz), 10 to 55 to 10 Hz in 1 min. cycles.

**Humidity** – Nonoperating: 5 cycles (120 hours) of MIL-E-16400G. Omit freezing and vibration and allow a post-test drying period at  $+25^\circ\text{C}$ ,  $+5^\circ\text{C}$  and  $20^\circ\text{C}$  to 80% relative humidity.

**Shock** – Operating and Nonoperating: 30 g's, 1/2 sine, 11 ms duration. Total of 12 shocks.

## ORDERING INFORMATION

**336A Digital Oscilloscope** ☎ \$6,000  
Includes: 2 10X Probes (P6148A),  
Pouch (016-0718-00),  
Front Panel Cover (016-0719-00),  
Crt filter (378-0225-00),  
Operators Manual (070-7360-00).

### INTERNATIONAL POWER PLUG OPTIONS

Opt. A1- A5 – Available NC  
See page 108 for descriptions.

### OPTIONAL ACCESSORIES

HC100 – Plotter \$950  
GPIB Cable – (012-0630-03) \$110  
Mesh Filter – (378-0223-00) \$31  
Viewing Hood – (016-0297-00) \$7.50

### RECOMMENDED PROBES

P6148A – 10X Probe \$175  
A6303 – Current Probe \$1,340  
AM 503 – Current Probe  
Amplifier \$1,450

### 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

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

## CHARACTERISTICS

### DIGITAL STORAGE SYSTEM

**Sample Rate** – 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 bits. Horizontal: 10 bits.

**Record Length** – 1 K.

**Pre/Post Trigger** – 1/8, 1/2, 7/8 of waveform.

**Acquisition Modes** – Normal, Avg. (16, 64, or 256 sweep averages), Envelope (1, 16, 64, 256 sweeps), Continuous Envelope (2 ms to 0.2 s/div).

**Save Reference Memory** – 8 screens of 2 waveforms, for a total of 16 waveforms (16 K).

### VERTICAL SYSTEM (2 Identical Channels)

**Bandwidth** – 50 MHz (0°C to  $+40^\circ\text{C}$ ); 40 MHz ( $+40^\circ\text{C}$  to  $+50^\circ\text{C}$ ).

**Deflection Factor and Accuracy** – 5 mV to 10 V/div,  $\pm 3\%$ .

**Vertical Modes** – CH 1, CH 2, Dual.

**CMRR** – At least 10:1 at 10 MHz (5-MHz storage).

**Input R and C** – 1 M $\Omega$ , 33 pF.

**Maximum Input Voltage** – 200 V (dc + peak ac) or 200 V p-p ac to 1 kHz or less.



## SONY/TEKTRONIX 314

The SONY/TEKTRONIX 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** – 10 MHz and 35 ns.

**Deflection Factor** – 1 mV/div to 10 V/div  $\pm 3\%$ .

**Operating Modes** – CH 1, CH 2, CH 2 Invert, chop, alternate, add, and X-Y.

**Input R and C** – 1 M $\Omega$ , 47 pF.

**Max Input Voltage** – 300 V (dc + peak ac).

### HORIZONTAL SYSTEM

**Sweep Speeds** – 1  $\mu$ s/div to 5 s/div. X10 magnifier extends sweep rate to 100 ns/div.

**Accuracy** – X1:  $\pm 3\%$  (1  $\mu$ s/div to 0.2 s/div);  $\pm 4\%$  (0.5 s/div to 5 s/div). X10:  $\pm 5\%$  (0.1  $\mu$ s/div and 0.2  $\mu$ s/div);  $\pm 4\%$  (0.5  $\mu$ s/div to 20 ms/div);  $\pm 5\%$  (50 ms/div to 0.5 s/div).

### TRIGGER SYSTEM

**Sensitivity** – Internal: 0.3 div at 1 MHz, 1.0 div at 10 MHz. External: 150 mV at 1 MHz, 500 mV at 10 MHz.

**Modes** – Normal, Auto, Single sweep.

**Sources** – Internal: CH 1, CH 2, or composite; external.

### 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** – 200 kHz.

### CRT SYSTEM

**CRT** – 8 x 10-div (0.6 cm/div) display. Accelerating potential is 2 kV.

**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. 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).

### POWER REQUIREMENTS

**Line-Voltage Range** – 90 to 130 VAC or 180 to 264 VAC.

**Line Frequency** – 48 to 440 Hz.

**Power Consumption** – 29 W max. at 115 VAC.

**External DC Source** – 11-14 VDC or 22-28 VDC.

**DC Current Drain** – 1.6A at +12 V or 0.8 A at 24 V.

## 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

**Bandwidth (-3 dB)** – 5 MHz.

**Deflection Factor and Accuracy** – 5 mV/div to 10 V/div  $\pm 3\%$  (0°C to + 40°C).

**Operating Modes** – CH 1, CH 2, Chopped, Alternate, Add, Invert CH 2, and X-Y.

**Input R & C** – 1 M $\Omega$ , 47 pF.

**Max Input Voltage** – 250 V (dc + pk ac), 250 V p-p.

### HORIZONTAL SYSTEM

**Sweep Speeds** – 500 ms/div to 1 s/div.

**Accuracy** – X1:  $\pm 3\%$ ; X10:  $\pm 5\%$  (0°C to + 40°C). X1:  $\pm 4\%$ ; X10:  $\pm 6\%$  (-15°C to + 55°C).

### TRIGGER SYSTEM

**Sensitivity** – Internal: 0.3 div at 0.5 MHz, 0.75 div at 5 MHz. External: 15 mV at 0.5 MHz, 50 mV at 5 MHz.

**Modes** – Normal and Auto (p-p).

**Trigger Source** – CH 1, CH 2, external.

### X-Y OPERATION

**Deflection Factors** – Same as vertical system.

**X-Axis Bandwidth** – 150 kHz.

### ADVANCED FUNCTIONS

**AC Voltmeter** – Ranges: 2, 20, 200, and 700 V (autoranging). Accuracy:  $\pm 0.5\%$  of reading, + 10 counts, 40 to 500 Hz. Max input Voltage: 700 Vrms.

**Ohmmeter** – Ranges: 2, 20, 200, and 2000 k. Accuracy:  $\pm 0.6$  of reading, + 3 counts.

### POWER REQUIREMENTS

**Line-Voltage Range** – 90-132 V or 180-250 VAC.

**Line Frequency** – 48 Hz to 440 Hz.

**Maximum Power Consumption** – 17 W.

**External DC Source** – 9 to 32 V.

**Charge Time** – At least 16 hours for full charge.

**Operating Time** – 2 hrs (scope), 10 hrs (DMM), 1.6 hours (combined).

### ENVIRONMENTAL

**Ambient Temperature** – Operating: -15°C to + 55°C (Oscilloscope), 0°C to + 55°C (DMM). Nonoperating: -25°C to + 75°C.

**Altitude** – Same as 336A.

**Vibration** – Same as 336A.

**Humidity** – Same as 336A.

**Shock** – Same as 336A.

## 314

- Industrial Control Systems
- Biophysical Instrumentation
- Communication Equipment Service

## 305

- Electromechanical Measurements
- Medical Electronics Maintenance
- Automotive/Motor Vehicle
- Plant Maintenance
- Field Service

## ORDERING INFORMATION

**314 CRT Storage Oscilloscope \$5,700**  
Includes:

2 ea P6149A X10 Probes, Carrying Case and Pouch (016-0612-00), Carrying Strap (346-0131-02), External DC Current Assembly (012-0406-00), 2 1.6A fuses (159-0098-00), 2 0.8A 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).

**305 Oscilloscope/DMM \$3,610**  
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), Blue crt Filter (378-2016-01), External dc Cable Assembly (012-0406-00), Service Manual (070-2423-01), Operators Manual (070-2424-00).

### OPTIONAL ACCESSORIES

**Viewing Hood** – Order 016-0297-00 \$7.50  
**Adapter Connector BNC to Binding Post** – Order 103-0033-00 \$7.00

### RECOMMENDED CAMERAS

**C308P Opt. 01** \$2,135  
**Camera Adapter** – Order 016-0327-01 \$220

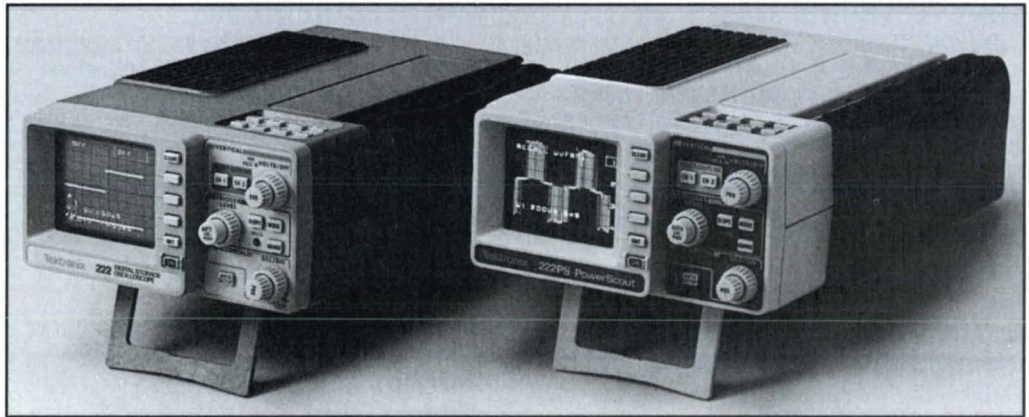
### PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width, w/handle	237	9.3
Height, w/o pouch	112	4.4
Depth, handle not extended	347	13.6
<b>Net Weight</b>	<b>kg</b>	<b>lb</b>
w/o accessories	4.7	10.5
Shipping	7.6	17.0

**C**apture your measurements in out of the way places with family of compact digital scopes.

## 222/NEW 222PS

- Floatable to  $\pm 850$  V/channel (222PS),  $\pm 400$  V/channel (222)
- 10 MHz Bandwidth
- Digital Storage
- 100 ns Glitch Capture
- 6 kV Peak Surge Rating (222PS)
- Auto Setup/Save Setup/Recall
- Exclusive Motor Trigger (222PS)
- Auto Trigger
- Save Reference Memory
- 10 MS/s Dual Digitizers
- Fully Programmable via RS-232
- Replaceable X10 Probes Standard (222PS)
- Ultra-Portable
- Rugged Construction
- Battery Operation
- DC Operation
- 4.4 lbs Total Weight
- UL Listed
- 3 Year Warranty



The 222 and 222 PowerScout are the optimum scopes for industrial maintenance and field service. The new 222 PowerScout offers an unprecedented safety margin to users making measurements on industrial power systems.

## BATTERY-OPERATED HANDHELD OSCILLOSCOPES

The 222 and new 222 PowerScout (222PS) provide unsurpassed power in the world of HandHeld oscilloscopes. Both instruments come standard with a 10 MHz bandwidth, 10 MS/s digitizing rate, RS-232 interface and full programmability in a size that goes anywhere. Battery operation eliminated the need for available power. The ability to charge and operate the scope from 12-28 VDC or 16-20 VAC makes the 222 or 222PS truly portable scopes on the go.

### UNMATCHED SAFETY

Because it is floatable to  $\pm 850$  V per channel, the 222 PowerScout is designed to safely make measurements on industrial power systems. It is the first scope to be U.L. listed for measurements on line voltages to 600 VAC, and is specified to withstand peak surge voltages as high as 6 KV

The channels are fully isolated and double-insulated to ensure operator safety. The 222 is capable of safely measuring to  $\pm 400$  V per channel or 800 V p-p.

### AUTOSETUP/SAVE/RECALL

The 222 Series AutoSetup/Save/Recall features eliminate the need for unnecessary manipulation of the front panel. Just push the AutoSet button and the scope selects all the parameters for you. Save and recall those setups for repetitive situations at multiple sites and see the savings in time.

### WAVEFORM STORAGE

After you've acquired your waveform using AutoSetup, save it in one of four 512 pt. reference memories. Recall it to compare with known good signals and make any adjustments to the source necessary to bring the equipment on line.

### RS-232 AND THE 222

After saving your waveforms and setups, make a permanent record. Simply connect the 222 or 222 PowerScout to your PC and transfer them, using the optional CAT 200 Software. Send them back to the scope when that same job is due again. In fact with CAT 200 software, you can control the entire front panel from a remote location utilizing the RS-232 port, modems and a phone line.

### SOPHISTICATED PROCESSING IN A SMALL PACKAGE

The 222 Series 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. These features make the 222 or 222PS the ultimate service tool. Both scopes come complete with a ballistic nylon carrying case that doubles as a neck strap for hands free operation.

### RUGGED DESIGN

The 222 Series is packaged in impact-resistant plastic, capable of withstanding 50 g's of force. The Scopes can operate in temperatures as low as  $-10^{\circ}\text{C}$  and still be accurate. The batteries allow for a minimum of three hours of remote operation.

### INDUSTRY STANDARD WARRANTY

The 222 Series comes standard with a full three year warranty. Optional service warranties are also available to make the 222 or 222 PowerScout the worry-free instrument for the technician on the move, anywhere in the world.

# BATTERY-OPERATED, HANDHELD, INDUSTRIAL SERVICE, DIGITAL STORAGE OSCILLOSCOPES

222/222PS

NEW

## CHARACTERISTICS

### DIGITAL STORAGE SYSTEM

**Maximum Sample Rate** – 10 MS/s.

**Resolution** – Vertical: 8 bits, 25 levels/div.

**Record Length** – 512 bytes.

**Pre/Mid/Post-Trigger** – 1/8, 1/2, 7/8 of waveform.

**Acquisition Modes** – Normal, Peak Detect, Accumulated Peak, Averaging.

**Save Reference Memory** – Four 512 byte acquisitions.

**Front Panel Save/Recall** – Save and recall up to four setups.

**Motor Trigger (222PS only)** – Trigger on first pulse in bursts separated by at least 2.25 ms modulated output of a motor controller.

### VERTICAL SYSTEM

**Bandwidth** – Repetitive: 10 MHz. Single shot: 1 MHz.

**Rise Time** – 35 ns.

**Deflection Factor** – 222: 5 mV/div to 50 V/div; 222PS: 50 mV/div to 500 V/div.

**Accuracy** – 222:  $\pm 3\%$  (+10°C to +55°C); 222PS: 4%.

**Operating Modes** – Channel 1, Channel 2, Dual.

**Input R & C** – 222: 1 M $\Omega$ , 30 pF; 222PS: X10 probe, 10 M $\Omega$ , 4.5 pF.

**Maximum Safe Input Voltage** – 222: 400 V (dc + peak ac), 800 V p-p @ 1 kHz or less; 222PS with P850 probes: 600 Vac or 850 V (dc + peak ac) 6 kV peak surge.

**Channel Isolation** – Greater than 1000:1 at 10 MHz.

### HORIZONTAL SYSTEM

**Sweep Speeds** – 50 ns/div to 20 s/div (X10 mode increases max sweep speed to 5 ns/div).

**Accuracy** – X1:  $\pm 2\%$ ; X10:  $\pm 5\%$ .

### TRIGGER SYSTEM

**Sensitivity** – Internal: 0.5 div at 10 MHz.

External: 250 mV at 10 MHz.

**Trigger Sources** – CH1, CH2 and External.

### X-Y OPERATION

**Accuracy** – Same as Vertical System.

**Useful Bandwidth** – Same as Vertical System.

**Skew between CH1 & CH2** – 5 ns.

### CRT SYSTEM

**Display** – 6 x 10 divisions (0.5 cm).

### RS-232 INTERFACE

**Maximum Applied Voltage** – 25 V (dc + peak ac).

**Baud Rates** – 300, 1200, 2400, 9600.

**Levels** – Compatible with RS-232C.

### POWER REQUIREMENTS

**Line Voltage Range** – 12 to 28 VDC, 16 to 20 VAC.

**Line Frequency** – 47 Hz to 400 Hz.

**Maximum Power Consumption** – 16 VA.

**Minimum Operating Time (batteries)** – Three hours at maximum sample rate, no trigger, and auto-shutdown defeated.

**Typical Operating Time (batteries)** – Four to six hours.

**Charging Time** – Three hours.

**Type** – Sealed lead acid.

**Discharge Protection** – Scope automatically shuts down when charge drops to 7.42 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 **\$2,595**

Includes:  
Operator Manual, Quick Ref. Guide, RS-232 Guide, AC adapter, Pouch, Feet, Probe Acc. Kit.

**222PS** Powerscout \*1  
Includes: 2 Replaceable P850 X10 probes.

### INSTRUMENTS OPTIONS

**Opt. 02** – Delete adapter **NC**

### WARRANTY PLUS SERVICE OPTIONS

**Opt. M2** – 2 yrs service **+\$171**

222 **^1**

**Opt. M3** – 2 yrs service + 4 cal's **+\$301**

222 **^1**

222PS **^1**

### INTERNATIONAL POWER PLUG OPTIONS

**Opt. A1 & A2** – Available **NC**

See page 108 for descriptions.

### OPTIONAL ACCESSORIES

**External Battery Charger** –

Order BAT200 **\$200**

**Battery/AC Adapter Pouch** –

Order 016-0993-00 **\$13.25**

**Viewing Hood** –

Order 016-1021-00 **\$10**

**CAT 200 Virtual Instrument Software** –

Order CAT 200 **\$395**

**EXT Trig to BNC Adapter** –

Order 103-0090-00 **\$11**

**European Power Adapter** –

Order 120-1826-00 **\$26**

**UK Power Adapter** –

Order 120-1827-00 **\$25**

**Spare Battery** –

Order 146-0075-00 **\$70**

**RS-232 Cable** –

Order 174-1453-00 **\$36**

**Cigarette Lighter Adapter** –

Order 174-1734-00 **\$12.50**

**External Trigger Probe** –

P6122 **\$80**

**P850** – Replaceable Probe for 222PS **^1**

**P400** – Replaceable Probe for 222PS **^1**

### PHYSICAL CHARACTERISTICS

Dimensions	mm	in.
Width	159	6.3
Height	86	3.4
Depth	252	9.9
<b>Weight</b>	<b>kg</b>	<b>lb</b>
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.

\*1 Contact your local sales representative.

221/214  
212

# HANDHELD, 500 kHz TO 5 MHz MINISCOPES

- DC to 5 MHz (221)
- 5 mV/Div to 100 V div (221)
- DC to 500 kHz (214/212)
- 1 mV/Div to 50 V/Div (214/212)
- CRT Storage (214)
- Floatable to 600 V
- Internal Battery Pack
- Integral Probe

## ORDERING INFORMATION

212 500 kHz, Dual-Channel ☎ \$2,450

Includes: Integral probes, Viewing Hood (016-0099-01), Carry Case (016-0512-00), Carry Strap (346-0104-00), Oprs. Manual (070-5052-00), Service Manual (070-5053-00).

214 500 kHz, Dual Channel ☎ \$3,225

CRT Storage Oscilloscope Includes: Same as 212, except Operators 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), Service Manual (070-1573-01), Operator Manual (070-1572-00), Battery.

### OPTIONS

(212/214 only)

Opt. 01 – 220 to 250 V NC

(48 to 52 Hz)

Opt. 02 – 90 to 110 V NC

(48 to 52 Hz)

### OPTIONAL ACCESSORIES

#### 10X Attenuator Package –

(212/214 ONLY) A slip-on tip to provide lower circuit loading (4.4 M $\Omega$ , 20 pF) and higher maximum input voltage

1000 V (dc + peak ac).

Includes: Flex Tip, 10X attenuator, Pincher Tip, Banana Tip, IC Adapter. Order 010-0378-01

\$100

#### Alligator Clip Kit –

Pair of alligator clips that connect probe and ground lead to large

(up to 3/8 inch) conductors.

Includes: Red Clip, Yellow Clip, 6-32 to Probe Adapter. Order 015-0231-00

\$36

#### Probe Tips –

To BNC Adapters (Panel Connector) 013-0084-01

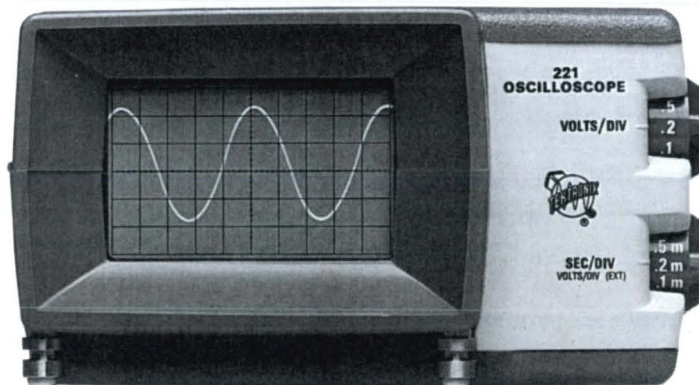
\$11.50

(Cable Adapter) 103-0096-00. \$15.75

### 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.



With bandwidths from 500 kHz (212/214) to 5 MHz (221), neckstraps for convenient viewing, and side mounted control knobs, the 200 Series miniscopes are ideal for industrial maintenance applications where portability is a must.

The 221/214/212 are lightweight, compact, and built of impact-resistant, double insulated plastic. Since they are double insulated they allow you to make "floating" measurements and can be elevated to 600 V (dc + peak ac) above ground when operated from batteries.

The 214 CRT Storage scope allows you to save waveforms for comparison to other 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.

## CHARACTERISTICS

### VERTICAL SYSTEM

**Bandwidth** – 221: dc to 5 MHz. 212/214: dc to 500 kHz (10 mV/div to 50 V/div); 100 kHz (1 mV/div).

**Deflection Factor and Accuracy** – 221: 5 mV/div to 100 V/div  $\pm 3\%$ . 212/214: 1 mV/div to 50 V/div  $\pm 5\%$ .

**Display Modes** – 221: Channel 1 only, XY. 212/214: CH 1, CH 2, CHOP (500 ms/div to 2 ms/div), ALT (1 ms/div to 5 ms/div).

**Input R and C** – 221: 1 M $\Omega$ , 29 pF. 212/214: 1 M $\Omega$ , 160 pF (1 mV/div to 50 mV/div); 140 pF (100 mV/div to 50 V/div).

**Maximum Input Voltage** – 1 mV/div to 50 mV/div: 600 V (dc + peak ac), 2 kHz or less. 0.1 V/div to 50 V/div: 600 V (dc + peak ac), 600 V p-p, ac, 5 MHz or less.

### HORIZONTAL SYSTEM

**Sweep Speeds** – 221: 1 ms/div to 200 ms/div  $\pm 3\%$ . 212/214: 5 ms/div to 500 ms/div  $\pm 5\%$ .

### TRIGGER SYSTEM

**Trigger Sensitivity** – 221: Internal: 0.5 div at 1 MHz, 1 div at 5 MHz. External: 0.5 V at 1 MHz, 1 V at 5 MHz. 212/214: Internal: 0.2 div at 500 Hz. External: 1 V.

**Maximum Ext Trigger Input Voltage** – 212/214: 8 V (dc + peak ac), 16 V (p-p ac) at 500 kHz or less.

### X-Y OPERATION (221 ONLY)

**X-Axis Deflection Factor** – 1 V/div  $\pm 10\%$ , dc to 500 kHz. 0.1 V/div using X10 mag.

**Maximum X-Axis 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.

### CRT SYSTEM

**Display** – 6 x 10 div (0.52 cm/div).

### STORAGE FEATURES (214 Only)

**Stored Writing Speed** – Normal: 80 div/ms.

Enhanced: 500 div/ms (0.1 ms to 5 s/div).

**Stored Luminance** – At least 8 fL at 25°C.

**Storage Viewing Time** – One hour.

### OTHER CHARACTERISTICS

**Insulation Voltage** – 500 Vrms or 700 V (dc + peak ac) using internal batteries.

**Power Sources** – Internal NiCad batteries provide three to five hours operation. Full recharge requires 16 hours.

### POWER REQUIREMENTS

**Line-Voltage Range** – 212/214: 110 to 126 VAC; Option 01: 220 to 250 V; Option 02: 90 to 110 V.

221: 90 to 250 VAC or 80 to 250 VDC.

**Line Frequency** – 212/214: 58 to 62 Hz; Options 01 and 02: 48 to 52 Hz. 221: 48 to 62 Hz

**Maximum Power Consumption** – 212/214: 3 W. 221: 5 W.

### ENVIRONMENTAL

**Ambient Temperature** – Operating (Batt. only):  $-15^{\circ}\text{C}$  to  $+55^{\circ}\text{C}$ . Charging or ac operation:  $0^{\circ}\text{C}$  to  $+40^{\circ}\text{C}$ . Nonoperating:  $-40^{\circ}\text{C}$  to  $+60^{\circ}\text{C}$ .

**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, per 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.

## 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.

## LONG ACQUISITION MEMORY WITH FLEXIBLE ALLOCATION AND TRIGGERING

The RTD 720 standard acquisition memory is 128 K (131,072 or > 65  $\mu$ s 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 ms after the trigger event at a sample rate of 1 ns/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

$\leq 5 \mu$ s, plus pretrigger fill time. This allows the capture of every event with event repetition rates in excess of 180,000 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  $\geq 400$  kilobytes 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 transferring 4 megabytes per second (2 megawords per second) is provided. This parallel port operates with TTL levels and is designed to work with a number of typical computer parallel data input ports.

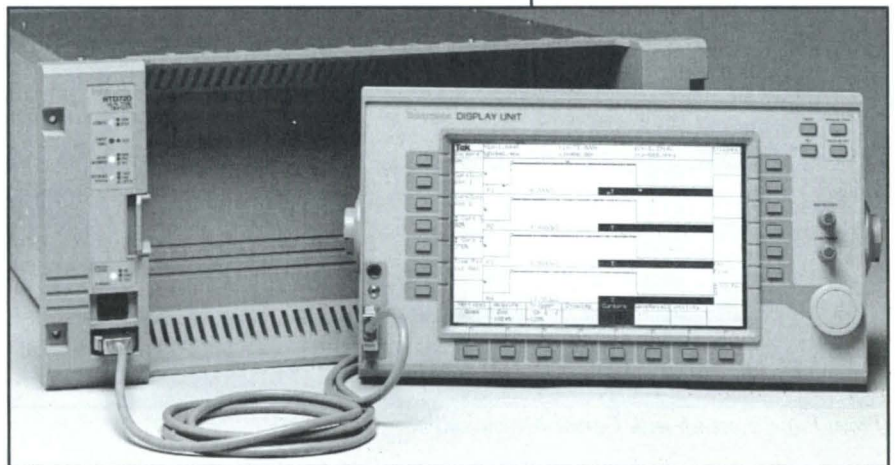
To further increase data transfer rates for the RTD 720, the instruments firmware supports predefinition of the information to be transferred so that time is not lost sending instructions and turning the interface around. These commands allow specifying from which channels to transfer data, which records 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 rapidly.

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## RTD 720

- 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
- Long Waveform Memory – 128 K Standard with Expansion Available to 4 M
- Fast Multiple Record Capability
- Optional Removable Display with Remote Capability



RTD 720 Transient Digitizer with Optional Front Panel



\*The RTD 720 Digitizer complies with the IEEE Standard 488.1 and Tektronix Standard Codes and Formats.

**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

**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, (Four Optional), single ended. Simultaneous digitizing on all channels, in dual and quad modes of operation.

**Input Range and Offset** – Input range 200 mV to 12.5 V full scale, input covered by 19 settings. Each range provides a signal offset capability and fast overdrive recovery.

**Bandwidth (-3 dB)** – Dc Coupling: dc to 500 MHz. Ac Coupling: 2 kHz to 500 MHz.

**Input Protection** – Thermal cut-off on attenuator at 5 Vrms for  $\geq 30$  ms (can be overridden in firmware). Diode bridge protection to amplifier for pulses  $\geq 25$  V at the amplifier, response time  $\leq 30$  ns.

**Standardize** – (Accuracy after Standardization – Mean value)

- $\Delta V$  DC Accuracy:  $\pm (1.0\% \text{ of signal} + 1.0\% \text{ of full scale})$ .
- Offset Accuracy:  $\pm (1.0\% \text{ of input range} + 0.5\% \text{ offset range} + 1.0\% \text{ of offset})$ .

**TIME BASE**

**Internal Clock Frequency** – 500 MHz  $\pm 25$  ppm (20°C to 30°C). 500 MHz +25 ppm - 100 ppm (0°C to 50°C). Short-term stability: 0.1 ppm/s (50 Hz/s). Long-term stability: 50 ppm/10 years.

**External Clock Input** – 500 MHz  $\pm 200$  ppm, 2 V peak to peak sine wave minimum amplitude with a 0 V average. Input impedance:  $50 \Omega \pm 3\%$ .

**DIGITIZING**

**Vertical Resolution** – 8 bits providing 256 discrete levels ( $\geq 48$  dB dynamic range). This provides a resolution of  $< 800 \mu\text{V}$  on the 200 mV full scale input range.

**Maximum Sample Rates –**

Single Channel	2 GS/s (500 ps/pt)
Dual Channel	1 GS/s (1 ns/pt)
Four Channel	500 MS/s (2 ns/pt)

**Standardize** – Sets interleave timing between ADCs for single channel and dual channel operating modes for highest signal fidelity.

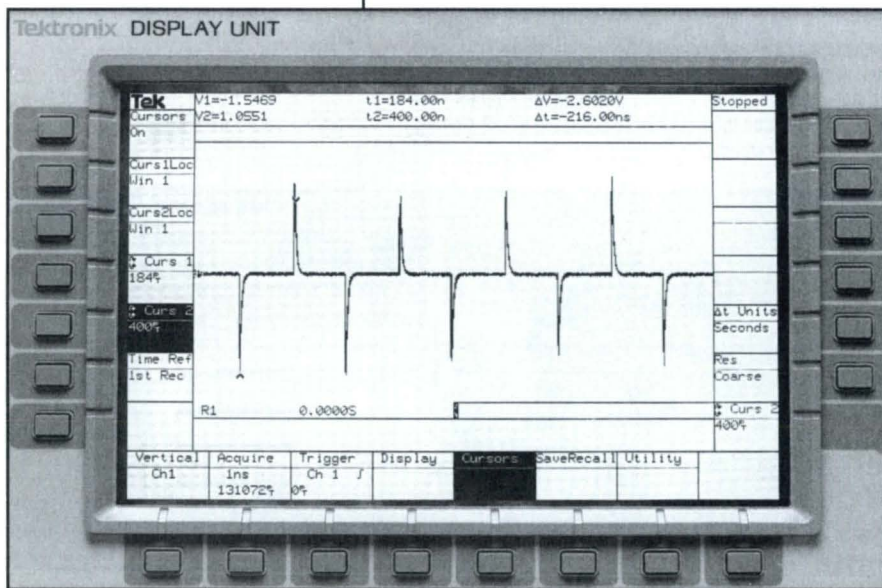
**Acquisition Memory –**

- 128 K waveform points standard.
- 512 K waveform points battery backed-up (optional).
- 1 M waveform points (optional)
- 4 M waveform points (optional).

Acquisition memory is shared equally among all active channels (1, 2, or 4).

**Multiple Records** – Memory can be further segmented up to 1024 records per channel.

Re-arm time between records –  $\leq 5 \mu\text{s}$  + pretrigger fill time. This allows capture of multiple triggered waveform events at an event rate of over 180,000 events per second and on all active channels. All records are time-stamped, for comparing time between events.



Front Panel close-up with Cursor Measurements

## 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  $\Omega$ ); External 50  $\Omega$ .

**Trigger Slope** – Positive or Negative Slope.

**Trigger Level Range & Accuracy** – Internal:  $\pm 62.5\%$  of full scale input range in 0.5% steps with an accuracy of  $\pm (1.0\%$  of setting + 1.0% of input range). External:  $\pm 6.2$  V, programmable in 50 mV steps with an accuracy of  $\pm (3\%$  of setting + 120 mV).

### Trigger Sensitivity –

Coupling	Internal	External
DC		
dc to 500 MHz	10% full scale	1 V pk-pk
AC		
1 KHz to 500 MHz	10% full scale	1 V pk-pk
DC HF Rej		
dc to 30 KHz	10% full scale	1 V pk-pk

### Trigger Modes –

<b>Auto</b>	A trigger will be generated after approximately 60 ms if a valid trigger does not occur.
<b>Normal</b>	The unit will wait indefinitely until a valid trigger occurs.

### Trigger Position –

<b>Pre-Trigger</b>	Waveform data captured prior to the trigger event. To approximately 100% of the record length settable in steps of 64 points.
<b>Post Trigger</b>	Time from trigger event until acquisition begins. To over 99,999,999 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.

**Standardize** – 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  $\geq 400$  kilobytes/s. 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 4 megabyte/s (2.0 megawords/s). 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 1 M 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  $55^\circ\text{C}$ ; Nonoperating:  $-51$  to  $71^\circ\text{C}$ .

**Humidity** – 0% to 95% relative humidity (Noncondensing) to  $55^\circ\text{C}$ .

**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** –  $\leq 350$  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.

**Warranty** – The RTD 720 carries a standard Tektronix one-year warranty covering labor and replacement parts. Options are available for extended warranty coverage.

## ORDERING INFORMATION

**RTD 720** Waveform Digitizer **\$23,200**  
Includes: 2 input channels, 128 K 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** – 4 acquisition channels (add 2 additional full function channels) **+\$2,500**  
**Opt. 10** – 512 K battery backed-up acquisition memory **+\$5,500**  
**Opt. 11** – 1 M acq. memory **+\$6,900**  
**Opt. 19** – Attachable display unit for waveform viewing and instrument control **+\$2,900**

### INTERNATIONAL POWER PLUG OPTIONS

**Opt. A1 - A5** – Available **N/C**  
See page 374 for description.

### PHYSICAL CHARACTERISTICS

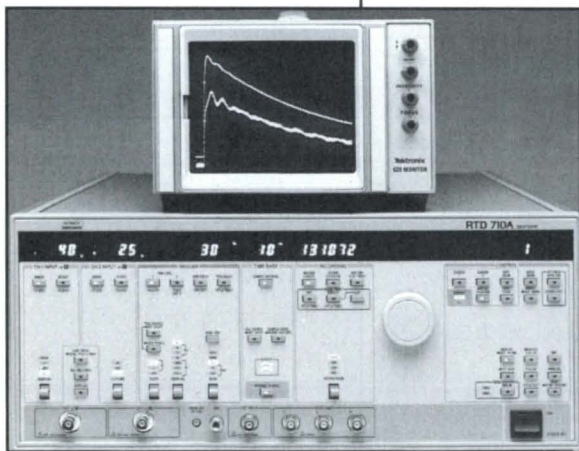
Dimensions	mm	in
Width	482.6	19
Height	225.25	8.75
Depth	635	25
<b>Weight =</b>	<b>kg</b>	<b>lb</b>
Net	19	49

# RTD 710A TRANSIENT DIGITIZER

- 200 MS/s Single Channel
- 100 MS/s Dual Channel
- 100 MHz Analog Bandwidth
- 10 Bit Vertical Resolution
- 256 K Word Waveform Memory
- Hardware Signal Averaging
- Internal/External A/D Clocking
- Cursor Measurements of Time, Voltage and Frequency

## APPLICATIONS

- Video and HDTV
- Ultrasonics, RADAR, LIDAR
- High Voltage Impulse Testing
- Power Supply & Power Conversion
- Communications and EW
- CCD Development
- Semiconductor & Hybrid Test
- ATE Systems



RTD 710A Programmable Waveform Digitizer

**GPIB\***  
IEEE-488

## 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 256 K (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 16 K times to reduce random signal noise.

Envelope capture mode records minimum and maximum values for each data point over successive acquisitions. This offers a powerful technique for capturing spurious events and for monitoring signal drift.

## INTERNAL AND EXTERNAL SAMPLE CONTROL

In addition to 66 internal time base settings, external strobing of the A/D converter system is supported. This provides the ability to synchronize sampling with external phenomena. The RTD 710A can be strobed from dc to 200 MHz. One typical application is CCD development where sampling can be synchronized with the CCD shift clock. Other applications are storage media testing and multiplexed data systems.

Sample rate switching is a unique feature provided to optimize usage of waveform memory. With sample rate switching it is possible to perform fast sampling during periods of interest and switch to a slower rate during quiescent periods. Up to 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.

\*The RTD 710A Digitizer complies with the IEEE Standard 488.1 and Tektronix Standard Codes and Formats.



## 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

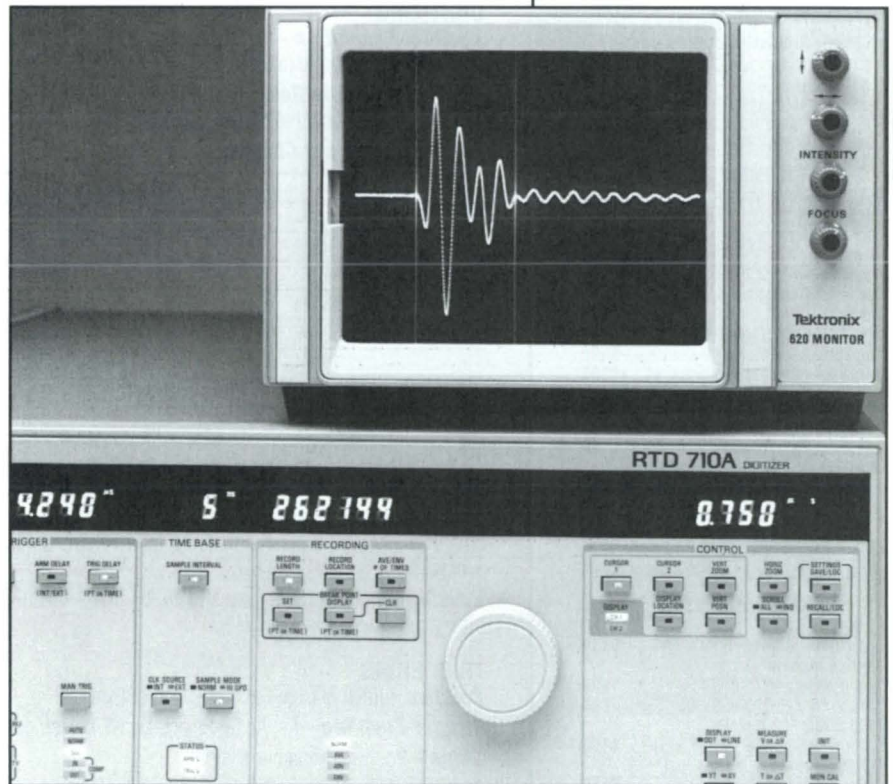
**Input Channels** – Two, single-ended. Supports X10 and X100 encoded probes for high input-voltage applications. Simultaneous digitizing in dual-channel mode.

**Input Ranges** –  $\pm 100$  mV to  $\pm 50$  V (200 mV to 100 V p-p) in 28 steps.

**Autocal Internal Reference** – Provides calibration of range accuracy and zero-offset. Range accuracy is  $\pm 0.4\%$  at 1 kHz and 97% full-scale, zero volt offset is  $\pm 0.2\%$ .

**Input Offset** –  $\pm 199\%$  of input range, selectable in either percent or volts. Accuracy  $\pm 1.5\%$  at  $\pm 100\%$  dc offset.

**Analog Bandwidth** – Dc to 100 MHz,  $0^\circ\text{C}$  to  $40^\circ\text{C}$ ; dc to 90 MHz,  $40^\circ\text{C}$  to  $50^\circ\text{C}$ . Selectable bandwidth limiting at 20 MHz.



RTD 710A Cursor Display on Tektronix 620 Monitor

**AC-Coupled Lower -3dB Point** – 10 Hz or less.

**Input R and C** –  $1\text{ M}\Omega \pm 2\%$ ,  $\approx 24\text{ pF}$ .

**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** –  $200\text{ MHz} \pm 0.001\%$ .

**Sample Rate: Internal Clock** – Channel 1 Only Mode: 200 MS/s to 5 S/s, 66 sampling steps. Dual-Channel Mode: 100 MS/s to 5 S/s, 65 sampling steps.

**External Clock** – Channel 1 Only Mode: dc to 200 MHz, Dual-Channel Mode: dc to 100 MHz. ECL levels, periodic or non-periodic clock rate.

**Sample Rate Switching** – Up to 5 breakpoints within a record.

## ORDERING INFORMATION

**RTD 710A** Waveform Digitizer **\$22,995**  
 (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. 09** - Adds 9503 Fast Data  
 Cache for 4 megawords total  
 memory **+\$18,000**  
**Opt. 11** - Adds 9504 Fast Data  
 Cache for 8 megawords total  
 memory **+\$37,000**  
**Opt. 19** - Blank Front Panel  
 (Includes Rack Mount Assembly) **-\$500**  
**Opt. 1R** - Rack Mount Package **+\$395**

### INTERNATIONAL POWER PLUG OPTIONS

**Opt. A1 - A5** - Available **NC**  
 See page 374 for complete description.

### WARRANTY-PLUS SERVICE OPTIONS

**Opt. M1** - 2 yrs + 2 calcs. **+\$1,800**  
**Opt. M9** - 2 yrs **+\$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 012-1117-01 **\$165**  
**HC100** - Color Plotter  
 Opt. 01 - GPIB Cable **\$1,050**

### 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

## 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, 8 K 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  $\geq 250$  kilobytes/s. All instrument functions, settings, and operating modes are programmable, with the exception of the power switch.

**Plotter Interface** - HPGL Protocol, IEEE-488 interface.

**Waveform Analysis Commands** - Window, Minimum, Maximum, Base, Top, Positive Cross, Negative Cross, Mid, Mean, Peak to Peak.

## EXTERNAL SIGNALS

**CRT Display** - X, Y, Z:  $\pm 1$  and  $\pm 5$  V p-p, internally selectable (set to  $\pm 1$  V at factory).

**Trigger Output** - Positive True, TTL.

**External Arm Input** - TTL Compatible.

**External Clock Input** - ECL Signal Level, 50  $\Omega$ . Dc to 200 MHz.

**Clock Output** - ECL signal level (open emitter out into 50  $\Omega$ ).

**Probe Calibration Output** - 0 to +4 V  $\pm 1\%$  square wave at 1 kHz  $\pm 0.005\%$  into 1 M $\Omega$ .

**Feed-Through Connectors** - Three 50  $\Omega$  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 megawords/s (20 bit word). Contact Tek Sales Engineer for information on memory cache products and interfacing information.

## ENVIRONMENTAL

**Temperature Range** - Operating: 0° to 50°C; Nonoperating: -30° to +70°C.

**Humidity** - 0 to 95% relative humidity (noncondensing).

**Altitude** - Operating: 4,570 m (15,000 ft) max. Nonoperating: 15,240 m (50,000 ft) max.

## POWER

**Line Frequency** - 48 Hz to 440 Hz.

**Power Consumption** - 350 W fully optioned.

**Line Voltage Range** - 90 VAC to 132 VAC (115 V); 180 VAC to 250 VAC (230 V).

**Electromagnetic Compatibility** - The RTD 710A qualifies under test limits specified in FCC Part 15, subpart J, Class A and VDE 0871 Class B.

## 9503/9504 FAST DATA CACHE

- Extremely Long Record Length
- Data rates to 100 megawords/s
- Partitionable Memory
- Very Fast Data Logging

The 9503/9504 Fast Data Cache buffer memories provide significant record length augmentation for high-speed, real-time digitizers. The 9503 is a memory buffer configured for 2 megawords per channel or 4 megawords single channel. The 9504 is an expandable memory buffer that starts with 4 megawords total memory and can be increased to a total of 32 megawords.

### LONG RECORD CAPTURE

They provide the economical solution to your digitized data storage needs for the logging of high speed, real-time data records. The 9503 and 9504, in conjunction with the RTD 710/A waveform digitizer, provide the fastest real-time data logging capability for multiple, complex waveforms in their class. The 9503 and 9504 support the high-speed single channel mode of the RTD 710A to capture data up to 200 megawords/s.

The 9503 or 9504 provides storage of long data records obtained from high speed analog-to-digital 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 the 9503 and 9504 fully compatible with the A/D outputs of the RTD 710 and RTD 710A waveform digitizers. They also accept data from the RTD 710/A operating in the high-speed mode to provide data storage at an effective sampling rate of 200 megawords/s. The standard configuration for either product provides 2 megawords of memory per channel. The 9503 memory length is fixed at 2 megawords per channel.

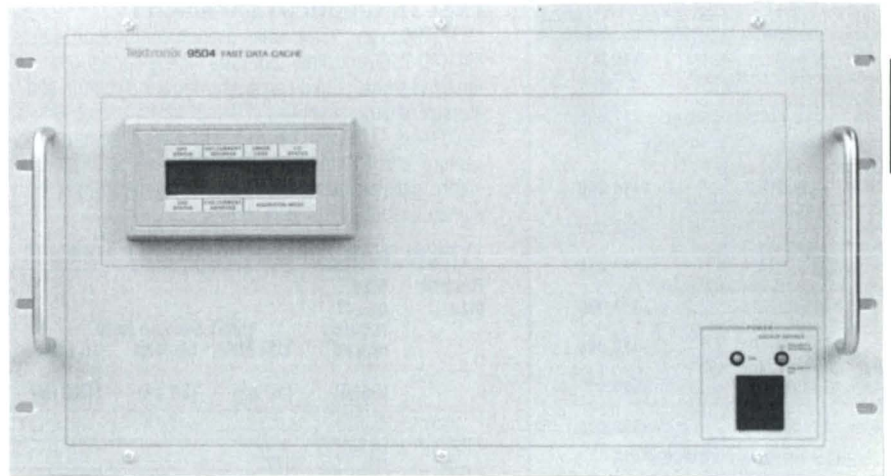
The 9504 can be configured with additional 2 megaword memory cards, to provide a maximum of 16 megawords of memory per channel.

### ECL DIFFERENTIAL OR TTL LEVEL INPUTS

The 16-bit inputs are selectable in groups of 4, and can be programmed for either ECL or TTL. Rear-panel BNC connectors allow control of start and trigger of data collection. The trigger input can also be connected to use the highest of the 16 bits as an information flag.

### MULTIPLE RECORDS CAPABILITY

Memory can be divided into a user-specified number of records with record length specified in segments of 256 words. Each record may be any number of 256-word segments up to the maximum size of the memory in that channel. Up to 64 K separate records (256 words each) may be stored per channel in the 9504. Multiple records capability is supported in all operation modes except pretrigger.



9504 Fast Data Cache Memory Buffer

## 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 1 memory to be interleaved with data from Channel 2 memory. Supports the RTD 710A high speed mode at 200 megawords/s single channel. Assumes RTD 710A Channel 1 data point zero to be first in combined record.

#### 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.

- **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/s TTL)**

### 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**



\*The 9500 Series of Fast Data Caches complies with the IEEE Standard 488.2 and Tektronix Standard Codes and Formats.

**ORDERING INFORMATION**

**9503** Fast Data Cache Unit **\$18,000**  
**9504** Fast Data Cache Unit **\$23,000**  
**9504F01** Fast Data Cache  
 2 megaword memory Module **\$7,500**

**INSTRUMENT OPTIONS**

**Opt. 11** – (8 MW total)  
 Adds 2 ea 9504F01 **+\$14,000**  
**Opt. 12** – (12 MW total)  
 Adds 4 ea 9504F01 **+\$28,000**  
**Opt. 13** – (16 MW total)  
 Adds 6 ea 9504F01 **+\$42,000**  
**Opt. 14** – (20 MW total)  
 Adds 8 ea 9504F01 **+\$56,000**  
**Opt. 15** – (24 MW total)  
 Adds 10 ea 9504F01 **+\$70,000**  
**Opt. 16** – (28 MW total)  
 Adds 12 ea 9504F01 **+\$84,000**  
**Opt. 17** – (32 MW total)  
 Adds 14 ea 9504F01 **+\$98,000**

**INTERNATIONAL POWER PLUG  
 OPTIONS**

**Opt. A1 - A5** – Available **NC**  
 See page 374 for complete description.

**PHYSICAL CHARACTERISTICS**

Dimensions	9503		9504	
	mm	in	mm	in
Height	133	5.25	267	10.5
Rack Depth	574	22.6	574	22.6
Overall Depth	622	24.5	622	24.5
Width	483	19.0	483	19.0
Weight =	lb	kg	lb	kg
Net	12.3	27	17.3	38

**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 <sup>1</sup> no. of records stored	Input Sample Rate		
		100 MHz	50 MHz	10 MHz
		(9504)	(10 ns)	(20 ns)
256	65,536	>380 K	>190 K	>38 K
512	32,768	>190 K	>95 k	>19 K
1,024	16,384	>95 K	>48 K	>9.5 K
2,048	8,192	>48 K	>24 K	>4.5 K
8,192	2,048	>12 K	>6 K	>1.2 K
16,384	1,024	>6 K	>3 K	>0.6 K

<sup>1</sup>Each channel (2X for single channel mode).

**CHARACTERISTICS**

**DIGITAL INPUT/OUTPUT SIGNALS**

**Number of Channels** – Two independent channels.

**Data Inputs** – 16 bits, clock, ground; Selectable between ECL and TTL, in groups of 4 bits.

**Data Input Rates** –

Up to 100 MHz: ECL.

Up to 25 MHz: TTL.

**Start Input** – Starts data capture in Pretrigger Mode; TTL signal into BNC.

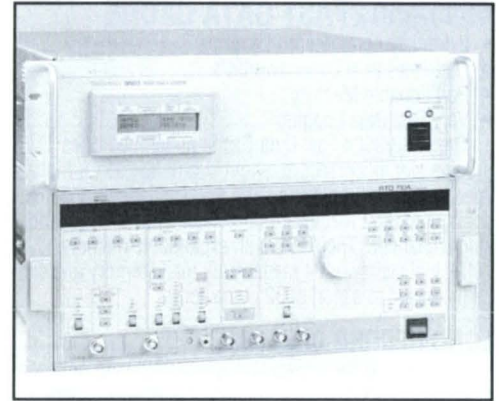
**Trigger Input** – Starts data capture in all modes except Pretrigger and marks trigger location on data. TTL signal into BNC.

**Arm Out** – TTL signal from BNC. TTL low while filling data record. Inhibits RTD 710/A rearm while 9503/9504 record is filling.

**MEMORY SIZE**

9503: 2 megawords/channel; or 4 megawords total.

9504: 2 megawords/channel; Expandable to 16 megawords/channel or 32 megawords total.



RTD 710A with 9503 Fast Data Cache

**COMPUTER INTERFACES**

**GPIB** – IEEE-488.2 and Tektronix Standard Codes and Formats.

**Parallel Port** – A waveform data (output only) 16 bit parallel port is provided capable of 5 megabytes/s (2.5 megawords/s). This provides TTL level outputs and has operating modes to allow use with a wide range of computers.

**ENVIRONMENTAL**

**Temperature Range** – Operating: 0°C to 50°C. Nonoperating: –20°C to +60°C.

**Relative Humidity** – 0 to 95%; noncondensing.

**Altitude** – Operating: 4,750 m (15000 ft) max. Nonoperating: 15,240 m (50000 ft) max.

**POWER**

**Line Frequency** – 48 to 63 Hz.

**Maximum Power Consumption** –

9503: max 360 W (285 W typical).

9504: max 735 W (580 W typical) for maximum memory.

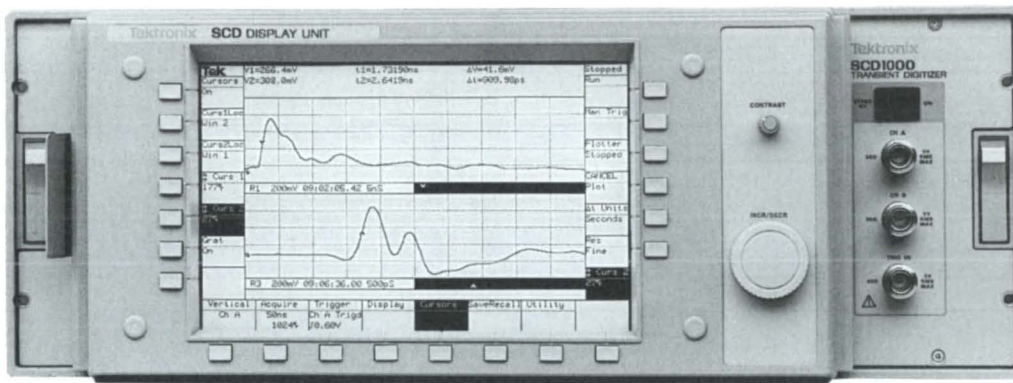
**Battery Backup** – Connector for battery on rear of instrument.

9503: 4.75 to 15 VDC, 100 mA maximum (fused).

9504: 4.75 to 15 VDC, 450 mA maximum (fused).

**9504F01 FAST DATA CACHE  
 MEMORY MODULE**

Two megawords (4 megabytes). 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.



SCD Series Transient Waveform Recorders

### SCD SERIES TRANSIENT WAVEFORM RECORDERS

- Ultra-high sample rate and bandwidth capture of single-shot events
- Display unit with cursors

### HIGH PERFORMANCE CAPTURE

The SCD5000 and SCD1000 are designed to capture low nanosecond and picosecond single-shot events. Whether the application involves Laser, ESD, EMP, Accelerators or other high-speed single-shot phenomena, the SCD series waveform recorders can capture the event with excellent fidelity.

The maximum acquisition rate of 200 GS/s provides time resolution to 5 ps. With time windows from 5 ns to 100  $\mu$ s, the SCD series recorders provide flexible acquisition windows. When the delay line is used, approximately 2.5 ns of pretrigger information can be captured.

The SCD5000 uses direct access with input sensitivity of 5 V and offset of  $\pm 4.0$  V. The SCD1000 provides quality conditioning of the input signal with 100 mV to 10 V full scale ranges, dc offset and ac or dc coupling. There are two input channels which can be configured to multiplex two signals or algebraically add or subtract two input signals to the single channel waveform recorder.

The waveform record length is selectable between 256, 512 or 1024 data points. With 16 built-in waveform locations, multiple trigger events can be stored into separate storage locations. Each record is time and date stamped for later comparison. There are 10 nonvolatile settings storage locations for quick instrument setup.

### STAND-ALONE OR SYSTEM SUPPORT

The SCD Series recorders are designed for use in either a stand-alone or a system environment. With the standard display unit, SCD waveform recorders allow full control of operation, viewing of up to 4 waveforms and cursor measurements.

In a system environment, there is a high-speed GPIB interface and commands to make data acquisition flexible and fast.

### OPTIONS EXPAND CAPABILITY

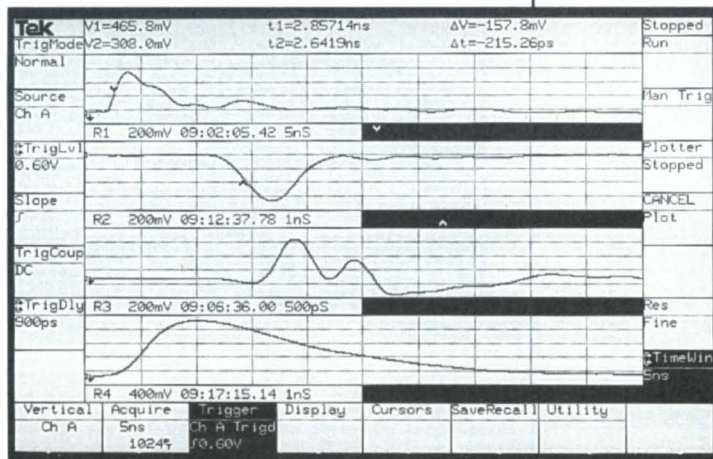
A fast waveform capture option (Opt. 1P) increases the capture rate by ten times, from one waveform per second to ten waveforms per second.

There is a choice of input connectors in addition to the standard Type-N connector. On the SCD1000, a choice of SMA or Tek Type II intelligent probe interface are available. On the SCD5000, SMA connectors can be chosen.

### CHARACTERISTICS

The characteristics are divided into 3 parts:

- Vertical characteristics for all SCD series recorders
- Trigger characteristics for all SCD series recorders
- SCD series common characteristics



Four unique acquisitions displayed.

- High single-shot sample rate to 200 GS/s
- High analog bandwidth
  - 4.5 GHz with SCD5000
  - 1 GHz with SCD1000
- Input sensitivity flexibility with SCD1000
- Time resolution to 5 ps per point
- Variable record length from 256 to 1024 points
- Display unit for easy control, viewing, and measurements



\*The SCD5000/SCD1000 Series of Digitizers complies with the IEEE Standard 488.1 and Tektronix Standard Codes and Formats.

## APPLICATIONS

- Laser measurements
- Accelerator diagnostics
- EMP and radiation testing
- Nuclear effects
- Telecommunications
- EMC/EMI measurements
- Radar
- Fluorescence decay
- High energy pulsed power sources

**Vertical –**

Parameter	SCD1000	SCD5000	SCD5000 Opt 01
Analog Bandwidth	dc coupled; dc to 1.0 GHz; ac coupled; 100 kHz to 1.0 GHz.	4.5 GHz	3.0 GHz
Rise time	≤ 350 ps	≤ 80 ps	≤ 120 ps
Input Range	100 mV to 10 V full scale input in a 1, 2, 5 sequence (7 steps)	±2.5 V direct access	±5 V direct access
Offset	±2.5 times input range (peak to peak)	±4 volts	±4 volts
Invert	Invert on A & B channels	No	No
Input Impedance	DC coupled; 50 Ω, AC coupled; 50 Ω in series with 2.2 μF	50 Ω, DC coupled	50 Ω, DC coupled
Coupling	AC and DC	DC	DC
Maximum Input Voltage	5 Vrms (0.5 W) or 0.25 W-sec. Pulses not exceeding 25 V peak	5 Vrms (0.5 W) or 0.25 W-sec. Pulses not exceeding 25 V peak	5 Vrms (0.5 W) or 0.25 W-sec. Pulses not exceeding 25 V peak
VSWR		Less than 1.5, dc to 3.5 GHz	
Vertical resolution	11 bits	11 bits	11 bits

**Triggering –**

Parameter	SCD1000	SCD5000	SCD5000 Opt 01
Source	CH A, CH B, External analog	External analog	External and internal analog
Coupling	AC or DC	AC only	AC only
Slope	Positive or Negative	Positive or Negative	Positive or Negative
Level range	Internal; ±125% of input range in 1% steps. External analog; ±1.25 V in 10 mV steps.	External analog; ±1.25 V in 10 mV steps.	External analog; ±1.25 V in 10 mV steps.
Sensitivity (sinewave) External input	50 mV, 20 kHz to 50 MHz 150 mV, 50 MHz to 500 MHz 350 mV, 500 MHz to 1 GHz	50 mV, 20 kHz to 50 MHz 150 mV, 50 MHz to 500 MHz 350 mV, 500 MHz to 1 GHz	50 mV, 20 kHz to 50 MHz 150 mV, 50 MHz to 500 MHz 350 mV, 500 MHz to 1 GHz
Sensitivity (sinewave) Internal input	0.05 x range, DC to 250 MHz 0.15 x range, 250 MHz to 1 GHz	N/A	500 mV, 20 kHz to 50 MHz 1.5 V, 50 MHz to 500 MHz 3.5 V, 500 MHz to 1 GHz
Sensitivity (pulse)	150 mV with minimum of 500 ps HAD (half amplitude duration) pulse.	150 mV with minimum of 500 ps HAD (half amplitude duration) pulse.	150 mV with minimum of 500 ps HAD (half amplitude duration) pulse.
Pretrigger view time	2.5 ns	N/A	2.5 ns

### SCD SERIES COMMON CHARACTERISTICS

**Time per Point** – 5 ps/point (5 nsec time window with 1024 point record length) to 400 ns/point (100  $\mu$ s time window with 256 point record length).

**Time Windows** – 5 ns to 100  $\mu$ s in a 1, 2, 5 sequence of 14 steps.

**Trigger delay** – 0% to 500% of time window with 0.06% resolution.

#### DIGITIZING

**Record Length** – 256, 512 or 1024 waveform data points.

**Internal-Calibration** – Internal signal standards for increased accuracy of vertical range, dc offset, trigger level, and window size.

**Multiple Records** – 16 waveform locations (first 4 locations are battery backed up).

**Auto Advance Mode** – Automatic capture of sequential events into separate waveform locations.

**Time Stamping** – Time and date stored with every acquisition.

#### SYSTEM CAPABILITIES

**GPiB** – IEEE-488.1 interface is standard for instrument control and waveform data transfer. Maximum transfer rate  $\geq$  500 kilobytes/s. Instrument functions, settings, and operating modes are programmable, with the exception of the power switch.

**Waveform Data Formats** – Either processed (using centroid algorithm) or raw waveform data available.

**Settings Storage** – 10 nonvolatile instrument settings.

**System commands** – Examples of commands include:

- Advance data into multiple waveform locations (16)
- NRepeat makes user specified single-shot acquisitions and automatically transfer to controller
- Calibrate command for increased time and amplitude accuracy
- Data Count allows partial waveform transfers

#### DISPLAY UNIT

**Compatibility** – Attaches to any SCD Series waveform recorder.

**Menu Functions** – Instrument settings and operating modes are programmable from the display unit.

**Waveform Display** – Up to 4 waveforms displayed.

**Local Cursor Measurements** – Volts,  $\Delta$ Volts, Time,  $\Delta$ Time, and 1/ $\Delta$ Time on one waveform or between any two waveforms.

#### SIGNAL CONNECTIONS

**Gate out** – Single BNC connector on back panel, output TTL level pulse is coincident with start of sweep.

**Video out** – TTL, VGA (600 x 400 resolution) compatible video signal output on back panel. Compatible with standard PC multiple-frequency monitors and video hardcopy units.

#### ENVIRONMENTAL (WITHOUT DISPLAY UNIT)

**Temperature Range** – Meets Mil-T-28800D type III, Class 5. Operating –0 to +50°C. Non-Operating –55 to +75°C.

**Humidity** – Meets Mil-T-28800D type III, Class 5. Up to 95% relative humidity (noncondensing).

**Altitude** – Exceeds Mil-T-28800D type III, Class 5. Operating: 15,000 ft. (4.5 km) maximum. Nonoperating: 50,000 ft. (15 km) maximum.

**Electromagnetic Compatibility** – FCC Part 15, Subpart J, class A and VDE 0871/6.78 class B.

#### POWER

**Line Frequency** – Operational from 48 to 440 Hz.

#### Power Consumption

SCD5000:  $\leq$  250 Watts maximum fully optioned.  
SCD1000:  $\leq$  300 Watts maximum fully optioned.

**Line Voltage Range** – 90 to 132 Vrms (115 V); 180 to 250 Vrms (230 V).

### ORDERING INFORMATION

#### SCD5000

4.5 GHz Waveform Recorder **\$46,900**

Includes: Standard configuration with detachable display unit and Type N connectors, power cord, Instruction Manual (070-6960-00), Instrument Interfacing Guide (070-7315-00) Quick Reference Card (070-7316-00), rackmount hardware.

#### SCD1000

1 GHz Waveform Recorder **\$29,900**

Includes: Standard configuration with detachable display unit and Type N connectors, power cord, Instruction Manual (070-6960-00), Instrument Interfacing Guide (070-7315-00), Quick Reference Card (070-7316-00), rackmount hardware.

#### OPTIONS

**Opt. 1P** – Increase waveform capture rate from one to ten 512-point waveforms per second. **+\$3,000**

**Opt. 1E** – Tek Type II Intelligent Probe interface (SCD1000 only). **+\$900**

**Opt. 2E** – SMA input connectors. **+\$200**

**SCD5000** **+\$250**

**SCD1000** **+\$250**

**Opt 01** – Add delay line with internal trigger pickoff (SCD5000) only. **+\$3,000**

**Opt. 20** – Delete detachable display unit. **–\$2,900**

#### SCD FAMILY FIELD UPGRADE

**SCDF019** – Add detachable display unit for SCD Series waveform recorder. **\$3,200**

**SCDF01P** – Add fast waveform capture option. **\$3,500**

**SCDF001** – Add delay line to SCD5000. **\$4,000**

#### OPTIONAL ACCESSORIES

See page 294.

**SCD1000/SCD5000** Service manual Order 070-6963-00 **\$150**

**GPiB Cable, Double Shielded, Low EMI** – 1 meter – 012-0991-01 **\$140**

**Type N male to SMA female adaptor** – **\*\***

**Type N male to BNC female adaptor** – Order 103-0045-00 **\$17**

**Type N male to GR adaptor** – Order 017-0021-00 **\$90**

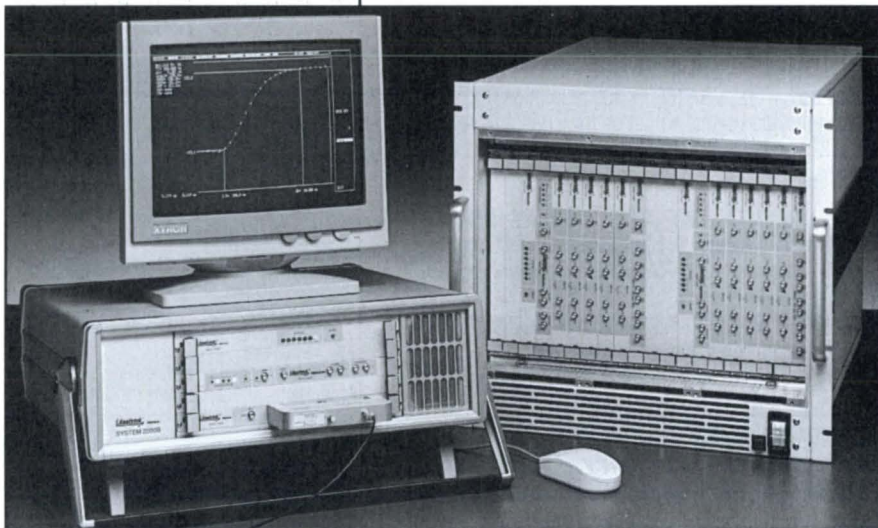
#### PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width	482.6	19
Height	177.8	7
Depth	762	30
Weight <sup>1</sup>	kg	lb
Net	24.5	54

<sup>1</sup> Contact your local sales office

## 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 and Modular Systems



Analytek 2000 Series



## 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
- High Speed and rf Circuits
- Automated Test Equipment

\*The Analytek 2000 Series of Digitizers complies with the IEEE Standard 488.2 and Tektronix Codes and Formats

## 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

Each 2004S Sampling Module has four simultaneous acquisition channels with sampling rates of 500 Mega-samples/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 2016S Sampling Module provides 16 simultaneous acquisition channels with sampling rates of 125 MS/s.

## HIGH THROUGHPUT SAMPLING

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 packaged separately so that the Accelerator Module can be configured to serve either one or two Sampling Modules. High Throughput Sampling Modules cannot be combined with other Analytek sampling modules under the control of a single processor. However, processor-sampler subsystems of both regular and high-speed samplers can coexist in a connected system.

Throughput of the 2004HS occurs at a rate of approximately 266 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 440 waveforms per second (at 8192 points per waveform). Alternately at 1024 points per waveform, the throughput is increased to approximately 2300 waveforms per second.

## 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 10.5 bit dynamic range to maximize useful information from the captured signals.

## LOW COST PER CHANNEL

As the number of signal acquisition 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.

## NEW SIGNAL AMPLIFIER AND ATTENUATOR

The 2004A Amplifier-Attenuator Module provides four channels of amplification or attenuation, with each channel independently programmable between 100x attenuation (-40 dB) and 10x gain (20 dB). It is designed especially for use with the Analytek waveform sampling modules due to the ability to calibrate the entire sampling channel under the control of the Series 2000 processor.

The 2004A may also be used as a general purpose amplifier-attenuator, independent of other 2000 Series modules. In such general purpose applications, the 2004A Amplifier-Attenuator can be directly register-programmed by a standard VME CPU.

## TIMING &amp; 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.

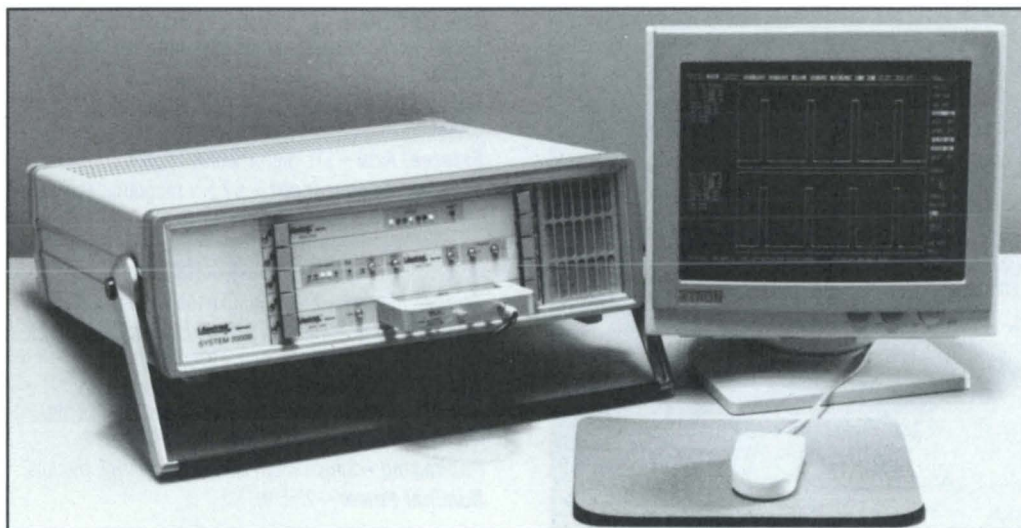
## AUTO-CALIBRATION

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.

## 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.





A high resolution monochrome monitor and mouse make the 2000B mainframe with its powerful ROM-resident software a fully standalone system.

### 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.)

### NEW INTERACTIVE MEASUREMENT SYSTEM SOFTWARE

The 2000AZ1 software product enables an Analytek Series 2000 system of up to eight 2000RV2 crates (15 GPIB addresses) or equivalent to operate from an IBM PC/AT or compatible computer. The connecting link is GPIB IEEE-488.2, supported by the National Instruments AT-GPIB or PCIIA interface board. Each GPIB address can represent up to 6 sampling boards. The maximum simultaneous display capacity is 48 waveforms. Within a GPIB address, boards can be enabled or disabled for group setup. Collected data can be tagged for storage on hard disk, or for preparation as a DADISP file, for off-line manipulation.

### CHARACTERISTICS

#### CHASSIS (MAINFRAMES)

**2000B Benchtop** – Standard size VME 5-card horizontal mounting chassis. Accepts one or two sampling modules, one spare slot.

**2000RV1 Rackmount** – Standard size VME 10-slot rackmount. Accepts up to six sampling modules, two spare slots.

**2000RV2 Rackmount** – Standard size VME 20-slot rackmount. Accepts up to twelve sampling modules, four spare slots.

#### Computer Interfaces –

IEEE-488.2 (GPIB); 2 each RS-232C; VME (Optional)

#### PHYSICAL CHARACTERISTICS

	B	RV1	RV2
<b>Dimensions</b>	<b>in</b>	<b>in</b>	<b>in</b>
Width	20	19	19
Height	7.4	17.5	17.5
Depth	19	26	26
<b>Weight</b>	<b>lb</b>	<b>lb</b>	<b>lb</b>
	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

#### 2000 SERIES MODULES AND SYSTEM COMPONENTS

##### 2004S, 2008S, 2016S, AND 2004HS SAMPLING MODULES

Sampling modules are available in either 4 channel (2004S), 8 channel (2008S), 16 channel (2016S), or 4 channel high throughput (2004HS) configurations.

**Input Channels** – SMA (LEMO on 2016S) connectors

**Input Range** – Full Scale 1.0 Volt ( $0 \pm 0.5$  V) with a  $\pm 950$  mV offset capability. DC offset can be set on each channel.

**$\Delta$  V DC Accuracy** –  $\pm 0.5\%$  Full Scale  $\pm 0.2\%$  of Signal after auto-calibration.

**Offset Accuracy** –  $\pm 0.5\%$  Full Scale  $\pm 0.5\%$  of Offset after auto-calibration.

**Input Bandwidth ( $-3$  dB)** – 300 MHz.

**Input Impedance and Coupling** –  $50 \Omega$  dc Coupled.

**ADC** – 12 bits providing resolution of 1 part in 4096.

**Dynamic Range** –  $\geq 60$  dB.

#### 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
- ##### 2004S, 2008S, 2016S and 2004HS Sampling Modules:
- **500 MS/s Max Sample Rate** (2004S & 2004HS)
  - **250 MS/s Max Sample Rate** (2008S)
  - **125 MS/s Max Sample Rate** (2016S)
  - **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)
  - **Up to 16 Channels per Module** (2016S)
  - **300 MHz Analog Bandwidth** (150 MHz with 2008S)
  - **12 bit Vertical Resolution**
  - **Patented VLSI Analog Memory**
  - **10.5 Bits Dynamic Range**
  - **8K Acquisition Memory per Module** (2K/Channel with 2004S & 2004HS)
  - **1K/Channel with 2008S** (0.5K/Channel with 2016S)
- ##### 2004HS High Throughput Sampling Module:
- **Throughput of 440 Waveforms/sec.** (at 8K Points/Waveform)
  - **Short Cycle Capability for Shorter Record Lengths** (e.g., 2,300 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)
- ##### 2000P Processor Module
- **Supports Up To 6 Sampling Modules and Corresponding Timing Module**
  - **Provides Local Instrument Control, Waveform Display and Analysis**
- ##### 2000 Series Fast Cache Memory
- **Available in 8, 16, 32 and 64 Megabyte Capacity**
  - **Single-Width Standard VME Package**



Simultaneous display of 24 waveforms using the AZIM1 Interactive Measurement Software.

#### SYSTEMS

##### 2000B Portable Benchtop System

- 1 - 2000B Chassis
- 2 - 4, 8, and 16 Channel Sampling Modules
- or
- 2 - High Throughput 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 - 4, 8, and 16 Channel Sampling Modules
- or

- 4 - High Throughput Sampling Modules
- 1 - 2000T Timing Module
- 1 - 2000P Processor Module
- 2 - Spare Slots Remaining

##### 2000RV2 Rackmount System

- 1 - 2000RV2 Chassis
- 6 - 4, 8, and 16 Channel Sampling Modules
- and
- 4 - High Throughput Sampling Modules
- or
- 12 - 4, 8, and 16 Channel Sampling Modules
- or
- 8 - High Throughput Sampling Modules
- 2 - 2000T Timing Modules
- 2 - 2000P Processor Modules
- 4 - Spare Slots Remaining

#### Record Length -

Module	Operating Mode (Post Trigger)	Waveform Data Samples Each Channel
2004S	4 Channels	2048
2004HS	2 Channels	4096
	1 Channel	8192
2008S	8 Channels	1024
2016S	16 Channels	512

**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  $\pm 0.01\%$ . Clock signal output is available as ECL level from 50  $\Omega$ .

**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  $\Omega$ .

**External Clock Accuracy** - (Required for specified operation)  $\pm 0.01\%$

**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** -  $\pm 2.5$  V programmable for level and slope: Resolution: 19.5 mV

Accuracy:  $\pm 35$  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 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:

- Finite impulse response (FIR) programmable low pass filter
- $\text{Sin}(x)/x$  interpolation algorithm
- Signal integration
- Signal averaging

The Processor Module uses data correction algorithms, which are applied to data generated from the acquisition units (except for High Throughput Module where correction is done in the 2004HA Accelerator Module and not in the Processor). 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.

### 2004A AMPLIFIER-ATTENUATOR MODULE

The Amplifier-Attenuator Module can be installed in any unused slot in a Series 2000 Chassis. The module can also be used independently of the Series 2000 architecture, in any standard size VME chassis.

**Inputs** - 4 Channels @ 50 Ω or 1 KΩ, BNC connectors.

**Gain** - 1, 2, 5, or 10x.

**Attenuation** - 1, 2, 5, 10, 20, 50, or 100x.

**Gain/Attenuation Accuracy** - ±1% at DC.

**Band Flatness** - ±1 dB from 0 to 400 MHz for 50 Ω inputs.

**Outputs** - 4 Channels into 50 Ω, SMA connectors.

**Output Level** - 2 Vp-p < 1% distortion; 4 Vp-p < 2% distortion.

**Noise** - 5 nV/sqrt Hz (110 μV rms R.T.I.).

**Offset Capability** - ±2x full scale.

**Bandwidth** - 0 to 400 MHz, 50 Ω; 0 to 200 MHz, 1 M Ω.

**Maximum Input Levels** - 50 Ω inputs - 0.5 Watts continuous; 100 V peak, 100 μs; 1 M Ω inputs, 10 Vp-p.

**Calibration** - Built-in AC calibration source; DAC controlled DC calibration source.

**VME Interface** - Standard data interface.

**Nominal Power** - 35 Watts per module.

### 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	1	2 GS/s	8K
2000SS3	1	1 GS/s	8K
2000SS4*1	2	500 MS/s	4K
2000SS8*1	1	500 MS/s	8K

\*1 Sampling rate is programmable from 1 MS/s through 500 MS/s

### SERIES 2000 CACHE MEMORY

Series 2000 dual-ported cache memory modules contain their own address register and each port is separately buffered for total compatibility with the **VMEbus** specification (Rev.C.1) and **VSBUS** specification (Rev. c). These modules may therefore reside in any standard Series 2000 slot (i.e., any slot not designated for a Series 2000 sampling module) or in any chassis employing the VMEbus or VSBUS backplanes. VMEbus options D32, D16, and D8 (32, 16, and 8-bit data path width) and A32, A24 (32 and 24 bit address path width) are incorporated as standard features.

### Cache Memory Module

Module	Description
2000MI	Cache Memory Interface Module
2008MM	8 Megabyte VME Cache Memory
2016MM	16 Megabyte VME Cache Memory
2032MM	32 Megabyte VME Cache Memory
2064MM	64 Megabyte VME Cache Memory
2000CBM	Cable Memory Interface Cable

### 2002MI VME CACHE MEMORY INTERFACE

The 2-channel Cache Memory Interface accepts data from either one or two 2000HA Accelerator Modules and transfers the data to one or more Cache Memory Modules via the **VME Subsystem Bus (VSBUS)**. Per-channel data transfer rates up to 5 megawords per second (10 megabytes per second) are achievable.

### 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.

### 2000AM AIR MANAGEMENT MODULE

Adequate cooling of the Series 2000 modules is necessary for proper operation. The maintenance of proper cooling air flow and signal continuity requires the use of a 2000AM air management module in any otherwise unoccupied slot in a Series 2000 chassis.

### 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.

### ORDERING INFORMATION

Tektronix, Inc. has an exclusive distribution agreement with Analytek Ltd.

2000B	Benttop 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
2016S	Sampling Module	³
2004SC	High Throughput Sampling Module	\$9,950
2004HA	Accelerator Module	³
2004HS1	Sampling Module¹	³
2004HS2	Sampling Module²	\$26,900
2004A	Amplifier-Attenuator Module	\$3,950
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 Memory Module	\$3,750
2002MI	2-Channel VME Cache Memory Interface	\$3,495
2008MM	8 Megabyte Cache Memory	\$3,295
2016MM	16 Megabyte Cache Memory	\$5,395
2032MM	32 Megabyte Cache Memory	\$10,395
2064MM	64 Megabyte Cache Memory	\$19,995
2000CBM	Cache Memory Interface Cable	\$89
2000DM1	14" Mono. Monitor	\$250
2000MC	Mouse	\$200
2000AZ1	Interactive Measurement System Software	\$795
2000CS	Control & Calibration Software	\$4,000
2000CV1	5-Slot Backplane Conversion Kit	\$1,250
2000CV2	10-Slot Backplane Conversion Kit	\$1,500
2000AM	Air Management Interface Module	\$79

¹ Consists of one each 2004SC and 2000HA modules. (4 channels)

² Consists of one each 2000HA and two 2004SC modules. (8 channels)

³ Contact AnalyTek

#### INTERNATIONAL POWER PLUG OPTIONS

Opt. A1 - A5 - Available NC  
See page 374 for description.

#### WARRANTY

The Analytek 2000 Series carries a standard Tektronix one-year warranty covering labor and replacement parts.

#### ADDITIONAL INFORMATION

For additional information, contact the Tektronix Sales Office nearest you.  
(800) 835-9433 ext. 170 or Analytek, Ltd.  
365 San Aleso Avenue  
Sunnyvale, California 94086  
(800) 366-5060  
(408) 745-1114

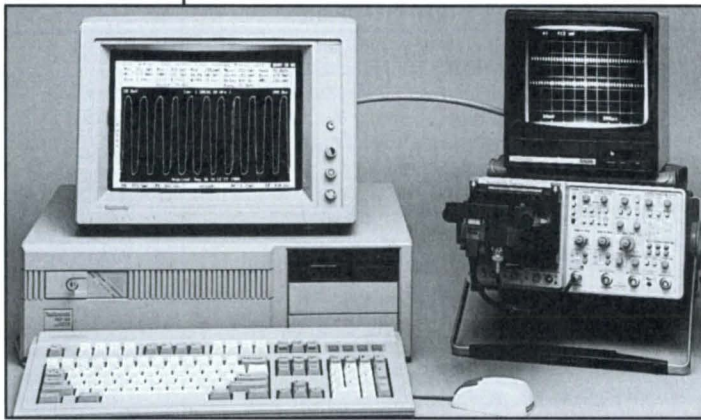
## Scan-Conversion Digitization

### TYPICAL APPLICATIONS

- High-Energy Physics
- High-Speed Transients
- Laser Research
- Electrostatic Discharge Tests
- High-Speed Logic Testing
- ECM Research
- Imaging

## DIGITIZING CAMERA SYSTEM

The DCS01 high-speed transient digitizing system combines the best of analog and digital capabilities in a powerful waveform digitization and analysis system. The DCS01 system includes a C1002 CCD (Charge Couple Device) Video Camera, a DX01 Video-Processor/Frame-Store Board, DCSGraph Software, cables, oscilloscope bezel adapter, and manuals for installation into your MSDOS computer. Integrating an analog oscilloscope and an 80286/80386-based personal computer with the DCS01 completes the acquisition system.

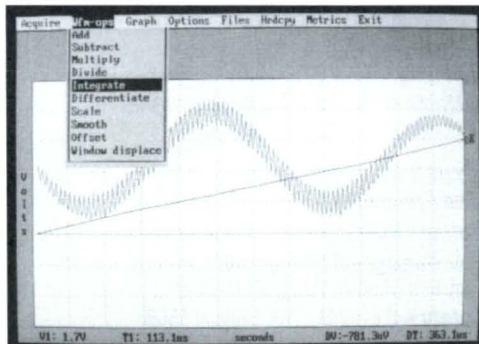


The Digitizing Camera System consists of a C1002 Video Camera, Frame Store Board inside the PC, DCS software, and cables. The system shown includes the DCS, TEK 2467B scope under GPIB control from the DCS software, and a DX05 video monitor.

### FEATURES

- 1-GHz Single-Shot with 7104 Scope
- Trigger on Light, External Trigger, or Save on Delta
- PCs can Support 4 DCS Boards
- MUX16's allow for up to 256 Cameras and GPIB Instruments
- DCSGraph, DCSGen and DCSLib Software – Includes Free Upgrades for One Year
- Capture of 2 Non-Crossing Waveforms
- Mouse Compatible Software
- Waveform Parametrics
- GPIB Support for 2467B and 11302A Oscilloscopes

The DCS's capabilities are best utilized when it is coupled with a microchannel plate (MCP) oscilloscope such as the Tektronix 7104 or 2467B. With an MCP scope, the digitizing system is capable of capturing both repetitive and transient signals at the scope's full bandwidth. For example, with a 7104 oscilloscope, the DCS01 delivers 1 GHz single-shot bandwidth with 250 GS/s acquisition rate. In addition, the MCP brightness enhances the single shot capture performance. When the DCS is used in conjunction with other types of analog scopes, the system capabilities depend on the individual oscilloscope's photographic writing rate.



Manipulate waveforms mathematically by using such procedures as integration, differentiation, addition, and subtraction with DCSGraph.

To operate the system, users acquire waveforms via an analog oscilloscope. The DCS01's camera produces a video signal, which is stored and processed in the frame-store board. The signal is then further analyzed using a variety of personal computer waveform-analysis software. The digitizing system is extremely accurate, delivering 99 percent accuracy with the standard DCS software.

## DCS SOFTWARE

DCSGraph allows you to acquire, graph, analyze and compute waveform parametrics with ease. Seventeen pulse parameters are automatically calculated as you reposition the two on-screen cursors. The software features MDA, CGA, EGA, and VGA support, pull down menus and optional mouse control so you can easily change system configurations and perform file translations. With DCSGraph, you can log a specified number of triggered waveforms, or store a 256K video image. In addition, the waveforms and pulse parameters can be printed on the Tek HC02 Video Copiers, the HC100 Color Plotter, the HC200 Printer, or the HP LaserJet printer. DCSGraph is standard with a DCS01, as DX01 Option 01, or as MUX Option 11.

DCSLib, written in Microsoft C, gives the accomplished programmer a library of functions to control the operation and function of the Frame Store Board. All hardware controls are included, plus two center-of-trace algorithms. Order S58DC01.

DCSGen is a text-only, menu-driven procedure generator to control local (in the PC) cameras or up to 256 cameras and GPIB instruments via the MUX 16. All the functions of DCSLib are available, plus routines for system focus, waveform calibration and GPIB communications. Available as MUX Option 10.

Both DCSGen and DCSGraph software can control GPIB programmable oscilloscopes to ensure that horizontal and vertical settings are correct and to facilitate some procedures. These programs can also store digitized video data in binary format. Waveform data arrays can be stored in ASCII, binary, or ADIF format for compatibility with many other Tek software products.

## C1002 CCD VIDEO CAMERA

The video signal is digitized to 490 (V) by 728 (H) pixels, in the CCD. In front of the CCD is a TEK designed, seven-element lens. The .3% distortion lens eliminates keystone 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 other objects near or distant.

The C1002R (ruggedized version) 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 Tek C-30 Series camera bezel adaptors.

The C1002R accepts only C-50 Series adaptors, and comes standard with the (016-0249-00) adaptor for 5000, 7000, and 11300 Series scopes. (See the camera section for C-30 and C-50 Series adaptors.)

A DX02 Camera Power Supply/Video Interface will allow two cameras to be used without a DCS frame store board. Camera or video outputs can be fed to an HC02 Video Copier, a VCR, or a TV monitor.

# IMAGERS, HIGH SPEED TRANSIENT DIGITIZERS, DIGITIZING CAMERA SYSTEMS

DCS

## THE DX01 FRAME STORE BOARD

The standard frame store board, which comes as part of the DCS01 system, captures video data in a 512 x 512 matrix of grey scale values which range from 0 to 255. This 8-bit, full-size board can be installed in any IBM PC, even XT's. The board also produces calibration signals for the system calibration routine, provides power for the C1002 Camera, has trigger in and reset out, as well as RS170 video output, real time comparison for the delta trigger, and summation of incoming video.

## CHARACTERISTICS

The following DCS specifications are valid when the camera system is operated at a temperature between 0 and 40°C.

### DCS01 DIGITIZING CAMERA SYSTEM

**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.

**Nominal Digitizing Resolution** – 12 bits of vertical resolution, nominal data accuracies to 99%.

**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** – 3 Hz.

**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: <4.0 A. Total is less than 18.0 W.

**Computer Compatibility** – IBM PC, XT, AT. Most configurations require 640K RAM plus Expanded Memory.

### PHYSICAL CHARACTERISTICS

	C1002		C1002R	
	mm	in	mm	in
Dimensions				
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

### DX02 CAMERA POWER SUPPLY AND VIDEO INTERFACE

**Number of Cameras Supported** – 1 or 2.

**Output per Camera** – +12 V ±5% at 0 to 600 mA with 1 mV ripple or less at 500 mA load.

**Video Out** – 75 Ω feedthrough from each camera.

**Input Power Requirements** – At 88 to 270 V AC, 40 to 440 Hz, 24 W maximum.

**Safety Certifications** – UL, CSA, VDE.

**EMI Compliance** – Qualifies under test limits specified for VDE 0871, Class B, emissions limitations.

### COMPUTER AND CONTROLLER REQUIREMENTS

The DCS requires the following base configuration for the PCs listed above: 1 MB of memory, MS-DOS V2.1 to 3.4, and a 5 1/4" or 3 1/2" disk drive. A hard disk is most desirable, as well as a mouse, a co-processor, color graphics card (VGA is preferred), a VGA monitor, and a National Instruments GPIB board if used with GPIB instruments. A video monitor (DX05) is recommended.

### C1002/C1002R CAMERA

**Focal length** – 10 mm at 5200 Å.

**F Number at Infinity** – F/1.3.

**Object-to-Image Distance** – 1633.54 mm at 0.075X, 144.72 mm at 0.833X.

**Field of View (Variable Mag.)** – 7.2 cm x 9.0 cm and 8.0 cm x 10.0 cm.

**Spectral range** – 350 nm to 1100 nm, 400 nm to 600 nm within 3 dB.

**Angular Range** – 23.45°

**Distortion** – Within 0.3% at image plane.

**Lens Resolution** – Center: 100 lines/mm. Edge: 20 lines/mm.

**Imaging Device** – Solid State, inter-line CCD.

**Pixels** – 490 vertical by 728 horizontal.

**Resolution** – 480 vertical lines by 540 horizontal lines.

**S/N Ratio** – Typical: 52 dB; minimum 50 dB. Gamma=1.

**Sensitivity** – 2.5 LUX

**Video Output** – 1 V p-p composite video, 75 Ω.

## ORDERING INFORMATION

### DCS01 CAMERA SYSTEM

<b>DCS01</b> Digitizing Camera System 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 (070-6175-01). Requires optional camera adaptors, see options.	<b>\$7,225</b>
<b>Opt. 1A</b> – Adaptor for 11302, 5K and 7K scopes (016-0248-01).	<b>+\$105</b>
<b>Opt. 2A</b> – Adaptor for Tek 2400 Series and scopes with 8 x 10 cm CRTs (016-0269-03).	<b>+\$115</b>
<b>Opt. 3A</b> – Adaptor for Tek 485 Series and scopes with 7 x 9 cm CRTs (016-0306-01).	<b>+\$120</b>
<b>Opt. 05</b> – Deletes C1002 and replaces it with the C1002R. Includes adaptor for 7104 and 11302A (016-0249-00) scopes.	<b>**</b>

### SOFTWARE FOR DCS01/DX01

<b>062-9859-00</b> – DCSGraph	<b>\$890</b>
<b>S58DC01</b> – DCSLib	<b>\$500</b>

### OPTIONAL INSTRUMENTATION

<b>2467B Opt. 10</b> – 400 MHz Portable MCP Scope. See page 82.	<b>\$13,960</b>
<b>7104</b> – 1 GHz Scope. Mainframe. See page 66.	<b>\$31,550</b>
<b>HC100</b> – Four Color Plotter. See page 295.	<b>\$950</b>
<b>HC200</b> – Epson FX compatible printer. See page 296.	<b>\$275</b>
<b>HC02</b> – 8 x 10 Thermal Video Copier. See page 297.	<b>+\$2,220</b>

### DX01 FRAME STORE BOARD

<b>DX01</b> DCS Frame Store Board Includes: DCS Frame Store Board, three BNC to SS cables (174-0430-00), operator's manual. <b>Opt. 01</b> – DCS01 Software (A C1002/R and DX01 with Option 01 is equivalent to a DCS01).	<b>\$3,110</b> <b>+\$885</b>
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### VIDEO CAMERA

<b>C1002</b> High Resolution CCD Video Camera Includes: Camera Cable (174-0449-00), Instruction manual. Requires optional camera adaptor(s) and external power (Option 04).	<b>\$3,455</b>
<b>C1002R</b> Ruggedized Camera for 7000 Series and 11300 Series Includes: Same as C1002 except adaptor (016-0249-00) is added. <b>Opt. 1A</b> – Adaptor for 5K, 7K, and 11300 Series (016-0248-01). <b>Opt. 2A</b> – Adaptor for Tek 2400 series scopes and scopes with 8 x 10 cm. CRT's (016-0269-03).	<b>\$3,900</b> <b>**</b> <b>**</b>
<b>Opt. 04</b> – DX02 Camera Power Supply and Video Interface. (Note: Please select one of the A0 through A5 power plug options.)	<b>+\$330</b>

### CAMERA POWER SUPPLY AND VIDEO INTERFACE

<b>DX02</b> – Power Supply/Video Interface, 110 V.	<b>\$385</b>
<b>220V Version</b> – A1 through A5 power plug options available. See page 374.	

\* Contact your local sales office

## DCS/MUX16 DX05

# IMAGERS, HIGH SPEED TRANSIENT DIGITIZERS, DIGITIZING CAMERA SYSTEMS

## DCS/MUX 16 Mainframe for DCS Frame Store Boards

- One host can control up to 256 DCS frame store boards (16 MUX16s)
- Supports up to 16 DCS boards
- Is fully programmable over GPIB

## DX05 Video Monitor

- 9 in. CRT
- Compact Size (8.3 in. w x 9.5 in. h)
- ≥ 600 Lines Resolution
- NTSC RS170A Video Input

### ORDERING INFORMATION

#### MUX16 SOFTWARE OPTIONS

- Opt. 10 – DCSGen software\*1 (MS-DOS) **+\$1,260**
- Opt. 11 – DCSGraph software\*1 (MS-DOS) **+\$1,510**
- MUX16** Rackmount Multi-Channel DCS Mainframe, 110V Includes: 18 open slots; 80286 CPU; Chassis slide; PC-III; Instruction manual; power cord; 2 m GPIB cable. **\$7,620**

#### MUX16 OPTIONS

- Opt. 04 – GPIB low-speed interface card (PCIIA) for use in the host controller PC **+\$625**

#### INTERNATIONAL POWER PLUG OPTIONS

- Opt. A1-A5 – See page 374 for description. **NC**

#### OPTIONAL ACCESSORIES

- Extra length C1002/2R to DX01 cables
- (4 meter) Order 174-1368-00 **\$190**
- (6 meter) Order 174-1369-00 **\$150**
- GPIB Board Kits** – GPIB driver software has been modified to operate with the MUX mainframe. (PC-III GPIB board and driver) Order 021-0452-00 **\$495**
- (PC-III GPIB board and driver) Order 021-0453-00 **\$795**
- DX05 MONITOR**
- DX05 – Video Monitor **\$420**

#### INTERNATIONAL POWER PLUG OPTION

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

\*1 On 5 1/4" and 3 1/2" disks.



\* The MUX16 complies with IEEE 488.2-1987 and with Tektronix Standard Codes and Formats

## DCS MUX16

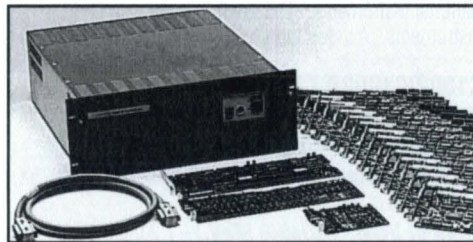
The DCS MUX16, in conjunction with a host controller, is part of a programmable multiple-channel digitizer system. Users can control up to 256 DCS frame store boards and/or GPIB instruments with one host controller.

### OPERATION

The MUX16 is designed to be used with a host controller. The host controller must have a compatible GPIB interface card capable of system controller/controller in charge operation. DCS software supports IBM PC's or compatibles as the host controller.

The MUX mainframe is a talker/listener to the controller via GPIB. The Frame Store Boards acquire video images. The waveform data is uploaded to the host controller for additional processing and/or storage.

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.



MUX16 – Rackmount

## DCS/MUX 16 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** – 350 W

### MUX 16 PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width	483	19.0
Height	178	7.0
Depth	540	21.2
<b>Weight</b>	<b>kg</b>	<b>lb</b>
Net	21.8	48
Shipping	21.3	47

## DX05 B/W VIDEO MONITOR

The DX05 black and white video monitor is recommended for use with the DCS01/DX01. It can also be used as a video display system together with the C1002 CCD camera and the DX02 power supply.

## DX05 CHARACTERISTICS

**Input Switchable Impedance** – 10 k $\Omega$ /75  $\Omega$ .

**Output Impedance** – 75  $\Omega$ .

**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@ 50 to 60 Hz.

## THE TEK FAMILY OF LOGIC ANALYZERS

Tektronix offers a range of logic analyzers to solve the problems of today's complex digital designs. This support is provided by three industry leading instruments: the DAS 9200, which is the highest performance digital instrumentation system on the market today, the PRISM 3000 Series – a complete set of analog and digital debug tools in a portable instrument, and the 1230, the most cost-effective modular logic analyzer available.

## NEW – THE HOTTEST COMBINED STATE/TIMING ANALYZER AND RISC/CISC MICROPROCESSOR SUPPORT MODULE

The 92A96 acquisition module for the DAS9200 is the newest addition to Tek's logic analyzer offering. It gives you the raw speed, width, and depth necessary for adapting to virtually any state or timing application. Turn-key support is available for the popular 32-bit RISC and CISC microprocessors. Coupled with the modularity and versatility of the DAS9200, the 92A96 is an ideal debug tool for almost any situation.

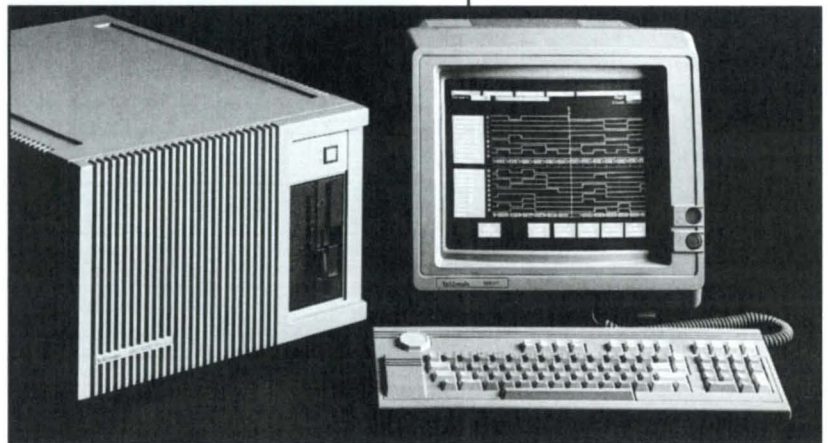
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# LOGIC ANALYZER SELECTION CHART

**T**ek'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
- 1, 2, and 3 Year On-Site or Return-to-Service Center Warranties
- Telephone Hot-Line Assistance Standard

LOGIC ANALYZER SELECTION GUIDE			
	DAS 9200 page 136	PRISM 3000 page 145	1230 page 152
<b>Timing Analysis</b> (Maximum Channels/Depth)			
2 GHz sampling rate	160/8K	4/12K	
400 MHz sampling rate	96/32K	20/12K	
200 MHz sampling rate	384/4K	20/12K	16/2K
100 MHz sampling rate			32/2K
50 MHz sampling rate			5
Glitch Detection(ns)	1.5	2	
Triggering:			
- Levels/States	4	2	14
- Timers/Counters	Yes	Yes	
<b>State Analysis</b> (Maximum Channels/Depth)			
200 MHz sampling rate	384/4K		
100 MHz sampling rate	384/32K		
25 MHz sampling rate			64/2K
20 MHz sampling rate	540/128K		
16 MHz sampling rate		96/8K	
Triggering:			
- Levels/States	16	7	14
- Range Recognizers	Yes	Yes	
- Timer/Counters	Yes	Yes	
- Timestamp	Yes	Yes	
<b>Performance Analysis</b>			
Statistical	Yes	Yes	
Real-Time		Yes	
<b>Microprocessor Support</b>			
Disassembly Formats	5	4	2
Multiple uP Support	Yes	Yes	
Register Deduction	Yes		
Microprocessor Control		Yes	
<b>Pattern Generation</b> (Maximum Channels/Depth)			
100 MHz	504/16K		
50 MHz	1008/8K		
<b>System Features</b>			
Modular	Yes	Yes	Yes
Portable		Yes	Yes
I/O: RS-232	Yes	Yes	Yes
GPIB	Yes	Yes	Yes
Ethernet	Yes		
Printer Support	Yes	Yes	Yes
Multiple Time bases	Yes	Yes	Yes
Time Correlated Data	Yes	Yes	
Auto Compare	Yes	Yes	Yes
Save Setups	Yes	Yes	Yes
<b>Digitizing Oscilloscope</b> (Maximum Channels/Depth)			
400 MS/s		1/32K	
200 MS/s		2/16K	
100 MS/s			2/2K



# MICROPROCESSOR SUPPORT CHART

## MICROPROCESSOR SUPPORT SELECTION GUIDE

Microprocessor Type & Mfg.	DAS 9200 page 136	PRISM 3000 page 145	1230 page 152	1241 <sup>2</sup>
<b>INTEL</b>				
8080A				2 MHz
8031/8051	12 MHz		12 MHz	12 MHz
8085	<sup>*3</sup>		6 MHz	
8086/8088	max <sup>*1</sup>	12.5 MHz	10 MHz	
8096/7			12 MHz	12 MHz
80C196			12 MHz	
80186/80188	max <sup>*1</sup>	16 MHz	10 MHz	8 MHz
80286	20 MHz	25 MHz	12.5 MHz	10 MHz
80386	33 MHz	33 MHz		
80386SX	max <sup>*1</sup>	16 MHz	16 MHz	
80376	max <sup>*1</sup>	16 MHz		
80486	33 MHz			
80860	40 MHz			
80960CA	33 MHz			
<b>ZILOG</b>				
Z80	8 MHz	20 MHz	8 MHz	
Z8001/3	<sup>*3</sup>			
Z8002/4	<sup>*3</sup>			
<b>MIPS</b>				
R3000	33-66 MHz			
<b>MOTOROLA</b>				
6800			max <sup>*1</sup>	max <sup>*1</sup>
6802			max <sup>*1</sup>	max <sup>*1</sup>
6809 & 6809E	max <sup>*1</sup>		2 MHz	2 MHz
68HC11	<sup>*3</sup>	12 MHz	12 MHz	12 MHz
68000/68010	16 MHz	16 MHz	16 MHz	16 MHz
68020	33 MHz	33 MHz		25 MHz
68030	33 MHz	33 MHz		25 MHz
68040	25 MHz			
88100	33 MHz			
68302	<sup>*3</sup>	16 MHz		
68332	<sup>*3</sup>			
DSP56000/1	<sup>*3</sup>	27 MHz		50 MHz
<b>AMD</b>				
29000	33 MHz			
<b>TEXAS INSTRUMENT</b>				
TMS32020	<sup>*3</sup>			20 MHz
TMS320C25	<sup>*3</sup>			25 MHz
<b>OTHER</b>				
ADSP2100				max <sup>*1</sup>
6502/C02			max <sup>*1</sup>	max <sup>*1</sup>
PACE 1750	40 MHz			
F9450	40 MHz			40 MHz
MII-Std 1750A	40 MHz			40 MHz
<b>BUS Support</b>				
IEEE-488 (GPIB)			10 MHz	
STD Bus			12.5 MHz	
VAXBI				max <sup>*1</sup>
VME	<sup>*3</sup>			
RS-232	19.2 k baud	19.2 k baud	19.2 k baud	

<sup>\*1</sup> max = Maximum CPU clock speed available from the manufacturer.

<sup>\*2</sup> Support for these processors is available for existing 1240/1241 logic analyzers. Consult your local sales engineer for details.

<sup>\*3</sup> Speed not warranted. Test in your application.

## Tek Offers a Wide Range of Microprocessor Support:

- Multiple Disassembly Formats
- Simultaneous State and Timing Analysis
- Time Correlated Displays
- Real-time & Statistical Performance Analysis
- Superior Microprocessor Probing
- Multiple Microprocessor Analysis

Please Note:

New and higher speed microprocessors are constantly being introduced and our support is continually expanding and being updated. Please consult your local sales engineer if the device or operating speed that you are using is not listed.

## The Standard By Which All Others Are Compared

- Up to 160 Channels with 500ps Resolution
- Up to 384 Channels with 2.5ns Resolution
- Up to 1536 Channels with 10ns Resolution
- More Than 500 Channels of 100 MHz Pattern Generation
- Memory Depth to 128K
- Broad Based Support for Popular RISC & CISC Microprocessors
- Multi-processor Support for up to 8 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



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 its operation is as familiar as operating a PC.

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 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

You can select between the 92A96, the 92A16 and 92HS8 acquisition modules for timing analysis. The 92A96 provides 96 channels on a single card, expandable to a system total of 1536 channels, with 100 MHz sampling on all channels and 8K or 32K memory depths. These cards can also sample at up to 400 MHz on a reduced number of channels with even greater depth of memory.

The 92A16 is a 16-channel acquisition card that samples at 200 MHz (5ns). It has 4 k bits of memory per channel. The 92A16 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. Unchallenged 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 are three families of acquisition cards. The 92A60/90 handles 40 MHz clock rates, 20 MHz bus rates and are available in either 32K or 128K memory depth versions. The 92A60 is 60 channels wide. The 92A90 is 90 channels wide.

The 92A96 handles clock and bus rates up to 100 MHz without compromising any performance features (like competitive products) and is available with memory depths of either 8K or 32K. The 92A96 is 96 channels wide and can be extended to 384 channels.

For extremely high speed applications, the 92A16 offers 200 MHz clock and bus rate acquisition with 4K memory depth. The 92A16 is 16 channels and can be expanded to 96.

The extremely sophisticated triggering of these instrument modules offer power beyond measure. And pre-programmed libraries 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

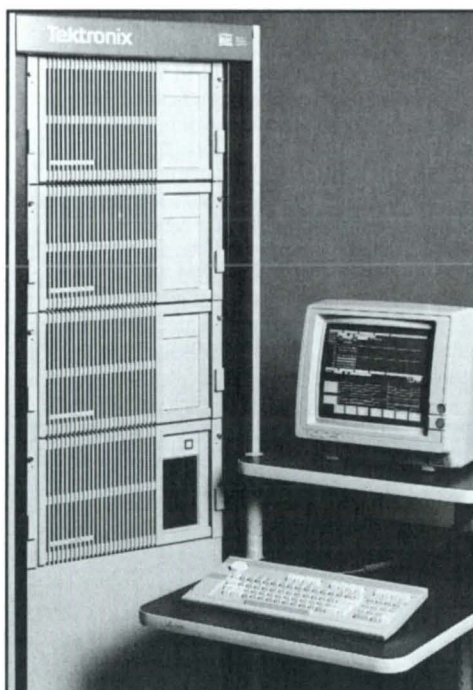
For stimulus requirements you can choose between the 92S16/S32 and the new 92SX109/SX118. These sub-systems offer data rates of up to 50 MHz and 100 MHz respectively. Patterns can be output either sequentially or algorithmically using a command structure that includes callable subroutines. These pattern generators can be combined with any of the acquisition cards to provide powerful stimulus/response systems.

### MULTI-TASKING 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.



*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.*

### 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.

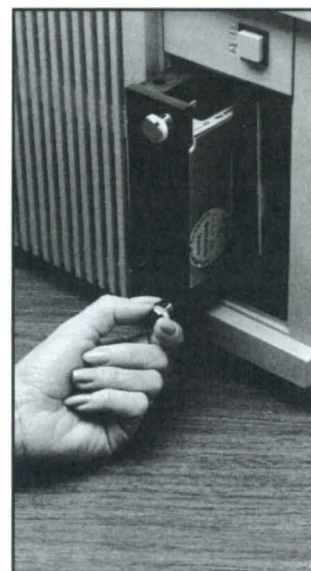
You can substitute 9201PC, IBM compatible PC software, for the standard display, the 9201T.

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.

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 accessible 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.*

**The Hottest State/  
Timing Logic  
Analyzer**

- 96-384 Channels @ 100 MHz Sync or Async
- 24-96 Channels @ 400 MHz Async
- 16 State Triggering at All Speeds
- Time-Correlated to Other State/Timing Modules
- Bus-Form Timing Display
- Compact, High Bandwidth Probes

**TODAY'S DESIGN PROBLEMS REQUIRE  
VISIBILITY OF MANY SIGNALS**

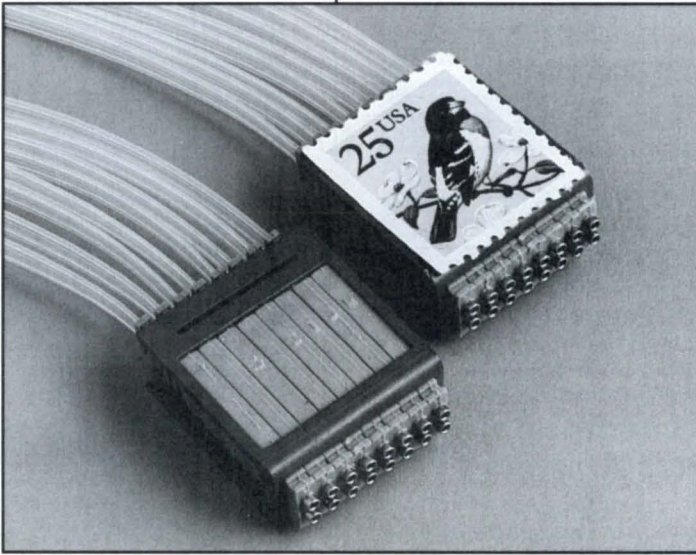
Trying to debug complex hardware with a logic analyzer that doesn't have enough channels is like trying to measure timing differences with a single-channel oscilloscope. Having "almost" enough channels means having to take time to select and disconnect some channels you HOPE you can do without, instead of being able to look at the whole system in context.

Viewing the whole problem in context is what debug with a logic analyzer is all about. Your success, however, requires that you have enough channels at your disposal, measurement performance commensurate with the design you are testing, and the ability to display all that data in a meaningful format.

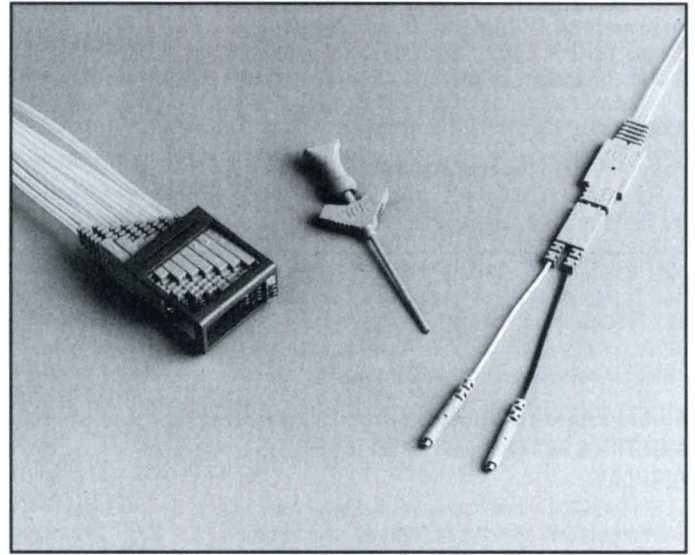
The 92A96, with greater than 150 MHz analog bandwidth, is able to provide 100 MHz synchronous acquisition with a setup and hold time window of 5 ns or less. That same bandwidth insures that your timing measurements have BOTH the resolution and accuracy you need.

**ONLY CONNECT PROBES ONCE!**

Probes for logic analyzers are usually optimized for either performance (at the expense of size and flexibility) or for large channel counts (at the expense of performance). These compromises make it difficult to perform timing analysis on large numbers of channels or to use the same probes for both state and timing analysis of the same signals or bus.



*The 92A96 provides the accessibility needed to observe the many signals of your most complex designs with 8-channel probes the size of the smallest US postage stamp.*



*For probing individual signals without the influence of long leadsets, the 8-channel probes of the 92A96 can easily be separated into single channel probes that bring the high bandwidth of the 92A96 right to the signals you need to see.*

The 92A96 provides 96 channels of 100 MHz acquisition (synchronous or asynchronous) on a single card. You can use these 96 channels for state or timing analysis or combine them with other 92A96 cards to extend the width to as many as 384 channels. Since all 92A96 cards can be used either independently or together, you can put several cards to work in separate mainframes to attack complex problems on different benches, and quickly configure them into one system when you're up against that elusive system problem in the final integration stage.

**WHY HIGH BANDWIDTH PROBES?**

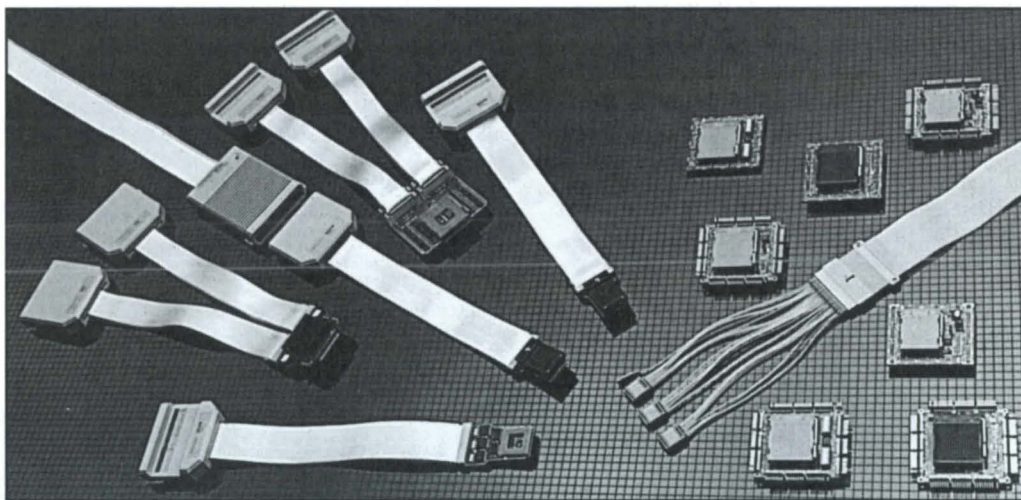
Most logic analyzers that advertise 100 MHz or faster timing resolution accomplish it by acquiring data through a low bandwidth probe and sampling it at a fast rate. This provides many sample points, which implies high-resolution, but is subject to the inaccuracies of the probes, which just round everything off.

The compact, separable, 8-channel probes of the 92A96 allow convenient connection to wide buses without compromising timing performance.

You can connect to a microprocessor bus for state analysis with disassembly, and switch to a fast asynchronous clock rate to see detailed bus timing WITHOUT SWITCHING PROBES!

**SEE ALL YOUR TIMING CHANNELS WITH  
BUS-FORM DISPLAYS**

Since most analyzers can't handle hundreds of timing channels, they don't worry about how to display more than a few channels at a time. With the DAS9200 bus waveform display, multiple 32-bit buses can easily fit on the same timing diagram as control signals, even if it is all correlated and locked to a microprocessor disassembly display in another window.



Shown are just some of the High-Performance 32-bit RISC and CISC microprocessors already supported by the 92A96 family (i860, i960, 80486, 80386, 29000, 88100, 68020, 68040, 68030).

#### REAL-TIME CLOCKING AT 100 MHZ

The variety of bus behavior exhibited by today's microprocessors reflects the advanced levels of complexity that are being integrated on-chip. Pipelined bus cycles, bursted operation, dynamic bus sizing, diverse I/O operations, DMA cycles, coprocessor communication, on-board wait-state generation, cache coherency operations, coprocessor communications and diversity of bus cycle termination are just a few reasons why tracking these buses requires more than the simple synchronous clocking capabilities provided by most logic analyzers.

The 92A96 attacks these challenges by providing a 16-state, 100 MHz state machine that is completely programmable to internally emulate the machine-state operation of these complex buses and determine the correct sample point for each signal needed to monitor the processor's operation.

Tek's turnkey microprocessor support packages come with complete pre-programmed setups for clocking as well as channel names, channel groups, symbol tables and a sample reference memory that allows you to quickly familiarize yourself with processor-specific capabilities.

#### REAL-TIME TRIGGERING AT 100 MHZ

The 92A96 extends the DAS9200's proven real-time state machine triggering to true 100 MHz operation across 384 channels. Other analyzers may recognize a single event at full speed, but can't make trigger decisions fast enough to consider the next sample.

As with other DAS9200 acquisition cards, the 92A96 offers both user-defined and pre-programmed trigger libraries and full symbolic triggering to simplify the task of specifying complex trigger events.

#### TIME-STAMPING AT 100 MHZ

Precise time correlation of data from multiple modules and timing measurements of processor activity are provided by the 44-bit timestamp that the 92A96 adds to each cycle as it is stored. This time value offers 10 ns resolution over a two-day range and can also be

displayed in several forms with the acquired data.

The 92A96 is offered both in an 8K bit/channel version and one with 32K bits/channel.

#### WHY DEEP MEMORY?

Other vendors offer many excuses why they think you don't need deep acquisition memory, but they don't have your manager breathing down their neck when development grinds to a halt due to a complex system bug.

The simple fact is that whatever initially caused the problem you're chasing has happened and gone before visible symptoms appear, and the only way to nail it quickly and confidently is to trigger on the symptom and look backwards through the acquired data until you find



The high-bandwidth probes and advanced 100 MHz clocking state machine of the 92A96 allow the 92A96 to interfaced to virtually any processor or bus without a complex, bulky hardware interface.

the cause. Only a deep trace buffer with full trigger positioning can prepare you for this kind of problem. The 92A96 is offered both in an 8K bit/channel version and one with 32K bits/channel.

#### THE DESIGNER'S EDGE

Only the 92A96 provides the speed, width, depth and versatility you need to conquer the problems that arise in today's products and those that follow.

## The Hottest RISC/CISC Real-Time Micro-processor Analyzer

- 96-384 Channels @ 100 MHz Sync or Async
- 100 MHz Clocking State Machine Tracks Fast, Complex Buses
- 100 MHz Triggering State Machine
- 100 MHz Timestamp
- Support for Popular 32-bit RISC and CISC CPUs
- Available in 8K or 32K Memory Depths
- Provides Timing Analysis Through Same Probes
- Monitor Multiple Micro-processors

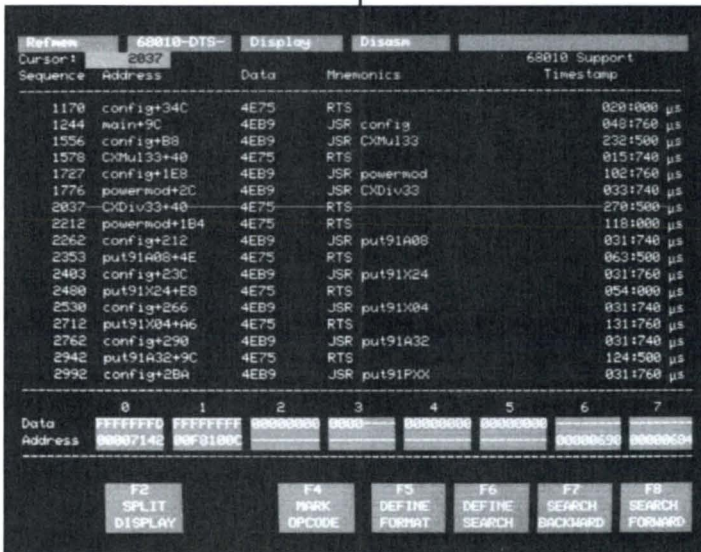
**CONFIGURED SUPPORT PACKAGES MAKE MICROPROCESSOR ACTIVITY EASY TO UNDERSTAND**

If you join the unprecedented 32K memory depth of the 92A96D or the 128K memory depth of the 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.

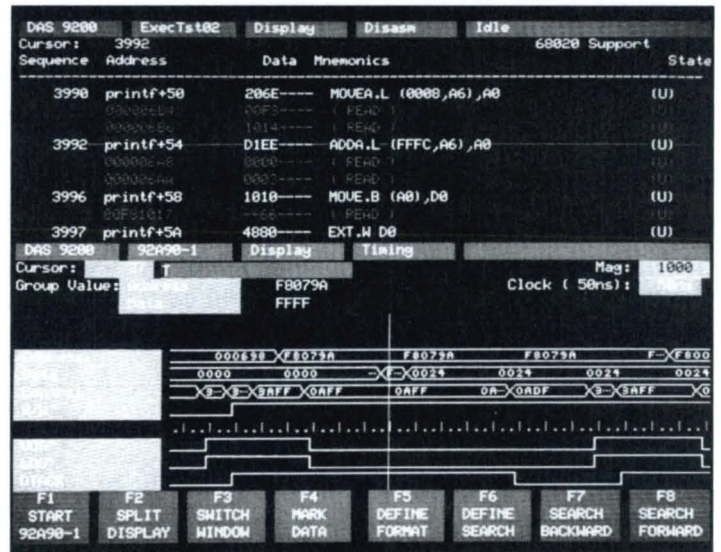
**THE NAME OF THE GAME IN DESIGNING TODAY'S ADVANCED PRODUCTS IS INTEGRATION**

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 subroutine trace display format can condense several thousand cycles of processor bus activity into a single screen of meaningful information.



Using the time correlated, split-screen display, you can observe detailed system interactions in any format you choose.

**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.

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.

**MICROPROCESSOR SUPPORT SELECTION GUIDE**

Microprocessor Type & Mfg.	Speed ( MHz )	Package Style	Order This Support Package Based on Module Used			Price
			92A60/A60D	92A90/A90D	92A96/A96D	
<b>Intel</b>						
8085	*3	DIP	92DM902	92DM902		*4
8031/51	*3	DIP	92DM901	92DM901		*4
8086	*1	DIP	92DM03	92DM03		\$1,250
8088	*1	DIP	92DM04	92DM04		\$1,250
80186	*1	LCC/PGA	92DM05	92DM05		\$1,250
80188	*1	LCC/PGA	92DM06	92DM06		\$1,250
80286	20	LCC/PGA	92DM08	92DM08		\$1,600
80386	33	PGA		92DM09A	92DM09A	*4
80386SX	16	PQFP		92DM10		*4
80376	16	PQFP		92DM10		*4
80486	33	PGA			92DM12	\$4,950
8060*2	40	PGA		92DM15	92DM15	\$4,950
80960CA	33	PGA			92DM17	\$4,950
<b>Zilog</b>						
Z80	8	DIP	92DM41	92DM41		\$ 900
Z8001/3	*3	DIP	92DM903	92DM903		*4
Z8002/4	*3	DIP	92DM904	92DM904		*4
<b>Motorola</b>						
6809	*1	DIP	92DM24	92DM24		\$ 900
6809E	*1	DIP	92DM24	92DM24		\$ 900
68HC11	*3	PLCC	92DM907	92DM907		*4
68302	16	PGA	92DM27	92DM27		\$1,250
68332	*3	QFP	92DM910	92DM910		*4
68000/010	16	DIP	92DM27	92DM27		\$1,250
68000/010	16	PGA	92DM27 w/Opt. 2S	92DM27 w/Opt. 2S		\$1,250
68020	33	PGA	92DM31	92DM31	92DM31A	\$2,500
68030	33	PGA	92DM33	92DM33	92DM33A	\$2,500
68040	25	PGA			92DM34	\$4,950
88100*2	33	PGA		92DM35	92DM35A	\$4,950
56000	*3	PGA	92DM906	92DM906		*4
<b>Texas Instruments</b>						
TMS32020	*3	PGA	92DM905	92DM905		*4
TMS320C25	*3	PGA	92DM905	92DM905		*4
<b>Other</b>						
AMD 29000*2	33	PGA			92DM72	\$4,950
MIPS R3000	33/66	PGA			92DM74	\$4,950
RTX2000	*3	PGA	92DM908	92DM908		*4
PACE 1750	40	PGA/DIP	92DM64	92DM64		\$1,000
F9450	40	DIP	92DM64 w/Opt. 13	92DM64 w/Opt. 13		\$2,600
MII-Std 1750A	40		92DM64	92DM64		\$1,000
RS-232	19.2 k baud	N/A	A6740G	A6740G	A6740G	\$1,500
VME	*3	N/A		92DM909		\$ 750

\*1 Maximum CPU clock speed currently available from the manufacturer is supported.

\*2 Requires two acquisition modules.

\*3 Speed not warranted - test in your application.

\*4 Contact your local sales office.

Note: New and 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.

**STANDARD CONFIGURATIONS**

Model Number	Recommended Application	Composed of:	Performance Overview	Price
<b>DAS9230</b>	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	<b>\$37,300</b>
<b>DAS9232</b>	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	<b>\$59,300</b>
<b>DAS9240</b>	Timing Analysis	1 92A16 with P6461 probes 1 92A16E with P6461E probes	32-Ch 200 MHz async/sync	<b>\$36,300</b>
<b>DAS9241</b>	Wide Timing Analysis	2 92A16 with P6461 probes 2 92A16E with P6461E probes	64-Ch 200 MHz async/sync	<b>\$51,250</b>
<b>DAS9242</b>	High Speed Timing Analysis	1 92HS8 1 92A16 with P6461 probes 1 92A16E with P6461E probes	8-Ch 2 GHz async 32-Ch 200 MHz async/sync	<b>\$62,050</b>
<b>DAS9250</b>	Single 8- or 16-bit Processor Support	1 92A60 without leadset	60-Ch, 20 MHz async/sync Supports one 8- or 16-bit processor	<b>\$19,500</b>
<b>DAS9252</b>	Single 8-, 16-, or 32-bit Processor Support	1 92A90 without leadset	90-Ch, 20 MHz async/sync Supports one 8-, 16-, or 32-bit processor	<b>\$23,000</b>
<b>DAS9254</b>	Dual 8-, 16-, or 32-bit Processor Support	2 92A90 without leadsets	180-Ch, 20 MHz async/sync Supports two 8-, 16-, or 32-bit processors	<b>\$36,300</b>
<b>DAS9256</b>	270 Channel Software Analysis for 8-, 16-, or 32-bit Processors	3 92A90 without leadsets	270-Ch, 20 MHz async/sync Supports three 8-, 16-, or 32-bit processors	<b>\$51,800</b>
<b>DAS9258</b>	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 async/sync Supports four 8-, 16-, or 32-bit processors	<b>\$73,800</b>
<b>DAS9281</b>	96 Channel High-Performance Processor Support	1 92A96 with leadsets	96-Ch, 100 MHz sync / 24-Ch, 400 MHz async Supports one high-performance processor	<b>\$30,950</b>
<b>DAS9282</b>	192 Channel High-Performance Processor Support	2 92A96 with 1 set of leadsets (100 ch)	192-Ch, 100 MHz sync /48-Ch, 400 MHz async Supports two high-performance processors	<b>\$47,860</b>
<b>DAS9283</b>	288 Channel High-Performance Processor Support	3 92A96 with 1 set of leadsets (100 ch)	288-Ch, 100 MHz sync / 72-Ch, 400 MHz async Supports three high-performance processors	<b>\$64,770</b>
<b>DAS9284</b>	384 Channel High-Performance Processor Support	4 92A96 with 1 set of leadsets (100 ch)	384-Ch, 100 MHz sync / 96-Ch, 400 MHz async Supports four high-performance processors	<b>\$81,680</b>

Each standard configuration includes a 9201T color display and DAS9220 mainframe except the DAS928X series which include a DAS9220 mainframe. Additional options are available. Please consult your local sales engineer.

Options A1-A5, International Power Plugs, are available as no charge options for each preconfigured system. Please refer to page 374.

**WARRANTY, INSTALLATION, AND EXTENDED SUPPORT**

All DAS9200 products and pre-configured systems are covered by a 1 year comprehensive, on-site warranty. This warranty provides you with a priority response if ever your system needs service. There are no materials, time, travel, or expense costs to deal with. Plus, you have toll-free access to the National Support Center (NSC). The NSC is staffed from 6:00 am to 6:00 pm PST. Questions regarding the systems capabilities or operation can now be easily answered in just one free phone call.

You have the option to extend this support at the time you purchase your system for a total coverage period of two or three years.

On-site installation is also available as an option to your system. When you purchase on-site installation, the service technician will:

- Set-up and configure your system.
- Configure and integrate all optional accessories.
- Run diagnostics to completely verify functionality.

To gain the benefit of these services, specify the following options with your order:

- Option Q0: On-Site Installation
- Option W2: 2 Yr HW/SW Support & NSC Hotline Access
- Option W3: 3 Yr HW/SW Support & NSC Hotline Access



## ORDERING INFORMATION

### DAS9200 MAINFRAMES

<b>DAS9219</b> Basic Mainframe	<b>\$11,400</b>
Includes: 2 Mbyte RAM, 20 Mb Hard Disk, 400 kb Floppy Drive	
<b>Opt. 07</b> - Sub. 8 Mbyte System RAM for 2 Mbyte	<b>+\$2,995</b>
<b>Opt. 10</b> - Sub. 1.2 Mb FD for Std. 400 kb FD	<b>+\$250</b>
<b>Opt. 13</b> - Sub. 40 Mb HD for Std. 20 Mb HD	<b>+\$700</b>
<b>Opt. 14</b> - Sub. 20 Mb Removable HD for Fixed HD	<b>+\$1,200</b>
<b>Opt. 16</b> - Sub. 80 Mb HD for Std. 20 Mb HD	<b>+\$1,550</b>
<b>Opt. 2C</b> - GPIB/Expansion Interface (92C02)	<b>+\$1,950</b>

### DAS9220 High Performance Mainframe

Includes: 8 Mbyte RAM, 40 Mb Hard Disk, 1.2 Mb Floppy Drive	
<b>Opt. 14</b> - Sub. 20 Mb Removable HD for Fixed HD	<b>+\$1,220</b>
<b>Opt. 16</b> - Sub. 80 Mb HD for Std. 40 Mb HD	<b>+\$1,220</b>
<b>Opt. 2C</b> - GPIB/Expansion Interface (92C02)	<b>+\$1,950</b>

### DAS9229 Basic System

Includes: 9201T Display and DAS9219 Mainframe	
<b>Opt. 07</b> - Sub. 8 Mbyte System RAM for 2 Mbyte	<b>+\$2,995</b>
<b>Opt. 10</b> - Sub. 1.2 Mb FD for Std. 400 kb FD	<b>+\$250</b>
<b>Opt. 14</b> - Sub. 20 Mb Removable HD for Fixed HD	<b>+\$1,200</b>
<b>Opt. 16</b> - Sub. 80 Mb HD for Std. 20 Mb	<b>+\$1,550</b>
<b>Opt. 2C</b> - GPIB/Expansion Interface (92C02)	<b>+\$1,950</b>

<b>DAS92E9</b> Expansion Mainframe	<b>\$6,850</b>
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### OPTIONS COMMON TO ALL DAS MAINFRAMES

<b>Opt. 04</b> - VDE (German EMI Std., 220V Only)	<b>+\$1,200</b>
<b>Opt. 05</b> - Rackmount Kit	<b>+\$400</b>
<b>Opt. 1B</b> - 125V/208 V 3-Phase Power Supply	<b>+\$180</b>
<b>Opt. 3C</b> - Expansion Only Interface (92C03)	<b>+\$1,500</b>

### INTERNATIONAL POWER PLUG OPTIONS

<b>Opt. A1-A5</b> - Available	<b>NC</b>
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See page 374 for description.

### DISPLAY AND DISPLAY SOFTWARE

<b>9201T</b> Color Graphic Display	<b>\$3,700</b>
<b>9201PC</b> 9201T Display Emulation Software	<b>\$1,000</b>
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.	
<b>Opt. W9</b> - 1 Year Software Support	<b>+\$150</b>
Includes Access to the US National Support Center and Telephone Hot Line.	

### COMMUNICATION INTERFACES

<b>92C02</b> GPIB/Mainframe Expansion Interface	<b>\$1,950</b>
<b>92C03</b> Mainframe Expansion Interface Only	<b>\$1,500</b>
<b>92LAN</b> Ethernet LAN Interface	<b>\$3,600</b>

### DAS9200 TRAINING SYSTEMS

<b>92WBOOK</b> DAS9200 Workbook/Tutorial, Software and Training Aid	<b>\$95</b>
<b>92WBMP</b> DAS9200 Microprocessor Support Workbook	<b>\$95</b>
<b>92WBPCL</b> DAS9200 Programetic Control Language (PCL) Workbook	<b>\$95</b>

*Note: 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.*

## INSTRUMENT MODULE SELECTION GUIDE

The following instrument cards include probes. A maximum of seven instrument cards may be installed in a DAS9220 or DAS9219 depending on type. A maximum of eight instrument cards may be installed in a DAS92E9 depending on type. Each mainframe includes sufficient power for all card slots. Additional options are available, please consult your local Sales Engineer.

MODULE TYPE	Description	Resolution		Maximum Channels per Card	Maximum Channels per System	Memory Depth (per Chan.)	Price
		Internal Clock	External Clock				
<b>92A16</b>	Master	5 ns	5 ns	16	384	4K	<b>\$9,750</b>
<b>92A16E</b>	Expander	5 ns	5 ns	16	NA	4K	<b>\$9,550</b>
<b>92A60</b>	Master or Expander	50 ns	50 ns	60	360	32K	<b>\$9,990</b>
<b>92A60D</b>	Master or Expander	50 ns	50 ns	60	360	128K	<b>\$13,500</b>
<b>92A90</b>	Master or Expander	50 ns	50 ns	90	540	32K	<b>\$12,700</b>
<b>92A90D</b>	Master or Expander	50 ns	50 ns	90	540	128K	<b>\$16,900</b>
<b>92A96</b>	Master or Expander	2.5 ns	10 ns	96	1,536	8K	<b>\$17,950</b>
<b>92A96D</b>	Master or Expander	2.5 ns	10 ns	96	1,536	32K	<b>\$20,950</b>
<b>92HS8</b>	Master	500 ps	1.43 ns	8	160	8K	<b>\$25,980</b>
<b>92HS8E</b>	Expander	500 ps		8	NA	8K	<b>\$25,980</b>
<b>Pattern Generator</b>							
<b>92S16</b>	Algorithmic	20 ns	20 ns	18	936	1K	<b>\$7,290</b>
<b>92S32</b>	Sequential or Expander	20 ns	20 ns	36	1008	8K	<b>\$9,430</b>
<b>92SX109</b>	Algorithmic	10 ns	10 ns	9	468	2K	<b>\$9,600</b>
<b>92SX118</b>	Sequential or Expander	10 ns	10 ns	18	504	16K	<b>\$12,500</b>

**ORDERING INFORMATION**

**DAS9200 ACQUISITION CARDS**

<b>92A16</b> 16-Channel, 200 MHz Sync/Async, Master Acquisition Card, 4K deep Includes: (2) P6461 probes and leadsets <b>Opt. 2S</b> - Sub. 2-P6460 probes for 2-P6461	<b>\$9,750</b> <b>-\$1,700</b>	<b>92A60</b> 60-Channel, 20 MHz Sync/Async, Master/Slave Acquisition Card, 32K deep Includes: Probe and general purpose leadset	<b>\$9,990</b>
<b>92A16E</b> 16-Channel, 200 MHz Sync/Async, Expansion Acquisition Card, 4K deep Includes: (2) P6461E probes and leadsets <b>Opt. 2S</b> - Sub. 2-P6460 probes for 2-P6461	<b>\$9,550</b> <b>-\$1,300</b>	<b>92A60D</b> 60-Channel, 20 MHz Sync/Async, Master/Slave Acquisition Card, 128K deep Includes: Probe and general purpose leadset	<b>\$13,500</b>
<b>92HS8</b> 8-Channel, 2 GHz Async/350 MHz Ext. Async, Master Acquisition Unit, 8K deep Includes: Probes, leadsets, and MF Interface. <b>Opt. 05</b> - Rackmount Kit	<b>\$25,980</b> <b>+\$300</b>	<b>92A90</b> 90-Channel, 20 MHz Sync/Async, Master/Slave Acq. Card, 32K deep Includes: Probe and general purpose leadset	<b>\$12,700</b>
<b>92HS8C</b> 8-Channel, 2 GHz Async Expansion, Acquisition Unit, 8K deep without MF Interface. Includes: Probes, leadsets. <b>Opt. 05</b> - Rackmount Kit	<b>\$24,940</b> <b>+\$300</b>	<b>92A90D</b> 90-Channel, 20 MHz Sync/Async, Master/Slave Acq. Card, 128K deep Includes: Probe and general purpose leadset	<b>\$16,900</b>
<b>92HS8E</b> 8-Channel, 2 GHz Async Expansion, Acquisition Unit, 8K deep with MF Interface. Includes: Probes, leadsets. <b>Opt. 05</b> - Rackmount Kit	<b>\$25,980</b> <b>+\$300</b>	<b>92A96</b> 60-Channel, 100 MHz Sync/400 MHz Async, Master/Slave Acq. Card, 8K deep Includes: Probes and leadsets <b>Opt. 01</b> - 90-Channel Microprocessor Interface <b>Opt. 3S</b> - Subs. 90-Channel Micro. I/F for probes	<b>\$17,950</b> <b>+\$950</b> <b>-\$2,550</b>
		<b>92A96D</b> 60-Channel, 100 MHz Sync/400 MHz Async, Master/Slave Acq. Card, 32K deep Includes: Probes and leadsets <b>Opt. 01</b> - Add 90-Channel Microprocessor Interface <b>Opt. 3S</b> - Subs. 90-Channel Micro. I/F for probes	<b>\$20,950</b> <b>+\$950</b> <b>-\$2,550</b>

**DAS9200 PATTERN GENERATOR CARDS**

<b>92S16</b> 18-Channel, 50 MHz Algorithmic Pat. Gen., 1K deep. Includes 2-P6464 probe and leads. <b>Opt. 2S</b> - Sub. 2-P6465 probes for 2-P6464 probes	<b>\$7,290</b> <b>+\$600</b>	<b>92SX109</b> 9-Channel, 100 MHz Algorithmic Pat. Gen., 2K deep. Includes: 1-Pat. Gen. Multiplexer, and 1-P6464 probe and leads. <b>Opt. 09</b> - Add (1) P6464 Output Data Probe <b>Opt. 11</b> - Add 1-P6460 External Control Probe	<b>\$9,600</b> <b>+\$1,400</b> <b>+\$750</b>
<b>92S32</b> 36-Channel, 50 MHz Sequential Pat. Gen., 8K deep. Includes 4-P6464 probes and leads. <b>Opt. 1S</b> - Sub. 1-P6465 probe for 1-P6464 probe <b>Opt. 2S</b> - Sub. 2-P6465 probes for P6464 probes <b>Opt. 3S</b> - Sub 4-P6463 probes for 4-P6464 probes <b>Opt. 4S</b> - Sub. 2-P6463 probes for 2-P6464 probes	<b>\$9,430</b> <b>+\$300</b> <b>+\$1,200</b> <b>-\$1,600</b> <b>-\$3,600</b>	<b>92SX118</b> 18-Channel, 100 MHz Sequential Pat. Gen., 16K deep. Includes: 2-Pat. Gen Multiplerers, and 2-P6464 probe and leads. <b>Opt. 09</b> - Add (2) P6464 Output Data Probe	<b>\$12,500</b> <b>+\$2,800</b>

*Note: 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.*

## 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 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 the specific application.

## MULTIPLE PURPOSE INSTRUMENTS

The PRISM 3000 Series meets the needs of many engineering disciplines through its collection of application-specific modules. Using these modules, system designers and integration engineers can focus on:

- Software/firmware debug and optimization
- Hardware/software integration
- Multiple microprocessor integration
- High speed hardware timing analysis
- Digital waveform analysis

Each module can generally solve the problem at hand, but for complex problems, multiple modules are tightly integrated in the PRISM system to offer capability previously not available in a single instrument.

## ALL DATA IS 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, an intermodule triggering and high speed communication bus, provides data and event communication between all application modules in the system. As a result, all data from all modules is automatically time-stamped when it is acquired and time-correlated as it is displayed. This lets you view the timing relationships of data acquired from different modules in a clear, meaningful display.

## QUICK TO SET UP, LEARN, AND USE

Probes are small, low-profile, and easy to connect. At power-up, PRISM recognizes what hardware is connected, autoloads the correct software and acquires data with a single keystroke. Fast response, simplified menus, and on-line context-sensitive help, 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. As you use your PRISM to find and correct the faults, you will learn its capabilities and enhance your own digital debug skills at the same time.

## MULTIPLE PLATFORMS – 3001 & 3002

The PRISM 3000 Series is available in two platforms. The PRISM 3001 is a portable mainframe that is factory configured with one application module. The PRISM 3002 is a benchtop system that can be configured with up to four application modules (see page 150 for more details).

## Multiple Tools in One Configurable Instrument

- **Microprocessor State Analysis**
- **Microprocessor Control**
- **Real-time Performance Analysis**
- **2 GHz Timing Analysis**
- **400 MS/s Digitizing Oscilloscope**
- **All Data is Time-Stamped and Time-Correlated**



*The PRISM 3000 Series offers high performance solutions tailored to specific applications at competitive prices. See page 150 for different configurations.*

### PRISM 3000 APPLICATION MODULE SELECTION GUIDE

Product	Application	Channels/Card	Rate	Clock Type	Memory	Triggering
30MPX (page 146)	8/16/32-bit Micro-processor Hardware / Software Integration	96	16 MHz* <sup>1</sup>	Synchronous	8K	7 States
		9	200 MHz	Transitional	2K	8 Word/Range recognizers
			or 90 MHz	Synchronous	2K	8 Counter/Timers 4 TekLink Signals
30HSM (page 148)	High Speed Hardware Analysis	20	400 MHz	Transitional	24K	15 Trigger Tests
		or 4	2 GHz	Transitional	120K	4 Levels
		or 20	200 MHz	Dual Threshold Transitional	12K	2 Counter/Timers 4 Word Recognizers 4 TekLink Signals
30DSM (page 149)	Analog Waveform Analysis	1	400 MS/s	NA	32K	Edge: rising/falling
		or 2	200 MS/s	NA	16K	External Trigger

\*<sup>1</sup> Supports clock rates up to 33 MHz

The 30MPX module provides all the support you need for developing a microprocessor based design.

- Combined State and Timing Analysis
- 96 State Channels, 8K Deep
- Support 8/16/32 Bit Devices up to 33 MHz
- 9 Transitional Timing Channels, 2K Deep
- 200 MHz Transitional Timing or 90 MHz Synchronous
- Real-time Performance Analysis

### MICROPROCESSOR ANALYSIS MODULE

The 30MPX module offers all of the functionality needed for designers of microprocessor based systems on a single module. Microprocessor analysis, timing analysis, real-time performance analysis and microprocessor control are combined on a single card.

The 30MPX provides 96 channels of state analysis. Each channel has an 8K memory depth making it ideal for tracing complex program flow and capturing both the cause and the visible effect of software problems.

### MULTIPLE DISASSEMBLY FORMATS FOR RAPID ANALYSIS

Four disassembly display formats support rapid analysis of microprocessor activity. You can switch between hardware, software, control flow, or subroutine display without reacquiring data. These different display modes allow you to concentrate on the appropriate data display required to solve your problem.

### SIMULTANEOUS SUPPORT FOR UP TO FOUR MICROPROCESSORS

For analysis of multiple microprocessor based designs, up to four 30MPX modules can be used simultaneously. As data is acquired from each microprocessor, it is time-stamped and stored. You can then split the screen to display data from each processor. As you scroll the data from one processor, the data display for the second processor stays in sync. This powerful feature enables you to solve complex problems related to the interaction of multiple microprocessors.

### 200 MHZ TIMING ANALYSIS ON THE SAME MODULE

The 30MPX module provides 9 additional channels of 200 MHz transitional or 90 MHz synchronous acquisition with each channel storing 2K transitions.

Transitional storage only stores data when the state of the signal changes, rather than at every sample interval. The advantage of transitional storage is that you can capture long periods of time while maintaining maximum sampling resolution.

High speed timing analysis compliments the state analyzer by giving you detailed visibility of other parts of your circuitry such as control lines, I/O and clocks.

### TIME CORRELATION TIES EVERYTHING TOGETHER

All data acquired by the 30MPX's state and timing sections (or from any other PRISM module) is automatically time-stamped by the PRISM's high speed master clock. This time stamp is used to time-correlate ALL of your data as it is displayed in PRISM's split screen display.

The advantage of time-correlation is that you can easily and accurately correlate the activity of the microprocessor to high speed activity of your other circuits.

### REAL-TIME PERFORMANCE ANALYSIS

PRISM's unique real-time performance analysis capability gives you the ability to profile the performance of your software. A key aspect of REAL-TIME PA over the traditional statistical approach is that ALL activity is captured. No data is lost while the analyzer is processing the acquired data. This is especially vital in optimizing real-time embedded control systems.

With real-time performance analysis you can identify where in your program you should focus your efforts to fine tune your system for its optimum performance.



PRISM's split screen display can display both state and timing at the same time. The "link cursor" option links the two displays together so as one display scrolls, the second display stays in sync.

### PRISM 3000 SERIES MICROPROCESSOR SELECTION GUIDE

Microprocessor Type & Mfg.	Package Style	Speed	Order This Support Package	Price*1
<b>Intel</b>				
8086/8088	DIP	10 MHz	30DM04	\$1,150
80186/80188	PGA/PLCC/LCC	16 MHz	30DM06	\$1,150
80286	PGA/PLCC/LCC	25 MHz	30DM08	\$1,150
80386	PGA	30 MHz	30DM09A	*2
80386SX	PQFP	16 MHz	30DM10	\$1,800
80376	PQFP	16 MHz	30DM10	\$1,800
<b>Motorola</b>				
68000/68010	DIP/PGA/PLCC	16 MHz	30DM27	\$1,150
68020	PGA	33 MHz	30DM31	\$1,800
68030	PGA	33 MHz	30DM33	\$1,800
56000/1	PGA	27 MHz	30DM101	\$1,150
68HC11	PLCC/DIP	12 MHz	30DM91	\$800
<b>Zilog</b>				
Z80	DIP	8 MHz	30DM41	\$800
Z80	DIP	20 MHz	30DM41F	\$1,150

\*1 Options are required for different package styles, see page 151.

\*2 Contact your local sales office.

**THE PDT ADVANTAGE**

When logic analyzer users were asked what features they would most like to add to their logic analyzer, the majority answered that they would like a way to control the microprocessor. Tektronix responded to this challenge with the Prototype Debug Tool (PDT).

PDT adds emulator functionality to the 30MPX module for software/hardware integration through an innovative EPROM probe adapter (30RP1 probe). With PDT, your PRISM system has the ability to:

- Download code
- Start/Stop the Processor
- Set Software Breakpoints
- Set Hardware Breakpoints
- Single Step Code
- Memory Disassembly
- Examine/Change Memory
- Examine/Change Registers
- Emulate EPROM Memory
- Simultaneously start LA and uP

To add microprocessor control to your 30MPX module, you simply add the appropriate number of 30RP1 EPROM probe adapters and PDT software (30DDxx). A KEY advantage of the PDT approach is that to change microprocessors you only need new PDT software. Your investment in PRISM hardware tools is preserved as you change processors.

**SOFTWARE/HARDWARE INTEGRATION WITH PDT**

Many people integrate their hardware and software by simply using a logic analyzer along with an EPROM burner. They burn an EPROM, plug it into their circuit, connect a state analyzer to the microprocessor, start their program with the reset button, and trace their program flow with the logic analyzer. For many applications this is a tedious but adequate process. With PDT, the above process can be improved by an order of magnitude without expensive new tools.

By adding the PDT option to your PRISM you can bring up new hardware and perform all of your initial hardware and software integration with a single instrument.

**INTEGRATION WITH OTHER PRISM MODULES**

PDT links with all other parts of the PRISM system through TekLink. This means you can use PDT with the 30HSM High Speed Timing Analyzer or the 30DSM Digitizing Oscilloscope to bring up new boards and verify signal integrity. In addition you can use up to four 30MPX cards with PDTs to control up to four microprocessors at the same time.

**GENERAL PURPOSE PDT**

For the processors that are not supported with a microprocessor specific PDT (30DDxx), the General Purpose PDT (standard with the 30RP1 EPROM probe adapter) enables you to control any microprocessor and emulate your EPROM with a subset of the above features.

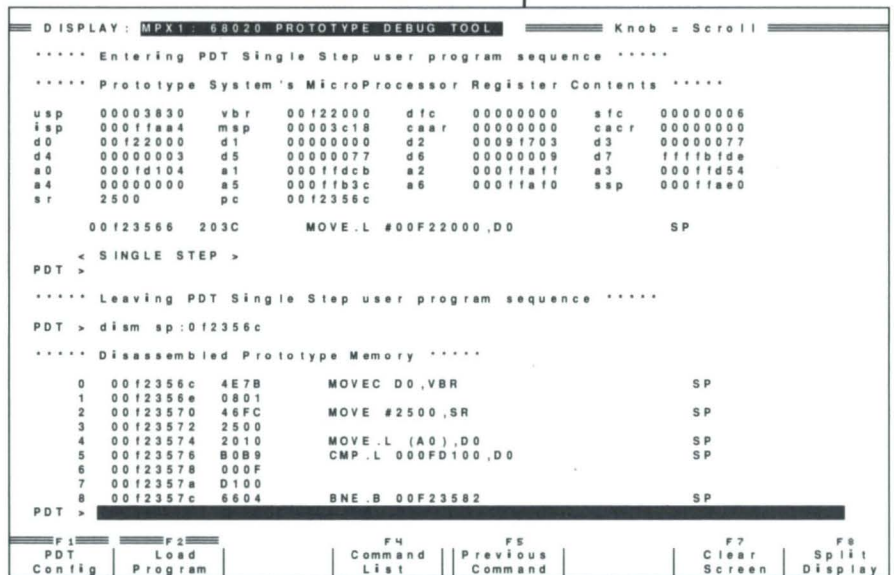
General Purpose PDT supports any microprocessor by plugging the 30RP1 probes into your system's EPROM sockets. With General Purpose PDT you can:

- Emulate your system EPROM
- Download code
- Set hardware breakpoints
- Patch EPROM memory
- Stop your application program.

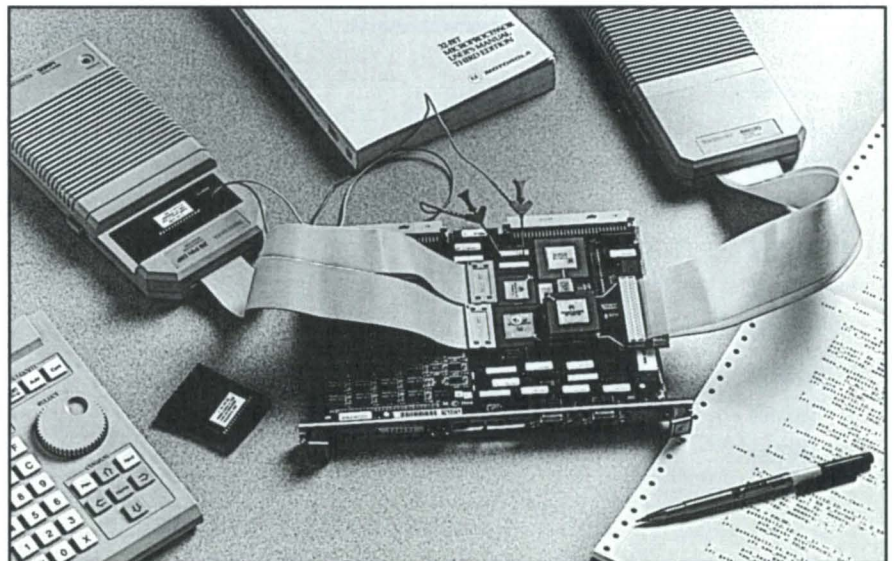
The KEY advantages of PRISM with PDT over other types of microprocessor debug tools is its real-time operation, high speed timing analysis, real-time performance analysis, and tight integration with other engineering tools, all in one system.

**L**ow cost option to the 30MPX for control of your microprocessor.

- Adds Emulator Functionality
- Real-Time Operation
- Assembly Level Debug
- Ideal for ROM Based Systems Development
  - Device Drivers
  - Diagnostic Code
  - Boot Code
- Ideal for Bringing Up Prototypes
- Debug New Kernels



*In Single Step mode, the instruction is displayed along with the register contents. This is just one of the emulator commands available on the PRISM Logic Analyzer.*



*Connection to your prototype is a simple matter of plugging EPROM probe adapters into your ROM sockets.*

## High Speed Acquisition Module for accurate timing analysis

- 2 GHz, 4 channels
- 400 MHz, 20 channels
- Dual thresholds
- 24 K transitionally stored memory
- 15 preset trigger tests
- 2.5 ns glitch detection

### HIGH-SPEED HARDWARE ANALYSIS

The 30HSM module is a complete high speed acquisition system for capturing and analyzing hardware faults in digital circuitry. A range of data acquisition modes, including 2 GHz transitional timing and Dual Threshold Mode, provide the ability to analyze a wide range of potential hardware problems.

The 30HSM's fault triggering lets you quickly locate hardware faults. Trigger selections include tests for set-up and hold time violations, pulse duration violations, and metastability. To save you time, these and other tests are pre-programmed in the 30HSM.

### PROBLEMS DETECTED BY THE HSM

The many features of the 30HSM enables the design engineer to detect complex problems such as:

- Bus Contention
- DMA Problems
- Glitches
- Propagation Delays
- Cross Talk
- Handshaking Errors
- Races & Hazards
- Setup & Hold Violations
- Metastability
- Ringing

### ACQUISITION MODES

The 30HSM incorporates three acquisition modes which provide you with the resources you need to efficiently solve the most demanding problems or make detailed measurements of your design's operation.

#### 400 MHz High Resolution Mode

The high resolution mode provides 400 MHz timing (2.5 ns) across 20 channels. Each channel can record 24K transitions. This mode makes it easy to debug problems caused by race conditions, setup/hold time violations, and propagation delays.

#### Dual Threshold Mode

The unique dual threshold mode provides 200 MHz timing (5 ns) across 20 channels. Each channel can record 12K transitions. This mode is uniquely suited to exposing difficult intermittent problems such as those caused by slow rise/fall times, bus contention, low drive or runt pulses, reflections, crosstalk, tri-state conditions, and excessive system noise.

#### 2 GHz Mode

The 2 GHz mode provides 4 channels of 500 ps resolution for resolving very fine timing relationships. Each channel can record 120K transitions.

```

SETUP: HSM1: HARDWARE ANALYSIS
Acquisition Mode: High Resolution
Memory Depth: Trigger Located at: T
Sample Rate Leadset Threshold Vthr Vref
Probe 0: 2 GHz 2 GHz TTL +01.400 +00.000
Probe 1: 2 GHz 2 GHz TTL +01.400 +00.000
Trigger Specification
ARM: Immediately, when TEST is satisfied, perform ACTION
TEST: Setup Time < 0.000.000.000.000.002.5
      BIN BIN BIN BIN
      CPEN / R/W LDS / CLK
      Measured from X 1 X X
      data event True (Mark data channels to be measured with U)
      to clock
      event Going True X X X 1
ACTION: Trigger Module

Events
Extend Events
Duration
Period
Delay
Accumulate Time
Count
Time While
Setup Time
Hold Time

Setup Time:
Performs the action if the amount of time any number of
data channels are stable before the clock edge is less
than the user-defined timer value.

Data Bus X X X X
Clock T Setup

F1 Load From F2 Add F5 Change F6 Channel F7 Quality F8 Split
Cursor 2nd Test Radix Grouping Storage Display
  
```

Application specific triggering and context-sensitive HELP make using the 30HSM a breeze.



### TRANSITIONAL STORAGE

The 30HSM stores data only when the state of the input signals change. This transitional storage can be contrasted with conventional storage where data is stored at every sample interval. By using transitional storage, the 30HSM enables you to capture long periods of time (up to 60 minutes) while maintaining maximum sampling resolution.

### TRIGGERING

The 30HSM makes setting up triggers easy by providing 15 predefined trigger tests for measuring timing related problems. Trigger resources include four 20-bit word recognizers, two counter/timers, and four intermodule TekLink signals.

*Sampling all 20 channels simultaneously at 2.5 ns, the 30HSM assures that you can make detailed timing measurements even if your design is based on the very newest logic families.*

## ANALOG PROBLEM SOLVING IN A DIGITAL INSTRUMENT

A powerful, multi-channel digital storage oscilloscope (DSO), the 30DSM has been tightly integrated into the PRISM 3000 Series logic analyzer. It provides uncompromising analog measurement performance to address the needs of engineers involved in the design and test of sophisticated digital electronic products.

## DESIGNED FOR THE DEMANDS OF TODAY'S HIGH-SPEED LOGIC FAMILIES

Each 30DSM contains two high-speed A/D converters and 32K of acquisition RAM. Measurement accuracy is insured by 8-bit vertical resolution, 350 MHz bandwidth triggering, user selectable interpolation and bandwidth limit filters, and a high-fidelity probe/attenuator combination. You can easily measure the worst-case propagation delay across a printed circuit board or make repeated measurements to determine the setup and hold margin of a memory system.

## FLEXIBLE ACQUISITION MODES PUT YOU IN CONTROL OF YOUR MEASUREMENTS

You can select between the single channel, 400 MS/s acquisition mode with a 32K record length or the dual channel, 200 MS/s mode with a 16K record length. In the single channel acquisition mode, the 30DSM can acquire single shot events up to 100 MHz (50 MHz in the dual channel mode).

Multiple 30DSMs can be integrated into your PRISM system to provide up to eight fully attenuated DSO channels. All channels are digitized simultaneously so you can determine exactly both the time and voltage relationships between them. Add a 30DSM to any PRISM system to increase the general-purpose utility for troubleshooting both the digital and analog sections of your design.

## CURSOR MEASUREMENTS MAKE IT EASY FOR YOU TO SEE WHAT HAPPENED

Every waveform captured by the 30DSM can be displayed to nearly the full 14" height of the display. You can easily overlap signals by moving them up or down in the display field. Four waveforms can be displayed at one time, selectable from any input probe or saved reference waveforms. You can even display multiple copies of the same signal.

There are two on-screen measurement cursors that can have either a vertical or a horizontal orientation. The voltage and time at the position of each cursor is always displayed on screen. The cursors can be assigned to any of the displayed waveforms. As an example, you can assign Cursor 1 to Channel 1 and Cursor 2 to Channel 2 and then measure the difference in voltage between the waveforms at any instant in time.

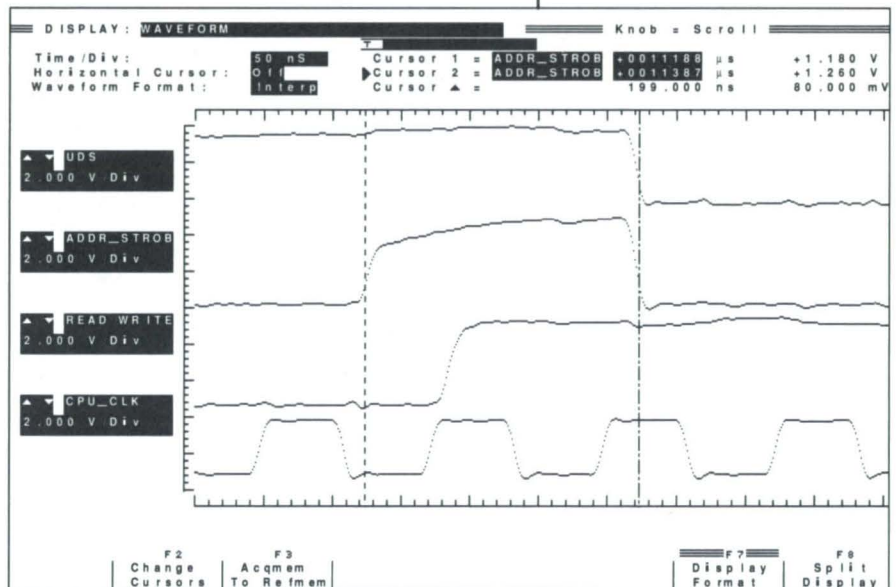
*Data acquired by any PRISM module is automatically time-correlated with all other data. Here the PRISM split screen display shows data acquired by the 30HSM correlated to signals acquired by the 30DSM.*

## TIME CORRELATED DATA TAKES THE PAIN OUT OF MIXED-MODE PROBLEM FINDING.

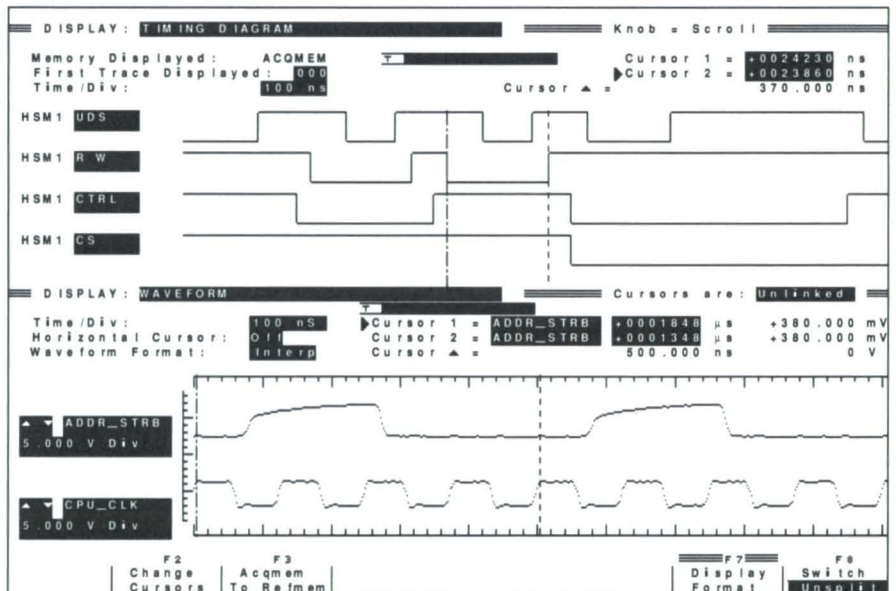
It's nearly impossible to troubleshoot today's complex digital designs using only an oscilloscope. The PRISM 3000 Series helps you overcome this limitation by combining the power of the 30MPX or 30HSM with the high-speed digitizing offered by the 30DSM. You will be able to trigger on, acquire, and display microprocessor execution, setup and hold time violations, or control line signal integrity. The PRISM system automatically correlates all acquired data, regardless of the acquisition mode.

**M**ulti-channel Digital Storage Oscilloscope for solving tough analog problems.

- 400 MS/s Digitizing
- 100 MHz Single Shot Bandwidth
- 350 MHz Analog Bandwidth
- 32K-bit Record Length
- 8-bit Vertical Resolution



*Multiple waveforms can be freely moved and sized on screen. Not only can you see the time relationship between these waveforms, but the quality of the signals as well.*



**M**ultiple mainframes and options allow you to select the most appropriate configuration for your application.

- 20MB Hard Disk
- MS-DOS Compatible, 3 1/2" Diskette
- Postscript/EPSON Printer Support
- Full Size QWERTY Keyboard
- RS-232 and GPIB Support

**MULTIPLE MAINFRAMES TO MEET YOUR NEEDS**

The PRISM 3000 Series was designed with a flexible architecture which enables Tektronix to offer all of the capability of the PRISM application modules in a package that best fits your needs. The different packages are:

- 3002C – Benchtop, 2-slot color mainframe
- 3002P – Portable, 2-slot mainframe
- 3002E – Two slot expansion mainframe
- 3001 – Low cost portable system



*The low cost 3001 logic analyzers offer the power of the entire PRISM 3000 Series in convenient, portable instruments. Adding the optional QWERTY keyboard further simplifies its operation.*

**PRISM 3002C MAINFRAME**

The PRISM 3002C is a two slot benchtop mainframe that can be extended to add two additional slots with the 3002E expansion mainframe. This unit features a full QWERTY keyboard, a high resolution 14" color display, 720KB MS-DOS compatible floppy, and a 20MB hard disk.

Designed for the lab environment, the 3002C can be configured to meet your most demanding applications.

**PRISM 3002P MAINFRAME**

The PRISM 3002P is a combination of the portability features of the 3001 with the expansion capability of the 3002C. The 3002P is identical to the 3002C except that the high resolution color CRT is replaced with a 9" high resolution flat panel display. The display folds down and is secured to the top of the mainframe and the keyboard is stored safely under the mainframe, making it easy to move from one location to another.

**PRISM 3002E EXPANSION MAINFRAME**

The 3002E is a two slot expansion mainframe that contains a power supply and interconnect cables. This low cost expansion enables you to add two additional application modules to any PRISM platform.

**PRISM 3001 SYSTEMS**

The PRISM 3001 is a low cost stand-alone mainframe that is factory configured with one PRISM application module. There are two versions available:

- 3001MPX – 8/16/32 bit  $\mu$ P analysis
- 3001HSM – High speed timing analysis

These traditional looking logic analyzers contain a 9" CRT, function key pads and control knob (a QWERTY keyboard is optional), and a MS-DOS compatible floppy.

For use in the lab, the 3001 can be expanded with a 3002E mainframe for an additional two slots.

**PRISM 3002 SYSTEMS**

Seven pre-configured 3002 systems are available. Each system can be expanded by adding the 3002E expansion mainframe for an additional two slots.

**DIFFERENT MAINFRAMES, SAME USER INTERFACE**

To make your design team more productive, the 3001 and 3002 configurations share the same user interface and operation. Thus, you can use a 3002 in the lab for design, and a 3001 in the field for repair without having to learn a new instrument.

**FASTRAK TRAINING PACKAGE**

FasTrak is a microprocessor based board and workbook designed to quickly teach you how to use your PRISM system. When you finish this tutorial you will be ready to use your PRISM to solve your most complex problems.

**PRISM 3000 SYSTEM SELECTION GUIDE**

Product	Description	Module	Display	Mass Storage	Price
3001MPX	1 slot portable	1 30MPX	9" Mono	720KB	<b>\$9,900</b>
3001HSM	1 slot portable	1 30HSM	9" Mono	720KB	<b>\$11,000</b>
3002CX	2 slot system	1 30MPX	14" Color	20MB/720KB	<b>\$14,100</b>
3002CXX	2 slot system	2 30MPX	14" Color	20MB/720KB	<b>\$21,700</b>
3002CH	2 slot system	1 30HSM	14" Color	20MB/720KB	<b>\$13,000</b>
3002CHH	2 slot system	2 30HSM	14" Color	20MB/720KB	<b>\$19,500</b>
3002CXH	2 slot system	1 30MPX, 1 30HSM	14" Color	20MB/720KB	<b>\$20,600</b>
3002CXD	2 slot system	1 30MPX, 1 30DSM	14" Color	20MB/720KB	<b>\$20,100</b>
3002CHD	2 slot system	1 30HSM, 1 30DSM	14" Color	20MB/720KB	<b>\$19,000</b>
3002ED	2 slot expansion	1 30DSM	none	none	<b>\$8,000</b>



ORDERING INFORMATION

3001 SERIES LOGIC ANALYZERS

<b>3001MPX</b> 8/16/32 Bit Microprocessor Analysis Instrument Includes: 96-CH state and 9-CH @ 200 MHz timing, P6480 state probe without leadset, P6486 high-speed probe with standard leadset, 720 KB floppy, and FasTrak training package.	<b>\$9,900</b>
<b>Opt. 1A</b> - 30DA01 Performance Analysis Software	<b>+\$650</b>
<b>Opt. 1F</b> - P6480 General Purpose Probe Adapter	<b>+\$450</b>
<b>Opt. 1K</b> - Add QWERTY Keyboard	<b>+\$500</b>
<b>Opt. 1L</b> - P6486 High Performance Leadset	<b>+\$500</b>
<b>3001HSM</b> High Speed Acquisition Instrument Includes: 20-CH @ 400 MHz, or 4-CH @ 2 GHz, or 20-CH @ 200 MHz dual threshold timing, 2 P6487 high-speed probes with standard leadsets, 720 KB floppy, and FasTrak training package.	<b>\$11,000</b>
<b>Opt. 1K</b> - Add QWERTY Keyboard	<b>+\$500</b>
<b>Opt. 1L</b> - Add two 400 MHz leadsets	<b>+\$1,000</b>
<b>Opt. 4L</b> - Add one 2 GHz leadset	<b>+\$1,200</b>
<b>Opt. 5L</b> - Add two 2 GHz leadsets	<b>+\$2,400</b>

PRECONFIGURED 3002 LOGIC ANALYZERS

<b>3002CX</b> PRISM 3002C M/F With 1 30MPX Includes: 3002C, 14-inch color monitor, 20 MB HDD, 720 KB FDD, keyboard, (1) 30MPX, (1) P6480, (1)P6486, & Performance Analysis SW.	<b>\$14,100</b>
<b>3002CXX</b> PRISM 3002C M/F With 2 30MPXs Includes: 3002C, 14-inch color monitor, 20 MB HDD, 720 KB FDD, keyboard, (2) 30MPX, (2) P6480, (2)P6486, & Performance Analysis SW.	<b>\$21,700</b>
<b>3002CH</b> PRISM 3002C M/F With 1 30HSM Includes: 3002C, 14-inch color monitor, 20 MB HDD, 720 KB FDD, keyboard, (1) 30HSM, (2) P6487	<b>\$13,000</b>
<b>3002CHH</b> PRISM 3002C M/F With 2 30HSMs Includes: 3002C, 14-inch color monitor, 20 MB HDD, 720 KB FDD, keyboard, (2) 30HSM, (4) P6487	<b>\$19,500</b>
<b>3002CXH</b> PRISM 3002C With 30MPX & 30HSM Includes: 3002C, 14-inch color monitor, 20 MB HDD, 720 KB FDD, keyboard, (1) 30MPX, (1) P6480, (1)P6486, (1) 30HSM, (2) P6487 & Performance Analysis SW.	<b>\$20,600</b>
<b>3002CXD</b> PRISM 3002C With 30MPX & 30DSM Includes: 3002C, 14-inch color monitor, 20 MB HDD, 720 KB FDD, keyboard, (1) 30MPX, (1) P6480, (1)P6486, (1) 30DSM, (2) P6109, & Performance Analysis SW.	<b>\$20,100</b>
<b>3002CHD</b> PRISM 3002C With 30HSM & 30DSM Includes: 3002C, 14-inch color monitor, 20 MB HDD, 720 KB FDD, keyboard, (1) 30HSM, (2) P6487, (1) 30DSM, (2) P6109	<b>\$19,000</b>

The above 3002 systems have options to substitute the color monitor with a flat panel display, add additional leadsets, and other options to customize the systems to your needs.<sup>1</sup>

3002 SERIES MAINFRAMES

<b>3002C</b> PRISM Mainframe With Color Monitor 2-slot system mainframe. Includes: 14-inch color monitor, 20 Mbyte hard disk, 720 KB floppy, QWERTY keyboard.	<b>\$6,500</b>
<b>3002P</b> PRISM Mainframe With EL Flat-Panel Display 2-slot system mainframe. Includes: 9-inch electro-luminescent flat panel display, 20 Mbyte hard disk, 720 KB floppy, QWERTY keyboard.	<b>\$7,200</b>

OPTIONS FOR BOTH 3002C AND 3002P

<b>Opt. 1B</b> - Accessory Bag	<b>+\$75</b>
<b>Opt. 1C</b> - 1200C01 RS232 COMM Pack	<b>+\$750</b>
<b>Opt. 2B</b> - 3002P Carrying Case (3002P only)	<b>+\$100</b>
<b>3002E</b> PRISM Expansion Mainframe 2-slot expansion mainframe. Includes: 9-inch & 4-foot TEKLink cable, mainframe mounting plate.	<b>\$2,000</b>

3002 SERIES INSTRUMENT MODULES

<b>30MPX</b> 8/16/32 Bit Microprocessor Analysis Application Module Includes: P6480 state probe w/o leadset, P6486 w/std leadset, FasTrak training package.	<b>\$7,600</b>
<b>Opt. 1A</b> - 30DA01 Performance Analysis Software	<b>+\$650</b>
<b>Opt. 1F</b> - P6480 General Purpose Probe Adapter	<b>+\$450</b>
<b>Opt. 1L</b> - P6486 high performance leadset	<b>+\$500</b>
<b>30HSM</b> High Speed Application Module Includes: 2 P6487 with standard leadset.	<b>\$6,500</b>
<b>Opt. 1L</b> - Add two high performance leadsets	<b>+\$1,000</b>
<b>Opt. 4L</b> - Add one 2 GHz leadset	<b>+\$1,200</b>
<b>Opt. 5L</b> - Add two 2 GHz leadsets	<b>+\$2,400</b>
<b>30DSM</b> Digitizing Oscilloscope Module Includes: Two P6109 - 10:1 probes.	<b>\$6,000</b>

ADDITIONAL PRODUCTS

<b>P6480</b> State Data Acquisition Probe w/o Lead	<b>\$750</b>
<b>Opt. 1F</b> - Add General Purpose Probe Adapter	<b>+\$450</b>
<b>P6486</b> High-Speed Data Acquisition Probe with Standard Leadset for 30MPX	<b>\$1,000</b>
<b>Opt. 1L</b> - Add one high performance leadset	<b>+\$500</b>
<b>P6487</b> High Speed Data Acquisition Probe with Standard Leadset for 30HSM	<b>\$1,100</b>
<b>Opt. 1L</b> - Add one high performance leadset	<b>+\$500</b>
<b>FasTrak</b> Micro Training Package	<b>\$450</b>
<b>1200C01</b> RS-232 COMM Pack	<b>\$750</b>
<b>30C02</b> GPIB COMM Pack	<b>*2</b>

INTERNATIONAL POWER PLUGS OPTIONS

Options **A1, A2, A3, A5** -available for the 3002 and 3001 platforms. Please refer to page 374 for description.

MICROPROCESSOR SUPPORT PACKAGES

<b>30DM04</b> 8086/88 SW and Probe Adapter, DIP Socketed	<b>\$1,150</b>
<b>Opt. 1S</b> - Substitute DIP Soldered	<b>NC</b>
<b>30DM06</b> 80186/188 SW and Probe Adapter PGA Socketed	<b>\$1,150</b>
<b>Opt. 1S</b> - Substitute PLCC Socketed	<b>+\$500</b>
<b>Opt. 2S</b> - Substitute LCC Socketed	<b>+\$400</b>
<b>Opt. 3S</b> - Substitute PLCC Soldered	<b>+\$500</b>
<b>30DM08</b> 80286 SW and Probe Adapter, PGA Socketed	<b>\$1,150</b>
<b>Opt. 1S</b> - Substitute PLCC Socketed	<b>+\$500</b>
<b>Opt. 2S</b> - Substitute LCC Socketed	<b>+\$400</b>
<b>Opt. 3S</b> - Substitute PLCC Soldered	<b>+\$500</b>
<b>30DM09A</b> 80386 SW and Probe Adapter, PGA Socketed	<b>*2</b>
<b>30DM10</b> 80386SX, 80376 SW and Probe Adapter, 3M PQFP Socketed	<b>\$1,800</b>
<b>Opt. 3S</b> - Substitute AMP PQFP Socketed	<b>+\$225</b>
<b>30DM27</b> 68000/10 SW and Probe Adapter, DIP Socketed	<b>\$1,150</b>
<b>Opt. 1S</b> - Substitute DIP Soldered	<b>NC</b>
<b>Opt. 2S</b> - Substitute PGA Socketed	<b>NC</b>
<b>Opt. 3S</b> - Substitute PLCC Socketed	<b>+\$800</b>
<b>Opt. 4S</b> - Substitute PLCC Soldered	<b>+\$500</b>
<b>30DM31</b> 68020 SW & Probe Adapter, PGA Socketed	<b>\$1,800</b>
<b>30DM33</b> 68030 SW and Probe Adapter, PGA Socketed	<b>\$1,800</b>
<b>30DM41</b> Z80 (8 MHz) SW and Probe Adapter, DIP Socketed	<b>\$800</b>
<b>Opt. 1S</b> - Substitute DIP Soldered	<b>NC</b>
<b>30DM41F</b> Z80 (20 MHz) SW and Probe Adapter, DIP Socketed	<b>\$1,150</b>
<b>30DM91</b> 68HC11 SW and Probe Adapter, 52-PIN PLCC Socketed & Soldered	<b>\$800</b>
<b>30DM101</b> 56000/1 SW and Probe Adapter, PGA Socketed	<b>\$1,150</b>
<b>30DA01</b> Performance Analysis Software	<b>\$650</b>

PROTOTYPE DEBUG TOOL SUPPORT PACKAGES

<b>30RP1</b> General Purpose PDT w/ROM Probe	<b>\$2,000</b>
<b>Opt. 01</b> - Add 24/28/32-Pin Gen. Purpose ROM Probe Adapter	<b>+\$350</b>
<b>Opt. 02</b> - Add 40-Pin DIP ROM Probe Adapter	<b>+\$350</b>
<b>30DD27</b> 68000/10 PDT Software	<b>\$1,500</b>
<b>30DD31</b> 68020 PDT Software	<b>\$3,000</b>
<b>30DD33</b> 68030 PDT Software	<b>\$3,000</b>

\*2 Contact your local sales engineer.

<sup>1</sup>Warranty-Plus options are available for all systems.

## 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

### FLEXIBILITY YOU WILL PUT TO USE EVERY DAY

The 1230 is a series of modular, general-purpose logic analyzers that support hardware timing analysis, microprocessor disassembly, and system integration applications.

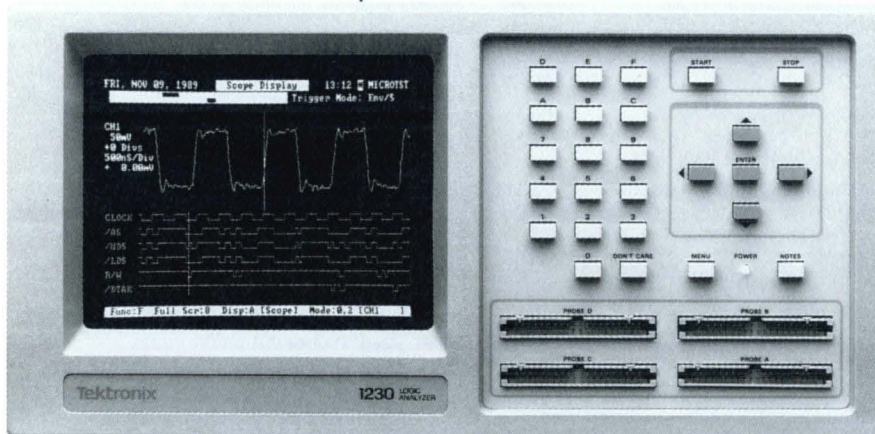
The 1230 provides 16, 25 MHz state channels or 8, 50 MHz, or 4, 100 MHz timing channels. Up to three 1230E1, 16 channel expander cards may be added to increase the number of channels. Refer to the configuration chart on the following page.

### 1230B – BATTERY POWER

The 1230B is a battery-powered version of the 1230. In addition to its self-contained, rechargeable battery, the 1230B also operates from 12 volts. The 1230B functions the same as the 1230 and uses the same probes and expansion modules, including the 1230DSM Digitizing Oscilloscope Module.

### 1230D ANALYZER AND OSCILLOSCOPE

The 1230D combines a 16-channel 1230 with a 2-channel, 100MS/s Digitizing Oscilloscope. It provides two versatile tools in one portable package. The 1230D can be expanded to 48 logic analysis channels.



The modular 1230 Series provides a strong growth path. You can expand the number of channels, add a Digitizing Oscilloscope module and microprocessor support probes as your testing needs change.

### BROAD MICROPROCESSOR SUPPORT

Optional disassembly probes let you conveniently attach to and monitor your microprocessor. Support is available for the 68000, 68HC11, Z80, 80286, 80386SX, and many others. Refer to the microprocessor selection guide on page 154 for a complete list.

### EASY TO LEARN AND USE

The 1230 Series features a large display and fast, interactive, pop-up menus. To save you time, most menu selections are made with a single keystroke. 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.

### DIGITIZING OSCILLOSCOPE

The 1230 Series combines a 100 MS/s digitizing oscilloscope 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 Module provides:

- 2 simultaneous channels
- 100 MS/s sampling rate
- 100 MHz analog bandwidth
- 8-bit vertical resolution
- 2048 samples per channel
- Repetitive sampling and signal averaging

### POWERFUL TRIGGERING – A TEK STANDARD

Like all Tek logic analyzers, the 1230 Series 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.

There are 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 Series supports two comparison modes: manual and automatic. 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.

In both compare modes, you can compare any two of the four memories. Differences are highlighted in the State Table.

### 1230 SERIES CONFIGURATION CHART

	1230/B or /D	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

### REMOTE CONTROL FOR LOW-COST AUTOMATED TESTING

By adding an optional RS232 or GPIB communications interface to the 1230 Series, the analyzer can be controlled remotely from a computer keyboard or via a program written for the computer. This capability lets you turn the instrument 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 analyzer 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 instrument setups and data over RS232. S43R101 also lets you create and run automatic, remote-controlled tests.

### THE COMPLETE SOLUTION

#### EVERYTHING YOU NEED TO LEARN AND USE ANY 1230 SERIES INSTRUMENT IS STANDARD.

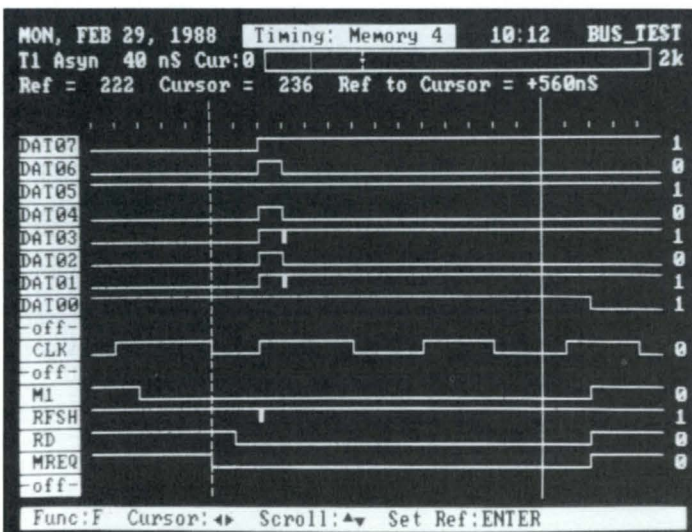
This includes the normal accessories you would expect: programmable-threshold acquisition probe, leadsets, grabber tips, and Operator's Manual. And there is a handy, pocket-sized quick reference guide included. Extensive instructional materials: training videotape, practice test circuit, and a workbook of application examples are also included at no additional cost.

#### TEACHING MATERIALS

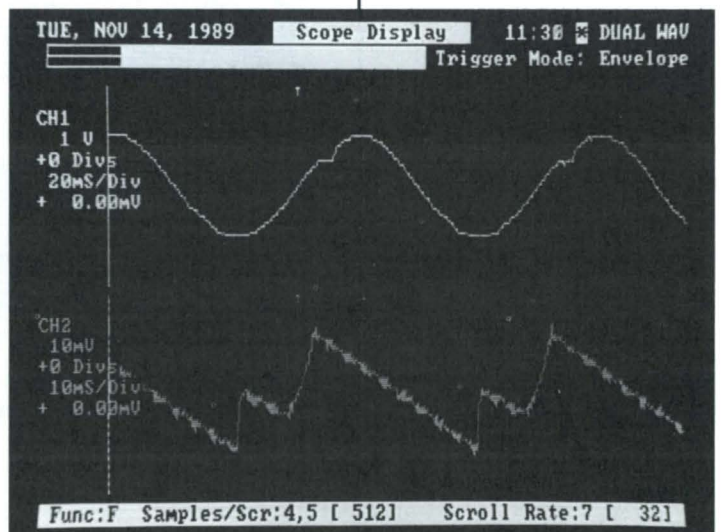
Tektronix developed the Basic Concepts of Logic Analysis self-study workbook (LABASIC) for those who need to learn or teach logic analysis theory and techniques. This optional workbook contains theory, instructors guide, exercises using the 1230, and student examinations.



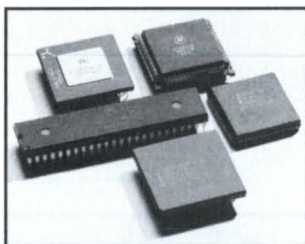
*Self-paced training materials quickly build your skills.*



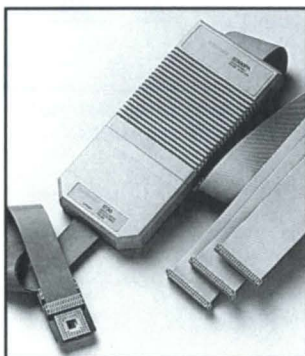
*Timing diagram displays up to 16 traces at once. Intensified areas indicate glitches.*



*Digitizing oscilloscope displays are available for single or dual trace, full-screen trace, and mixed scope and timing diagram traces.*



The 1230 Series supports an extensive list of popular microprocessors and micro-controllers.



Disassembly probes are compact and easy to connect.

## MICROPROCESSOR SUPPORT

### QUICK AND CONVENIENT CONNECTIONS

These compact microprocessor probes attach to the 1230 Series instruments 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.

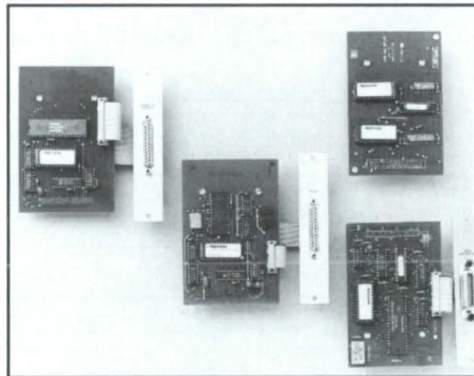
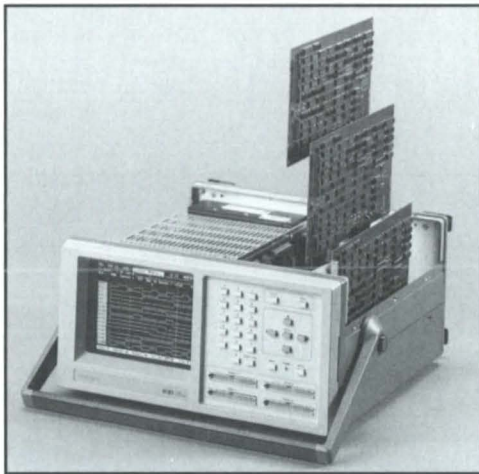
## 1230 SERIES MICROPROCESSOR AND BUS ANALYSIS SELECTION GUIDE

Microprocessor Type & Mfg.	Package Style	Minimum System Required	Order This Support Package	Price
<b>Intel</b>				
8085	DIP	1230C32	PM404	\$800
8031/8051	DIP	1230C32	DP8031D* <sup>1</sup>	\$800
8032/8052	DIP	1230C32	DP8031D* <sup>1</sup>	\$800
8086/8088	DIP	1230C48	DP8086D* <sup>1</sup>	\$1,500
80186/80188	PGA	1230C48	DP186P* <sup>1</sup>	\$1,600
8096/80C196	PLCC	1230C48	DP96PL* <sup>1</sup>	\$1,600
80286/80287	PGA	1230C48	DP286P* <sup>1</sup>	\$1,600
80286/80287	PLCC	1230C48	DP286PL* <sup>1</sup>	\$1,600
80386SX/80387SX	PQFP	1230C48	DP386SX* <sup>1</sup>	\$2,200
<b>Motorola</b>				
6800/6802	DIP	1230C32	PM407	\$800
6809/6809E	DIP	1230C32	PM406	\$800
68HC11	all	1230C32	DPHC11* <sup>1</sup>	\$800
68000/68010	DIP	1230C48	DP68KD* <sup>1</sup>	\$1,200
68000/68010	PGA	1230C48	DP68KP* <sup>1</sup>	\$1,200
<b>Other</b>				
Z80	DIP	1230C32	PM402	\$800
6502/C02/C802	DIP	1230C32	PM403	\$800
<b>Buses</b>				
GPIB	n/a	Any 1230	DPGPIB* <sup>1, 2</sup> 1230 Opt. 07* <sup>3</sup>	\$800 \$195
RS232	n/a	Any 1230	A6740G	\$1,500
STD	n/a	1230C32	PM405	\$800

\*<sup>1</sup> Requires 1230 Disassembly Probe Adaptor (1230DPA).

\*<sup>2</sup> Hardware interface and full disassembly.

\*<sup>3</sup> Hardware interface only.



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.

Both the 1230DSM and 1230E1 cards install easily allowing you to reconfigure your instrument in less than five minutes.

## STANDARD 1230 SERIES CONFIGURATIONS

Model Number	Recommended Application	Composed of:	Performance Overview	Price
<b>Base Configurations</b>				
<b>1230</b>	HW state/timing analysis	1 1230 Mainframe & (1) P6444 Probe	16-Ch 25 MHz synchronous 4-Ch 100 MHz asynchronous	☎ <b>\$2,995</b>
<b>1230C32</b>	HW state/timing analysis or 8-bit processor support	1 1230 Mainframe & (1) P6444 Probe 1 1230E1 & (1) P6444 Probe 1 Parallel Printer Port	32-Ch 25 MHz synchronous 8-Ch 100 MHz asynchronous	☎ <b>\$4,325</b>
<b>1230C48</b>	HW state/timing analysis 8- or 16-bit processor support	1 1230 Mainframe & (1) P6444 Probe 2 1230E1 & (2) P6444 Probes 1 Parallel Printer Port	48-Ch 25 MHz synchronous 12-Ch 100 MHz asynchronous	☎ <b>\$5,525</b>
<b>1230C64</b>	HW state/timing analysis or 8- or 16-bit processor support	1 1230 Mainframe & (1) P6444 Probe 3 1230E1 & (3) P6444 Probes 1 Parallel Printer Port	64-Ch 25 MHz synchronous 16-Ch 100 MHz asynchronous	<b>\$6,725</b>
<b>Battery Operated Configurations</b>				
<b>1230B</b>	HW state/timing analysis	1 1230B Mainframe & (1) P6444 Probe	16-Ch 25 MHz synchronous 4-Ch 100 MHz asynchronous	<b>\$4,995</b>
<b>1230B32</b>	HW state/timing analysis or 8-bit processor support	1 1230B Mainframe & (1) P6444 Probe 1 1230E1 & (1) P6444 Probe 1 Parallel Printer Port	32-Ch 25 MHz synchronous 8-Ch 100 MHz asynchronous	<b>\$6,325</b>
<b>1230B48</b>	HW state/timing analysis or 8- or 16-bit processor support	1 1230B Mainframe & (1) P6444 Probe 2 1230E1 & (2) P6444 Probes 1 Parallel Printer Port	48-Ch 25 MHz synchronous 12-Ch 100 MHz asynchronous	<b>\$7,525</b>
<b>1230B64</b>	HW state/timing analysis or 8- or 16-bit processor support	1 1230B Mainframe & (1) P6444 Probe 3 1230E1 & (3) P6444 Probes 1 Parallel Printer Port	64-Ch 25 MHz synchronous 16-Ch 100 MHz asynchronous	<b>\$8,725</b>
<b>Configurations Including a Digitizing Oscilloscope Module</b>				
<b>1230D</b>	HW state/timing analysis or system integration	1 1230 Mainframe & (1) P6444 Probe 1 1230DSM & (2) P6109 Probes	16-Ch 25 MHz synchronous 4-Ch 100 MHz asynchronous 2-Ch 100MS/s Digitizing Scope Module	<b>\$5,990</b>
<b>1230D32</b>	HW state/timing analysis, system integration, or 8-bit processor support	1 1230 Mainframe & (1) P6444 Probe 1 1230E1 & (1) P6444 Probe 1 1230DSM & (2) P6109 Probes 1 Parallel Printer Port	32-Ch 25 MHz synchronous 8-Ch 100 MHz asynchronous 2-Ch 100MS/s Digitizing Scope Module	<b>\$6,990</b>
<b>1230D48</b>	HW state/timing analysis, system integration, or 8-bit or 16-bit processor support	1 1230 Mainframe & (1) P6444 Probe 2 1230E1 & (2) P6444 Probes 1 1230DSM & (2) P6109 Probes 1 Parallel Printer Port	48-Ch 25 MHz synchronous 12-Ch 100 MHz asynchronous 2-Ch 100MS/s Digitizing Scope Module	<b>\$8,190</b>

Options A1-A5, International Power Plugs, are available as no charge options for each preconfigured system. Please refer to page 374.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.

## ORDERING INFORMATION

### ADDITIONAL OPTIONS FOR 1230 SERIES SYSTEMS

<b>Opt. 01</b> – RS-232 interface and S43R101 PC S/W	<b>+\$495</b>
<b>Opt. 02</b> – Parallel printer port	<b>+\$195</b>
<b>Opt. 03</b> – GPIB interface	<b>+\$695</b>
<b>Opt. 04</b> – International notes (English, German, French, French Canadian, Dutch, Spanish, and Italian)	<b>+\$150</b>
<b>Opt. 05</b> – Rackmount (1230 and 1230D only)	<b>+\$495</b>
<b>Opt. 06</b> – Accessory bag	<b>+\$65</b>
<b>Opt. 07</b> – GPIB acquisition leadset	<b>+\$195</b>
<b>Opt. 09</b> – International notes II (English, Danish, Finnish, Norwegian, and Swedish)*	<b>+\$150</b>
<b>Opt. 21</b> – Service manual	<b>+\$200</b>
<b>Opt. 22</b> – Service maintenance kit	<b>+\$1,500</b>
<b>Opt. 23</b> – Substitute VHS-PAL video tape	<b>NC</b>

### 1230 SERIES ACQUISITION MODULES

<b>1230E1</b> 16 Channel Expansion Card. Includes: (1) P6444 probe, leadsets and grabbers	<b>\$1,200</b>
<b>1230DSM</b> 100 MS/s Digitizing Oscilloscope Card. Includes: (2) P6109 probes and operator's manual	<b>\$2,995</b>

### RELATED PRODUCTS

<b>P6443</b> 16-channel TTL/CMOS probe	<b>\$500</b>
<b>P6444</b> 16-channel programmable threshold probe	<b>\$700</b>
<b>S43R101</b> 1230/PC RS232 application software	<b>\$95</b>
<b>K217</b> Instrument cart	<b>\$625</b>
<b>Opt. 01</b> – Brown finish (matches 1230)	<b>NC</b>
<b>Securing strap</b> – Order 346-0070-03	<b>\$55</b>

<b>LABASIC</b> Concepts of Logic Analysis Workbook	<b>\$15</b>
<b>LAGUIDE</b> Concepts Instructor's Guide	<b>\$10</b>

### WARRANTY

All 1230 Series products are covered by a one-year warranty. This can be extended to 3 or 5 years with Warranty-Plus options. Consult your local Sales Engineer for details.

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

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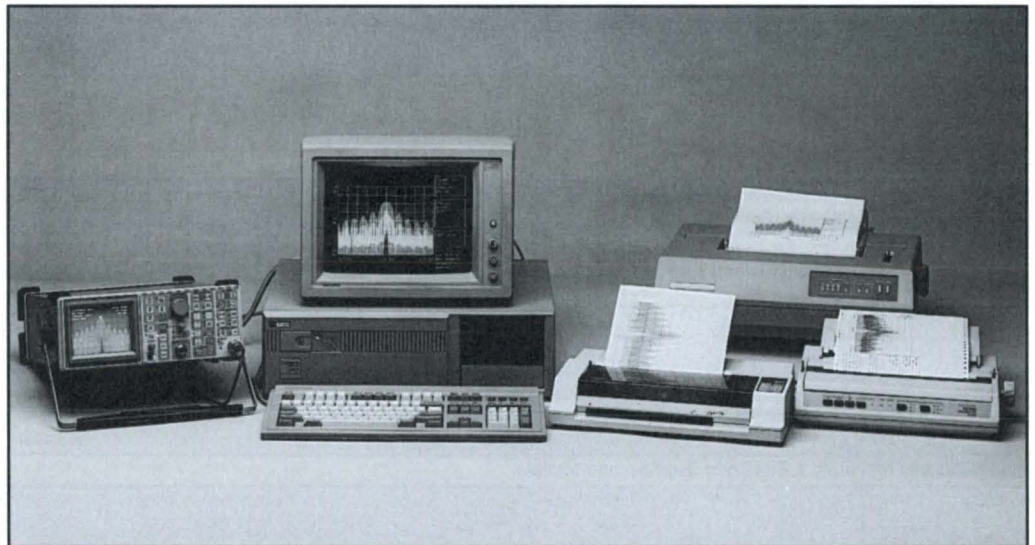
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### TEKTRONIX SPECTRUM ANALYZERS

	2710	2712	492PGM/ 2754P	495P/ 2753P	497P	492BP/ 2755AP	494AP/ 2756P	2782
<b>Coaxial Frequency Range</b>	10 kHz - 1.8 GHz	9 kHz - 1.8 GHz	10 kHz - 21 GHz	100 Hz - 1.8 GHz	100 Hz - 7.1 GHz	10 kHz - 21 GHz	10 kHz - 21 GHz	100 Hz - 33 GHz
<b>Resolution Bandwidth Range</b>	3 kHz - 5 MHz	300 Hz - 5 MHz	1 kHz - 3 MHz	10 Hz - 3 MHz	10 Hz - 3 MHz	100 Hz - 3 MHz	10 Hz - 3 MHz	3 Hz - 10 MHz
<b>Basic Signal Sensitivity</b>	-117 dBm	-129 dBm	-110 dBm	-131 dBm	-130 dBm	-120 dBm	-134 dBm	-135 dBm
<b>Sideband Noise for 1 GHz</b>	-100 dBc/Hz @ 90 kHz Offset	-100 dBc/Hz @ 9 kHz Offset	-103 dBc/Hz @ 30 kHz Offset	-105 dBc/Hz @ 30 kHz Offset	-105 dBc/Hz @ 30 kHz Offset	-105 dBc/Hz @ 30 kHz Offset	-105 dBc/Hz @ 30 kHz Offset	-105 dBc/Hz @ 10 kHz Offset
<b>Viewable Dynamic Range</b>	80 dB	80 dB	80 dB	90 dB	90 dB	90 dB	90 dB	100 dB
<b>Frequency Reference Aging Rate</b>	1 x 10 <sup>-5</sup> Per Year	2 x 10 <sup>-6</sup> Per Year	1 x 10 <sup>-5</sup> Per Year	1 x 10 <sup>-7</sup> Per Year	1 x 10 <sup>-7</sup> Per Year Option 02	1 x 10 <sup>-6</sup> Per Year	1 x 10 <sup>-7</sup> Per Year	1 x 10 <sup>-6</sup> Per Year
<b>Residual Spurious Responses</b>	-100 dBm	-100 dBm	-95 dBm	-100 dBm	-100 dBm	-100 dBm	-100 dBm	-100 dBm
<b>Intermod- ulation Distortion @ -27dBm into mixer</b>	-70 dBc	-70 dBc	-70 dBc	-70 dBc	-70 dBc	-70 dBc	-70 dBc	-90 dBc
<b>Price (US Domestic)</b>	\$8,750	\$11,950	\$20,900	\$22,900	\$26,250	\$32,450	\$43,255	\$69,550



Utility software for Tektronix Spectrum Analyzers provides for a variety of display formats including color copies, four-color plots and dot matrix printouts.

## TEKTRONIX SPECTRUM ANALYZERS AND ANCILLARY PRODUCTS—UNSURPASSED PERFORMANCE VALUES

Tektronix spectrum analyzers give you more for your money—for unexcelled performance at every frequency and price range. From 100 Hz to 325 GHz, Tektronix spectrum analyzers are available in portable, benchtop and rackmount configurations and satisfy the diverse needs of research, design, equipment maintenance and production.

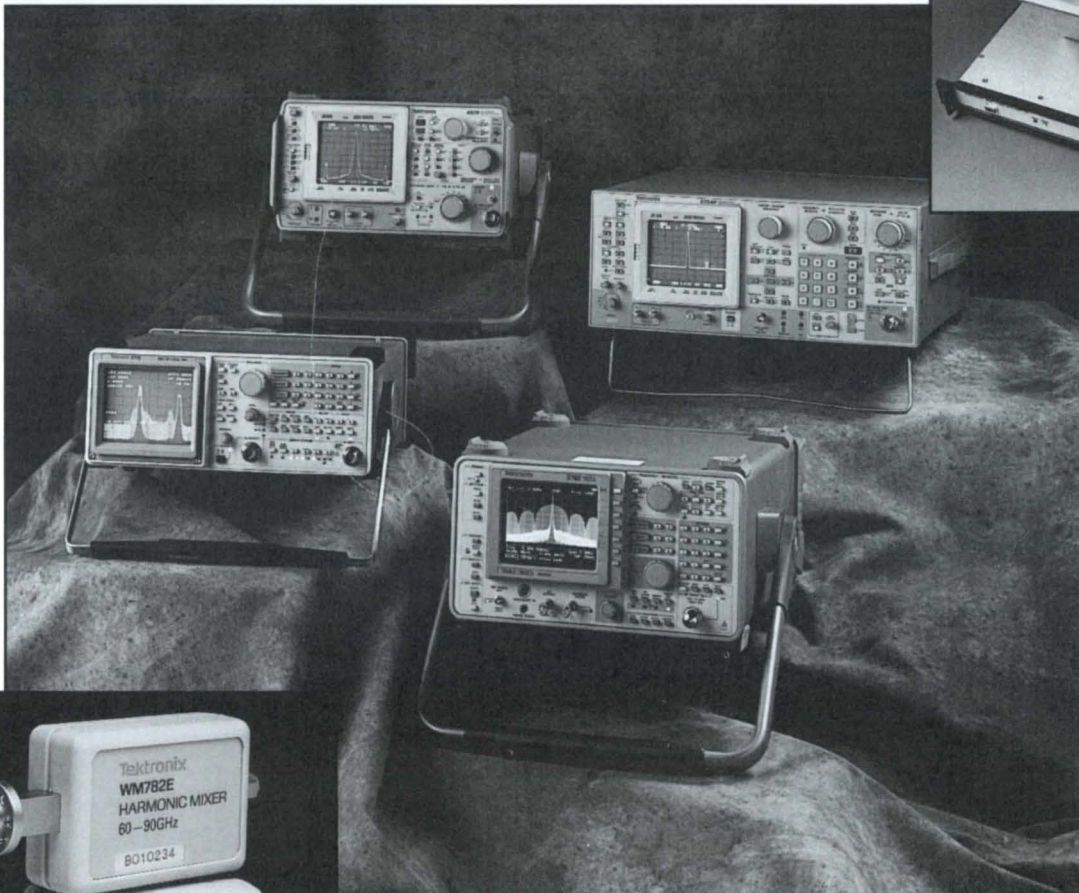
Each analyzer is fully programmable so you can automate complex measurements—on RF and microwave

component or system production testing. And Tektronix offers a full line of support software.

Measurements of CATV and other broadband distribution systems are now improved with the introduction of Tektronix' new 2721/22 Non-Interfering CATV/Broadband System Sweep. The 2722 Receiver is capable of storing and downloading up to 50 waveforms to an external serial printer, or PC. This waveform storage capability allows a new level of maintenance documentation for CATV and broadband systems.



*Tektronix 2721/22 Non-Interfering System Sweep provides swept frequency response measurements of broadband cable distribution systems.*



*Tektronix offers a wide variety of Spectrum Analyzers for any measurement need. Top L to R: 497P Quasi-Microwave Spectrum Analyzer and 2754P Lab Performance Benchtop Spectrum Analyzer. Bottom L to R: 2712 Low-Cost Portable Spectrum Analyzer and 2782 High Performance Microwave Spectrum Analyzer.*



*Calibrated Waveguide Mixers extend the frequency range of Tektronix Microwave Spectrum Analyzers to 325 GHz.*

## FEATURES/BENEFITS

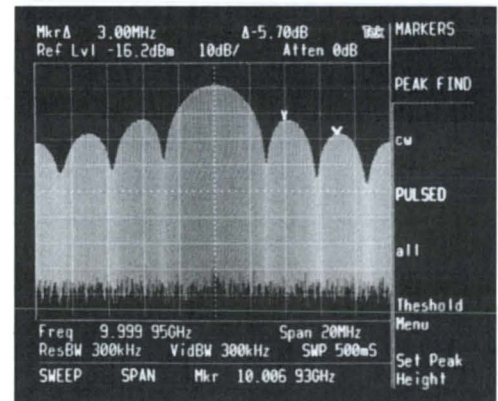
- 100 Hz to 33 GHz Coaxial Frequency Range and Wide Bandwidth Preselection for More Measurement Productivity
- External Waveguide Mixer Support to 325 GHz with Frequency Calibration to 1.2 THz
- Full-range Sweep from 0 Hz to 33 GHz
- Resolution Bandwidths from 3 Hz to 10 MHz in a 1, 3, 10 Sequence
- 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

## STANDARD IN SPECTRUM ANALYZER PERFORMANCE

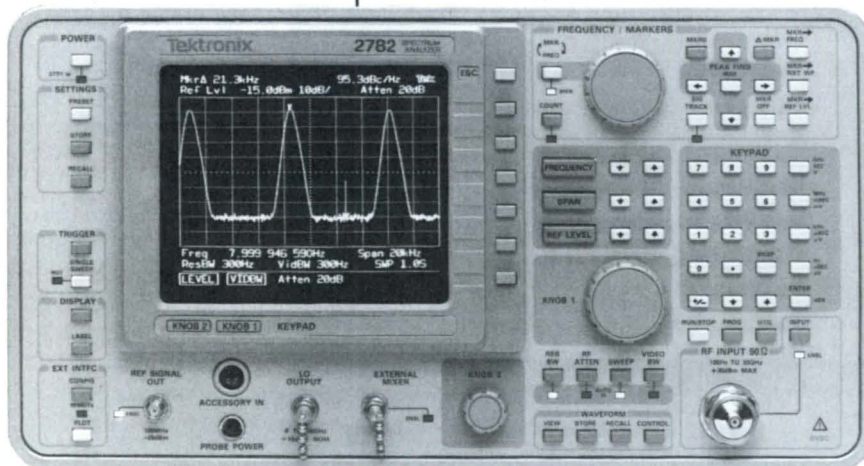
The Tektronix 2782 offers you leadership measurement performance, not just through minor enhancements, but by truly extending the state of the art. For example, the 33 GHz coaxial input gives you more frequency range without resorting to external mixers. And you can see it all with the full-range 0 Hz 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 WM782 Waveguide Mixers and you are set; you do not even have to peak these mixers.



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.



## 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

## 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. N = L.O. harmonic.

**Counter (S/N ≥ 20 dB) –**

Range: 100 Hz to 1.2 THz

Resolution: Selectable from 1 Hz to 1 GHz

Accuracy:  $\pm [F(RE + 10^{-10})] + 8N \text{ Hz} + 1 \text{ LSD}$

$\Delta \text{Count: } \pm [\Delta F(RE + 10^{-10})] + 16N \text{ Hz} + 2 \text{ LSD}$

where: F = counter frequency; RE = reference error; N = L.O. harmonic; LSD = least significant digit.

**Frequency Reference Accuracy –**

Aging:  $1 \times 10^{-6}$ /year,  $< 7 \times 10^{-9}$ /day

Temp. Drift:  $< \pm 5 \times 10^{-7}$  from  $-10^\circ\text{C}$  to  $+55^\circ\text{C}$  with respect to  $25^\circ\text{C}$

**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%
1 kHz to 2 MHz	±1%
< 1 kHz	±7%



**Resolution Bandwidth (6 dB)** – 3 Hz to 10 MHz in 1, 3, 10 sequence.

Accuracy:

10 MHz, 3 MHz	± 20%
1 MHz to 100 Hz	± 15%
30 Hz, 10 Hz	± 20%
3 Hz	+50%, -10%

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			
	100 Hz to 6.5 GHz	6.5 GHz to 12 GHz	12 GHz to 21 GHz	21 GHz to 33 GHz
Frequency Offset				
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 10 MHz	-105 dBm
10 MHz to 2.5 GHz	-135 dBm
2.5 GHz to 6.5 GHz	-132 dBm
6.5 GHz to 21.25 GHz	-125 dBm
21.25 GHz to 28 GHz	-120 dBm
28 GHz to 33 GHz	-107 dBm

**Using WM782 Waveguide Mixer Series (typical) – (1 kHz RBW)**

Band	Frequency	Sensitivity
Q	33 GHz to 50 GHz	-114 dBm
U	40 GHz to 60 GHz	-114 dBm
V	50 GHz to 75 GHz	-112 dBm
E	60 GHz to 90 GHz	-102 dBm
W	75 GHz to 110 GHz	-102 dBm
F	90 GHz to 140 GHz	-97 dBm
D	110 GHz to 170 GHz	-92 dBm
G	140 GHz to 220 GHz	-82 dBm
J	220 GHz to 325 GHz	-77 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 <sup>-18</sup> W/div to 1 kW/div

Reference Level:

Range	-140 dBm to +30 dBm
Resolution	0.1 dB

*Measurements 0.2 dB/1 dB incremental. ±1.5 dB cumulative over 90 dB range. +2 dB, -3.5 over 100 dB range cumulative over 90 dB range.*

**Frequency Response** – (for ≥ 10 dB RF attenuation and 20°C - 30°C temperature range)

100 Hz – 6.5 GHz:	±1.0 dB
6.30 – 12.775 GHz:	±4.0 dB
12.40 – 21.25 GHz:	±4.0 dB
21.05 – 28.025 GHz:	±4.0 dB
26.30 – 33.00 GHz:	±4.5 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: ±1.0 dB over the range 0 to 50 dB and ±1.5 dB over the range of 100 dB.

**Band Switching Uncertainty** – ±1.5 dB referred to 100 MHz reference signal

**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<sup>-9</sup>/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** –  $< -80$  dBc +20 Log N except as noted below:

Residual Signals	$< -77$ dBm, 100 Hz to 10 MHz
	$< -100$ dBm, 10 MHz to 6.5 GHz
	$< -92$ dBm, 6.5 GHz to 21 GHz
	$< -82$ dBm, 21 GHz to 28 GHz
	$< -80$ dBm, 28 GHz to 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.  
 $> +15$  dBm, 28 GHz to 33 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	$< -90$ dBc

## 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:  $\pm 0.4\%$ .

**Nonvolatile Memory** – CMOS battery backed-up RAM, memory retention guaranteed to  $-10^\circ\text{C}$ .  
Battery Type: Lithium cells.

Battery Life: 1.8 years @  $20^\circ\text{C}$ , 1 year @  $50^\circ\text{C}$  (batteries are not used while the instrument is connected to a power source).

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 $\mu\text{s}$ in 1, 2, 5 sequence
Accuracy	5%, 50 $\mu\text{s}$ and slower; 10%, 20 $\mu\text{s}$ 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; 0.5 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  $\Omega$ .

### VSWR –

RF Atten	Center Frequency Ranges		
	100 Hz to 6.5 GHz	6.5 GHz to 28 GHz	28 GHz to 33 GHz
10 dB-70 dB	$< 2:1$	$< 2.5:1$	$< 3.0:1$

### Maximum Safe Input Power –

AC Average Power:  $+30$  dBm with  $\geq 10$  dB attenuation.  
Pulse Power: 50 W peak, 1  $\mu\text{s}$  and 0.005 duty factor with  $\geq 50$  dB attenuation.  
DC: 0 volts.

**Local Oscillator Emission** – (at 0-dB RF attenuation)  $\leq -75$  dBm: 100 Hz to 6.5 GHz.  $\leq -65$  dBm: 6.5 GHz to 33 GHz.

**External Mixer Input** – (duplexer built-in)

Impedance: 50  $\Omega$ ; VSWR  $< 1.9:1$  at 525 MHz and  $< 2.2:1$  at 3.525 GHz.

LO Output Power:

$\geq 15$  dBm at 8.1 to 17.9 GHz

**LO Output** – Provides access to output of 1st LO at  $+4$  dBm minimum.

**Probe Power** – Provides operating voltage for active probes; output voltages are:

pin 1:  $+5$  V  $\pm 5\%$  @ 100 mA max

pin 2: ground

pin 3:  $-15$  V  $\pm 5\%$  @ 100 mA max

pin 4:  $+15$  V  $\pm 5\%$  @ 100 mA max

### Reference Signal Out –

Amplitude:  $-20$  dBm.

Amplitude Accuracy:  $\pm 0.3$  dB.

Frequency: 100 MHz (derived from reference oscillator).

### Ref In/Out –

Impedance: 50  $\Omega$  nominal.

Input Frequency: 10 MHz  $\pm 5$  Hz.

Input Signal Amplitude Range: 0 dBm minimum to  $+15$  dBm maximum.

Output Signal (when selected): Nominally 0 dBm at 10 MHz.

Allowable Phase Noise:  $\leq 100$  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.

**IF Output** –

Frequency: 25 MHz (3 MHz and 10 MHz Resolution Bandwidth)

Frequency: 4 MHz (1 MHz or less resolution bandwidth)  
Amplitude: +9 dBm nominal (-30 dBm reference level, 0 dB attenuation, -20 dBm RF input), 100 MHz CF 11 CH Res. BW

Impedance: Nominal 50 Ohms

VSWR: ≤1.5:1

**EXTERNAL INTERFACE PORTS**

**GPIB**  – Two GPIB ports (IEEE Std. 488-1978) are standard. Interface Functions: Port 1: SH1, AH1, T5, L3, SR1, RLO, PPO, DC1, DT1, C0.

Port 2: SH1, AH1, T5, L3, SR0, RLO, PPO, DC0, DT0, C1, C2, C3, C27, (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.

**CONFIGURATION**

**Weight** – 44 lbs. (20 kg).

**Dimensions** – 8.05 x 12.90 x 18.59 inches. 204.47 x 327.66 x 472.19 mm with front cover, feet, and handle folded back.

**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 Standard C22.2 No. 231; ISO/ANSI S82, Safety Requirements for Electronic Measuring and Controlling Instrumentation; IEC 348, 2nd Edition, Safety Requirements for Electronic Measuring Apparatus; FM–Electrical Utilization Standard Class 3810. UL 1244, 2nd Edition.



**ORDERING INFORMATION**

**2782** Microwave Spectrum Analyzer **\$69,550**  
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** – Service Manual prepared to the module-level. **+\$250**  
**Opt. B2** – Complete set of manuals, including, module-level Service Manual **+\$350**  
**Opt. 20** – Utility Software for PC, PC2A interface, GPIB cable. **+\$1,530**  
**Opt. 27** – Epson LT-386SX laptop PC, utility software, PC2A card, GPIB cable. **“1**  
**Opt. 28** – Compaq 386S Model 40 PC, utility software, PC2A card, GPIB cable. **“1**  
**Opt. 30** – Cradle mount for 19-inch rackmounting. **+\$750**

**WARRANTY INFORMATION**

The standard one-year Tektronix warranty can be extended with the *Warranty-Plus* Service Plans listed below. For more information, 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. M7** – +2 calibrations **+\$1,835**  
**Opt. M8** – +4 calibrations **+\$3,670**  
**Opt. M9** – Remedial service years 1-3 of ownership **+\$1,440**

**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 070-8244-00. **“1**  
**Cable** – for using WM782 Series Waveguide mixers with 2782. Order 012-1346-00 **\$95**  
**Service Kit** – Contact your local field office  
**SA-42** – Optical to Electrical Converter **\$3,845**  
**Rack Mount Adapter** – Order 016-1019-00 **\$825**

**“1** Contact your local sales office

# WM782 WAVEGUIDE MIXERS

## 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	\$1,870
33-50 GHz – Order WM782Q	\$2,175
40-60 GHz – Order WM782U	\$2,580
50-75 GHz – Order WM782V	\$2,930
60-90 GHz – Order WM782E	\$3,180
75-110 GHz – Order WM782W	\$3,260
90-140 GHz – Order WM782F	\$3,495
110-170 GHz – Order WM782D	\$4,870
140-220 GHz – Order WM782G	\$4,990
220-325 GHz – Order WM782J	\$11,230

26 to 60 GHz Set – Includes WM782A and WM780U. Order WM7826	\$4,450
26 to 90 GHz Set – Includes WM7826 plus WM782E. Order WM7827	\$7,630
26 to 140 GHz Set – Includes WM7827 plus WM782F. Order WM7828	\$11,125
26 to 220 GHz Set – Includes WM7828 plus WM782G. Order WM7829	\$16,110
33 to 75 GHz Set – Includes WM782Q and WM782V. Order WM78210	\$5,100
33 to 110 GHz Set – Includes WM78210 plus WM782W. Order WM78211	\$8,360
33 to 170 GHz Set – Includes WM78211 plus WM782D. Order WM78212	\$13,230

\*1 Contact your local sales office.

## WM782 SERIES

### WAVEGUIDE MIXERS

The Tektronix WM782 Series of Waveguide Mixers are a high-performance, broadband, zero dc bias, anti-parallel dual-diode type mixers for use with the Tektronix 2782 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 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 * <sup>1</sup> (dBm)	Freq. Response * <sup>2</sup> (dB)	Conv. Loss (dB)	1 dB Compression	Low-Pass Cut-Off Freq. * <sup>4</sup>
WM782A	A	26 to 40	-115	—	20	0 dBm	16 GHz
WM782Q	Q	33 to 50	-115	±3	20	0 dBm	20 GHz
WM782U	U	40 to 60	-115	±3	20	0 dBm	20 GHz
WM782V	V	50 to 75	-110	±3	25	0 dBm	28 GHz
WM782E	E	60 to 90	-105	±3 <sup>3</sup>	35	0 dBm	28 GHz
WM782W	W	75 to 110	-105	±3 <sup>3</sup>	35	0 dBm	28 GHz
WM782F	F	90 to 140	-95	±3 <sup>3</sup>	40	0 dBm	32 GHz
WM782D	D	110 to 170	-90	±3 <sup>3</sup>	45	0 dBm	40 GHz
WM782G	G	140 to 220	-85	±3 <sup>3</sup>	60	0 dBm	40 GHz
WM782J	J	220 to 325	-75	±3 <sup>3</sup>	70	0 dBm	40 GHz

\*<sup>1</sup> Equivalent average noise level using a 2782 Spectrum Analyzer in 1 kHz resolution bandwidth.

\*<sup>2</sup> Maximum amplitude variation across each waveguide mixer band using a 2782 Spectrum Analyzer.

\*<sup>3</sup> Over any 5 GHz bandwidth for millimeter wave mixers above 60 GHz.

\*<sup>4</sup> 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 * <sup>1</sup> 90 to 140 GHz	WR-08	UG-387/U-M	8.89x2.54x4.32 3.50x1.00x1.70	113.4 4.0
WM782D * <sup>1</sup> 110 to 170 GHz	WR-06	UG-387/U-M	8.89x2.54x4.32 3.50x1.00x1.70	113.4 4.0
WM782G * <sup>1</sup> 140 to 220 GHz	WR-05	UG-387/U-M	8.89x2.54x4.32 3.50x1.00x1.70	113.4 4.0
WM782J 220 to 325 GHz	WR-03			

\*<sup>1</sup> 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

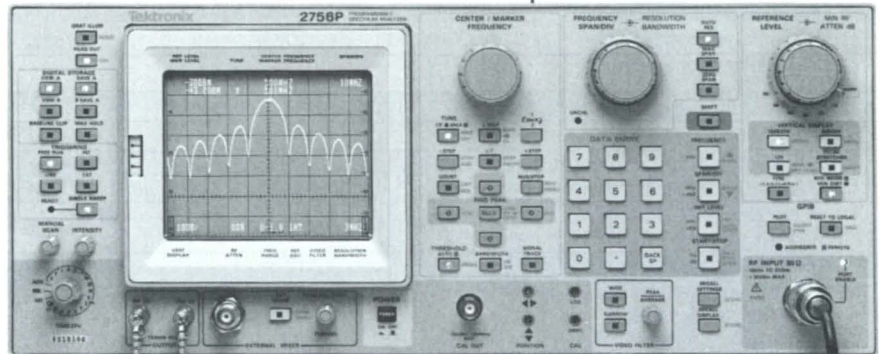
button. The *CW* Mode locates signals that exhibit CW characteristics and ignores all other signals. The *SPUR* Mode marks all signals that meet user-defined or automatic threshold criteria. User-definable threshold criteria are available for all signal processing modes.

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 individually 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 stand-alone 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" Setability 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% ( $1 \times 10^{-9}$ /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

**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**

	<b>2756P</b>	<b>2755AP</b>	<b>2754P</b>	<b>2753P</b>
<b>FREQUENCY-RELATED</b>				
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 <sup>-7</sup> per year (aging)	≤ 1x10 <sup>-6</sup> per year (aging)	≤ 1x10 <sup>-5</sup> per year (aging)	≤ 1x10 <sup>-7</sup> 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
<b>AMPLITUDE-RELATED</b>				
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
<b>AMPLITUDE-RELATED (cont.)</b>				
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 -27dBm)	-70 dBc (mixer level -27dBm)	-70 dBc (mixer level -27dBm)	-70 dBc (mixer level -27dBm)
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/A
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)	-80 dBm (typical)	-30 dBm (typical)	N/A	-100 dBm (typical)
Band 1 (1 kHz to 10 kHz)	-90 dBm (typical)	-85 dBm (typical)	-35 dBm (typical)	-105 dBm
Band 1 (10 kHz to 100 kHz)	-95 dBm	-85 dBm	-80 dBm	-110 dBm
Band 1 (100 kHz to 1 MHz)	-115 dBm	-105 dBm	-100 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
<b>TIME-RELATED</b>				
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 $\mu$ sec/div to 10 sec/div	20 $\mu$ sec/div to 10 sec/div	20 $\mu$ sec/div to 10 sec/div	20 $\mu$ sec/div to 10 sec/div
Sweep Time Accuracy	$\pm 5\%$	$\pm 5\%$	$\pm 5\%$	$\pm 5\%$
Marker Time Measurement Accuracy	$\pm 10\%$	$\pm 10\%$	$\pm 10\%$	$\pm 10\%$
Delta Marker Time Measurement Accuracy	$\pm 5\%$	$\pm 5\%$	$\pm 5\%$	$\pm 5\%$
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
<b>EXTERNAL INPUT</b>				
RF Input Impedance	50 $\Omega$ nominal	50 $\Omega$ nominal	50 $\Omega$ nominal	50 $\Omega$ nominal
VSWR (10 dB input attenuation)				
< 2.5 GHz	1.3:1 max	1.3:1 max	1.3:1 max	1.3:1 max
2.5 GHz to 6.0 GHz	1.7:1 max	1.7:1 max	1.7:1 max	N/A
6.0 GHz to 18 GHz	2.3:1 max	2.3:1 max	2.3:1 max	N/A
18 GHz to 21 GHz	3.5:1 max	3.5:1 max	3.5:1 max	N/A
Local Oscillator Emission Level (10 dB input attenuation)	$\leq -80$ dBm	$\leq -80$ dBm	$\leq -80$ dBm	$\leq -80$ 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
<b>EXTERNAL OUTPUT</b>				
Calibrator	100 MHz $\pm 10$ Hz, -20 dBm $\pm 0.3$ dB	100 MHz $\pm 100$ Hz, -20 dBm $\pm 0.3$ dB	100 MHz $\pm 1$ kHz, -20 dBm $\pm 0.3$ dB	100 MHz $\pm 10$ Hz, -20 dBm $\pm 0.3$ 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; $\pm 2.5$ V max	0.5 V/div; $\pm 2.5$ V max	0.5 V/div; $\pm 2.5$ V max	0.5 V/div; $\pm 2.5$ 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
<b>GENERAL SPECIFICATIONS</b>				
Power Requirements				
Voltage	90-132/180-250 Vac	90-132/180-250 Vac	90-132/180-250 Vac	90-132/180-250 Vac
Frequency	48-440 Hz	48-440 Hz	48-440 Hz	48-440 Hz
Power	210 W max @ 115 Vac, 60 Hz	210 W max @ 115 Vac, 60 Hz	210 W max @ 115 Vac, 60 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 x 609.6mm 7 x 17 x 24 in.	177.8 x 431.8 x 609.6mm 7 x 17 x 24 in.	177.8 x 431.8 x 609.6mm 7 x 17 x 24 in.	177.8 x 431.8 x 609.6mm 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 $\mu$ s	9 $\mu$ s	9 $\mu$ s	9 $\mu$ s
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
<b>ENVIRONMENTAL (PER MIL-T-28800C, TYPE III, CLASS 5, STYLE E)</b>				
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
<b>IEEE STD. 488 (GPIB)</b>				
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 **\$43,255**

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); 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 **\$32,450**

Includes: same as 2756P.

**2754P** Programmable Spectrum Analyzer **\$20,900**

Includes: same as 2756P.

**2753P** Programmable Spectrum Analyzer **\$22,900**

Includes: same as 2756P.

#### OPTIONS

**Opt. 07** - 75  $\Omega$  dBmV input and calibration in addition to the normal 50  $\Omega$  dBm input and calibration. (Not combinable with Options 21 and 22; no external mixer capability) **+\$750**

Includes: 42-inch, 75  $\Omega$  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), PC2A interface GPIB cable. **\$1,530**

The PC2A is a National Instruments GPIB interface card.

**Opt. 27** - Epson LT-386SX (with 80386SX processor, VGA LCD display, 2 Mb RAM, 40 Mb removable hard drive, 1.44 Mb 3.5" diskette drive, serial/parallel interface, battery pack and charger, DOS), GRASP software, PC2A interface and GPIB cable.

**NOTE:** For more information on any of these bundled software and computer packages, please contact your local Tek sales representative.

**Opt. 28** - COMPAQ Deskpro 386S, Model 40 (with 80386SX processor, VGA color monitor, 2 MB RAM 40 MB hard drive, 1.2 MB floppy drive, serial/parallel interface, DOS), GRASP software, PC2A interface, and GPIB cable. **\*\***

**Opt. 30** - Rackmount 19" rack width **+\$250**

**Opt. 31** - Rackmount 19" rack width with rear panel input/output capability **+\$450\*\***

**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  $\geq$  4.5 MHz. (2755AP) **+\$1,500\*\***

**Opt. 45 (except 2754P)** - MATE/CIL 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 374.

#### OPTIONAL ACCESSORIES

**1405** - TV Sideband Analyzer Adapter (525/60 markers) **\$5,980**

**TR503** - Tracking Generator, 100 Hz to 1800 MHz **\$7,080**

**Microwave Comb Generator** - TM500-Series compatible. Order 067-0885-00 **\$2,265**

**2750 Series** - Rack Adapter Parts Kit. Contact Tektronix Sales Representative.

**Tek HC100** - Color Plotter **\$950**

**CRT Visor** - Order 016-0653-00 **\$60**

**75  $\Omega$  to 50  $\Omega$  minimum loss adapter** - Order 011-0112-00 **\$70**

**DC blocking capacitor** - N connector Order 015-0509-00 **\$345**

**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 **\*\***

#### SERVICE MANUALS

2753P	Volume 1	070-6306-00	<b>\$80</b>
	Volume 2	070-6307-00	<b>\$150</b>
2754P	Volume 1	070-6097-00	<b>\$80</b>
	Volume 2	070-6098-00	<b>\$150</b>
2755AP	Volume 1	070-6032-01	<b>\$80</b>
	Volume 2	070-6033-01	<b>\$150</b>
2756P	Volume 1	070-6318-00	<b>\$80</b>
	Volume 2	070-6319-00	<b>\$150</b>

#### WARRANTY-PLUS SERVICE OPTIONS

For more information see page 378.

<b>Opt. M1</b> - 2 years service and 2 calibrations	<b>+\$2540</b>
2756P	<b>+\$2,346</b>
2755AP	<b>+\$2,366</b>
2754P	<b>+\$1,984</b>
2753P	<b>+\$3,769</b>
<b>Opt. M2</b> - 4 years service	<b>+\$3,510</b>
2756P	<b>+\$3,654</b>
2755AP	<b>+\$3,016</b>
2754P	<b>+\$5,081</b>
2753P	<b>+\$4,693</b>
<b>Opt. M3</b> - 4 years service and 4 calibrations	<b>+\$4,733</b>
2756P	<b>+\$3,969</b>
2755AP	<b>+\$656</b>
2754P	<b>+\$592</b>
2753P	<b>+\$585</b>
<b>Opt. M7</b> - 2 calibrations	<b>+\$476</b>
2756P	<b>+\$1,312</b>
2755AP	<b>+\$1,183</b>
2754P	<b>+\$1,170</b>
2753P	<b>+\$952</b>
<b>Opt. M8</b> - 4 calibrations	<b>+\$1,884</b>
2756P	<b>+\$1,755</b>
2755AP	<b>+\$1,782</b>
2754P	<b>+\$1,782</b>
2753P	<b>+\$1,508</b>

\*\* Contact your local sales office.

## 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 0.000001% ( $1 \times 10^{-9}$ /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

## 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

handles it all with a single keystroke, with automatic noise normalization to 1Hz and automatic conversion for reference units such as dBm, dBmV, dBV, dB $\mu$ V, 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.

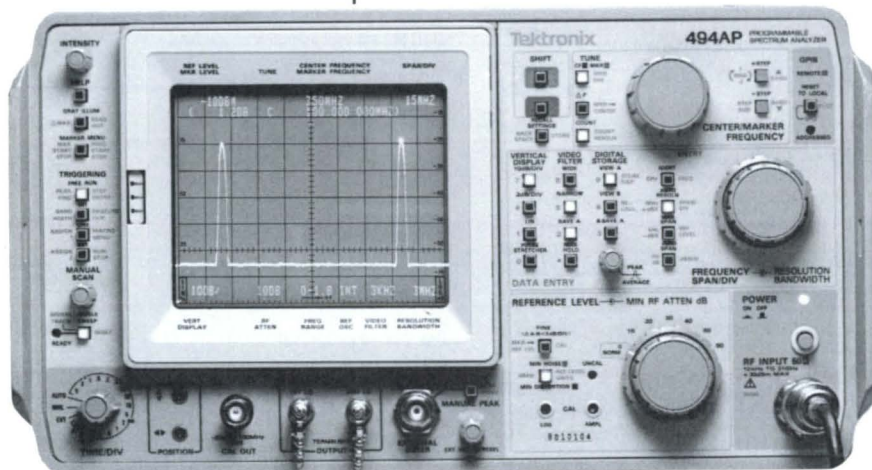
These instruments also offer operator convenience for measuring the bandwidth of filters, amplifiers, and other networks. Just enter the desired bandwidth point and select *BANDWIDTH* Mode, and the markers automatically update to display the new value.

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.



- 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

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

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 stand-alone 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	492PGM	497P	495P
<b>FREQUENCY-RELATED</b>					
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 ΔF	±14 Hz for 1 MHz ΔF	N/A	±14 Hz for 1 MHz ΔF	±13 Hz for 1 MHz ΔF
Frequency Reference Accuracy	≤ 1x10 <sup>-7</sup> /yr (aging)	≤ 1x10 <sup>-6</sup> /yr (aging)	≤ 1x10 <sup>-6</sup> /yr (aging)	≤ 1x10 <sup>-6</sup> /yr (aging)	≤ 1x10 <sup>-7</sup> /yr (aging)
Frequency Stability (residual FM)	≤ 5 Hz @ 1 GHz	≤ 12 Hz @ 1 GHz	≤ 12 Hz @ 1 GHz	≤ 5 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	10 Hz to 3 MHz	10 Hz to 3 MHz
Resolution Bandwidth Selectivity (-60 dB/-6 dB)	≤ 7.5:1 except 15:1 @ 10 Hz	≤ 7.5:1	≤ 7.5:1	≤ 7.5:1 except 15:1 @ 10 Hz	≤ 7.5:1 except 15:1 @ 10 Hz
Video Bandwidth Range	0.3 Hz to 30 kHz	0.3 Hz to 30 kHz	3 Hz to 30 kHz	0.3 Hz to 30 kHz	0.3 Hz to 30 kHz
<b>AMPLITUDE-RELATED</b>					
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	492PGM	497P	495P
<b>AMPLITUDE-RELATED (cont.)</b>					
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)	±2.5 dB	±2.5 dB	±3.0 dB	±2.5 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	±3.5 dB	N/A
Band 3 (3.0 GHz to 7.1 GHz)	±3.5 dB	±3.5 dB	±4.0 dB	±3.5 dB	N/A
Band 4 (5.4 GHz to 18 GHz)	±4.5 dB	±4.5 dB	±5.0 dB	N/A	N/A
Band 5 (15 GHz to 21 GHz)	±6.5 dB	±6.5 dB	±7.0 dB	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)	±2.5 dB	±2.5 dB	±3.0 dB	±2.5 dB	N/A
Band 3 (3.0 GHz to 7.1 GHz)	±2.5 dB	±2.5 dB	±3.0 dB	±2.5 dB (5.4 GHz to 7.1 GHz)	N/A
Band 4 (5.4 GHz to 18 GHz)	±3.5 dB	±3.5 dB	±4.0 dB	N/A	N/A
Band 5 (15 GHz to 21 GHz)	±5.0 dB	±5.0 dB	±6.0 dB	N/A	N/A
Displayed Average Noise Level (input terminated, narrowest resolution bandwidth and video filter)					
Band 1 (100 Hz)	-80 dBm (typical)	-30 dBm (typical)	N/A	-80 dBm (typical)	-100 dBm (typical)
Band 1 (1 kHz to 10 kHz)	-90 dBm (typical)	-85 dBm (typical)	-35 dBm (typical)	-90 dBm	-105 dBm
Band 1 (10 kHz to 100 kHz)	-95 dBm	-85 dBm	-80 dBm	-100 dBm	-110 dBm
Band 1 (100 kHz to 1 MHz)	-115 dBm	-105 dBm	-100 dBm	-120 dBm	-120 dBm
Band 1 (1 MHz to 1.8 GHz)	-134 dBm	-120 dBm	-110 dBm	-130 dBm	-131 dBm
Band 2 (1.7 GHz to 5.5 GHz)	-125 dBm	-120 dBm	-108 dBm	-127 dBm	N/A
Band 3 (3.0 GHz to 7.1 GHz)	-125 dBm	-119 dBm	-108 dBm	-126 dBm	N/A
Band 4 (5.4 to 12 GHz/12 to 18 GHz)	-111 -107 dBm	-105 / -100 dBm	-94 / -89 dBm	N/A	N/A
Band 5 (15 GHz to 21 GHz)	-105 dBm	-99 dBm	-88 dBm	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	±0.5 dB/10 dB; ±1.0 dB max ±1.5 dB/10 dB; ±3.0 dB max	±0.5 dB/10 dB; ±1.0 dB max ±1.5 dB/10 dB; ±3.0 dB max	±0.5 dB/10 dB; ±1.0 dB max ±1.5 dB/10 dB; ±3.0 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)	±0.5 dB/10 dB; ±1.0 dB max N/A
1.8 to 18 GHz					
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	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	492PGM	497P	495P
<b>TIME-RELATED</b>					
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	10 msec/div to 10 sec/div
Sweep Time Range, Real-Time Display	20 $\mu$ sec/div to 10 sec/div	20 $\mu$ sec/div to 10 sec/div	20 $\mu$ sec/div to 10 sec/div	20 $\mu$ sec/div to 10 sec/div	20 $\mu$ sec/div to 10 sec/div
Sweep Time Accuracy	$\pm 5\%$	$\pm 5\%$	$\pm 5\%$	$\pm 5\%$	$\pm 5\%$
Marker Time Measurement Accuracy	$\pm 10\%$	$\pm 10\%$	$\pm 10\%$	$\pm 10\%$	$\pm 10\%$
Delta Marker Time Measurement Accuracy	$\pm 5\%$	$\pm 5\%$	$\pm 5\%$	$\pm 5\%$	$\pm 5\%$
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	1.3:1 max	1.3:1 max	1.3:1 max	1.3:1 max	1.3:1 max
2.5 GHz to 6.0 GHz	1.7:1 max	1.7:1 max	1.7:1 max	1.7:1 max	N/A
6.0 GHz to 18 GHz	2.3:1 max	2.3:1 max	2.3:1 max	N/A	N/A
18 GHz to 21 GHz	3.5:1 max	3.5:1 max	3.5:1 max	N/A	N/A
Local Oscillator Emission Level (10 dB input attenuation)	$\leq -80$ dBm	$\leq -80$ dBm	$\leq -80$ dBm	$\leq -80$ dBm	$\leq -80$ 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 $\pm 10$ Hz, -20 dBm $\pm 0.3$ dB	100 MHz $\pm 100$ Hz, -20 dBm $\pm 0.3$ dB	100 MHz $\pm 1$ kHz, -20 dBm $\pm 0.3$ dB	100 MHz $\pm 100$ Hz, -20 dBm $\pm 0.3$ dB	100 MHz $\pm 10$ Hz, -20 dBm $\pm 0.3$ 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; $\pm 2.5$ V max	0.5 V/div; $\pm 2.5$ V max	0.5 V/div; $\pm 2.5$ V max	0.5 V/div; $\pm 2.5$ V max	0.5 V/div; $\pm 2.5$ 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	90-132/180-250 Vac	90-132/180-250 Vac	90-132/180-250 Vac	90-132/180-250 Vac	90-132/180-250 Vac
Frequency	48-440 Hz	48-440 Hz	48-440 Hz	48-440 Hz	48-440 Hz
Power	210 W max @ 115 Vac, 60 Hz	210 W max @ 115 Vac, 60 Hz	210 W max @ 115 Vac, 60 Hz	210 W max @ 115 Vac, 60 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 $\mu$ s	9 $\mu$ s	9 $\mu$ s	9 $\mu$ s	9 $\mu$ s
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 SPECTRUM ANALYZERS

## 490 SERIES CHARACTERISTICS (cont.)

	494AP	492BP	492PGM	497P	495P
<b>ENVIRONMENTAL (PER MIL-T-28800C, TYPE III, CLASS 3, STYLE C)</b>					
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
<b>IEEE 488 (GPIB)</b>					
Interface Functions	SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, and CO	SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, and CO	SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, and CO	SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, and CO	SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, and CO
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.

**492BP** Programmable Spectrum Analyzer **\$32,450**

Includes: same as 494AP

**492PGM** Programmable Spectrum Analyzer **\$20,900**

Includes: same as 494AP, except gray CRT filter (no filter set)

**497P** Programmable Spectrum Analyzer **\$26,250**

Includes: same as 494AP

**495P** Programmable Spectrum Analyzer **\$22,900**

Includes: same as 494AP

### OPTIONS

**Opt. 02 (497P)** - Precision Frequency Reference. 1 x 10<sup>-9</sup>/yr aging **+\$2,200**

**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:** For more information on any of these bundled software and computer packages, please contact your local Tek sales representative.

**Opt. 27** - Epson LT-386SX (with 80386SX processor, VGA LCD display, 2 Mb RAM, 40 Mb removable hard drive, 1.44 Mb 3.5" diskette drive, serial/parallel interface, battery pack and charger, DOS), GRASP software, PC2A interface, and GPIB cable. **\*1**

**Opt. 28** - Compaq Deskpro 386S, Model 40 (with 80386SX processor, VGA color monitor, 2 Mb RAM, 40 Mb hard drive, 1.2 Mb floppy drive, serial/parallel interface, DOS), GRASP software, PC2A interface, and GPIB cable. **\*1**

**Opt. 39** - Non-lithium (Silver) batteries for battery-backed memory **+\$50**

**Opt. 41 (all except 495P)** - Digital Microwave Radio Measurement Enhancement package **+\$450**

(492PGM) **\*1**

**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**

(492BP) **+\$750**

(497P) **\*1**

**Opt. 45 (all except 492PGM and 497P)** - MATE/CILL 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 374. **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 (015-0112-00); 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).

### SERVICE MANUALS

**492BP** - Volume 1 070-5565-01 **\$80**

Volume 2 070-5566-01 **\$150**

**492PGM** - Volume 1 070-7556-00 **\$100**

Volume 2 070-7557-00 **\$175**

**494AP** - Volume 1 070-5560-00 **\$80**

Volume 2 070-5561-00 **\$150**

**495P** - Volume 1 070-5084-00 **\$70**

Volume 2 070-5085-00 **\$150**

**497P** - Volume 1 070-7679-00 **\$70**

Volume 2 070-7680-00 **\$135**

### WARRANTY-PLUS SERVICE PLANS

For more information see page 378.

**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. 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**

\*1 Contact your local sales office.

## 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  $\pm 2$  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.

### 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 <sup>1</sup> (dBm)	Frequency <sup>2</sup> Response (dB)	Conversion <sup>3</sup> Loss, Typical (dB)	Low-Pass <sup>6</sup> Cutoff Frequency
18-26.5	WM780K	K	-100	$\pm 2$	30	12 GHz
26.5-40	WM780A	A	-95	$\pm 2$	30	16 GHz
33-50	WM780Q	Q	-90	$\pm 2$	35	21 GHz
40-60	WM780U	U	-90	$\pm 2.5$	35	16 GHz
50-75	WM780V	V	-90 @ 50 GHz -85 @ 75 GHz typ	$\pm 3$ <sup>4</sup> typical	35 @ 50 GHz 40 @ 75 GHz	28 GHz
60-90	WM780E	E	-80 @ 60 GHz -80 @ 90 GHz typ	$\pm 3$ <sup>4</sup> typical	35 @ 60 GHz 45 @ 90 GHz	28 GHz
75-110	WM780W	W	-80 @ 75 GHz -70 @ 110 GHz typ	$\pm 3$ <sup>4</sup> typical	45 @ 75 GHz 55 @ 110 GHz	30 GHz
90-140	WM780F	F	-75 @ 90 GHz -65 @ 140 GHz typ	$\pm 3$ <sup>4</sup> typical	50 @ 90 GHz 60 @ 140 GHz	32 GHz
110-170	WM780D	D	-70 @ 110 GHz -60 @ 170 GHz typ	$\pm 3$ <sup>4</sup> typical	50 @ 110 GHz 60 @ 170 GHz	40 GHz
140-220	WM780G	G	-65 @ 140 GHz -55 @ 220 GHz typ	$\pm 3$ <sup>4</sup> typical	55 @ 140 GHz 65 @ 220 GHz	40 GHz
220-325	WM780J	J	-55 @ 220 GHz, <sup>5</sup> -45 @ 325 GHz typ	$\pm 3$ <sup>4</sup> typical	65 @ 220 GHz 75 @ 325 GHz	40 GHz

<sup>1</sup> Equivalent average noise level (using a 2750 Series or 490 Series Spectrum Analyzer in 1 kHz resolution bandwidth).

<sup>2</sup> 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).

<sup>3</sup> LO drive  $\pm 10$  dBm peaking control optimized.

<sup>4</sup> Over any 5 GHz bandwidth for millimeter wave mixers above 60 GHz.

<sup>5</sup> Value estimated at 325 GHz.

<sup>6</sup> These low-pass filters are in LO/IF connector.

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  $\mu$ s 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** - 0 dBm typical.

### ORDERING INFORMATION

WM780 WAVEGUIDE MIXERS & SETS	
18-26.5 GHz - Order WM780K	\$1,655
26.5-40 GHz - Order WM780A	\$1,655
33-50 GHz - Order WM780Q	\$1,915
40-60 GHz - Order WM780U	\$2,280
50-75 GHz - Order WM780V	\$2,580
60-90 GHz - Order WM780E	\$2,805
75-110 GHz - Order WM780W	\$2,880
90-140 GHz - Order WM780F	\$3,080
110-170 GHz - Order WM780D	\$4,300
140-220 GHz - Order WM780G	\$4,400
220-325 GHz - Order WM780J	"
<b>18 to 40 GHz Set</b> - Includes WM780K, WM780A, Order WM7802	\$3,150
<b>18 to 60 GHz Set</b> - Includes WM780K, WM780A, WM780U, Order WM7803	\$5,320
<b>26.5 to 60 GHz Set</b> - Includes WM780A, WM780U, Order WM7806	\$3,860
<b>26.5 to 90 GHz Set</b> - Includes WM780A, WM780U, WM780E, Order WM7807	\$6,610
<b>26.5 to 140 GHz Set</b> - Includes WM780A, WM780U, WM780E, WM780F, Order WM7808	\$9,630
<b>26.5 to 220 GHz Set</b> - Includes WM780A, WM780U, WM780E, WM780F, WM780G, Order WM7809	\$13,945
<b>33 TO 50 GHz Set</b> - Includes WM780Q, WM780V, Order WM78010	\$4,410
<b>33 to 110 GHz Set</b> - Includes WM780Q, WM780V, WM780W, Order WM78011	\$7,230
<b>33 to 170 GHz Set</b> - Includes WM780Q, WM780V, WM780W, WM780D, Order WM78012	\$11,450
WM490 WAVEGUIDE MIXERS & SETS	
18-26.5 GHz - Order WM490K	\$1,445
26.5-40 GHz - Order WM490A	\$1,445
33-50 GHz - Order WM490Q	\$1,695
40-60 GHz - Order WM490U	\$1,990
50-75 GHz - Order WM490V	\$2,260
60-90 GHz - Order WM490E	\$2,450
75-110 GHz - Order WM490W	\$2,515
90-140 GHz - Order WM490F	\$2,700
110-170 GHz - Order WM490D	\$3,760
140-220 GHz - Order WM490G	\$3,850
220-325 GHz - Order WM490G, Option 1	+\$1,325
<b>18 to 40 GHz Set</b> - Includes WM490K, WM490A, Order WM4902	\$2,895
<b>18 to 60 GHz Set</b> - Includes WM4902 plus WM490U, Order WM4903	\$4,880
<b>18 to 90 GHz Set</b> - Includes WM4903 plus WM490E, Order WM4904	\$7,285
<b>18 to 140 GHz Set</b> - Includes WM4904 plus WM490, Order WM4905	\$9,940
WM780 & WM490 ACCESSORIES	
<b>Diplexer Assembly</b> - (required for 2750/490 Series), Order 015-0385-00	\$320
<b>Diplexer to Waveguide Mixer Interconnecting Cable Assembly</b> - (required for 2750/490 Series) 50-ohm, SMA-to-SMA, Order 012-0649-00	\$41
<b>Tapered Transition</b> - Extends WM780G/WM490G frequency coverage to 220-325 GHz, Order 119-1728-00	\$2,055
<b>Case</b> - Order 016-0465-01	\$30

<sup>1</sup> Contact your local sales office.

## General RF Applications – (GRASP)

- Performs Automated Spectrum Analysis on PC-Compatible Computers
- Applications Routines Are Selected Through Easy, Menu-Driven Operation
- Supports EGA and CGA Graphics

## 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.
- Supports EGA and CGA Graphics

## 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 A View 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

### UTILITIES

Talk/Listen (Command)  
Sensitivity Test  
Resolution Filters Test  
Calibration Assistance  
Select Instrument  
Select Disk

### SIGNAL SEARCH

Fast Search  
Precise Search  
Spur Search  
Automatic Identify

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 PC-compatible controllers.

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.

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. The 2402A TekMate, when ordered with a graphics card, makes an ideal remote-site PC.



### MONITOR

Enter Parameters  
Take a Measurement  
Report Errors  
Hang-Up/Monitor  
Immediate Call Back  
Show Parameters

### MEASUREMENTS

Harmonic Distortion  
Amplitude Modulation  
Signal-to-Noise

### WAVEFORM OPERATIONS

Acquire A View Waveform  
Acquire BView Waveform  
Send to instrument  
Store on Disk  
Load from Disk  
Graph Waveform  
Acquire Mode: Norm

### SIGNAL SEARCH

Fast Search  
Precise Search  
Spur Search

### UTILITIES

Talk/Listen (Command)  
Sensitivity Test  
Resolution Filters Test  
Calibration Assistance  
Select Instrument  
Select Disk  
User Program

*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 (S26RM00) and a remote-site module (S26RM01). At least one of each module is required to comprise a working remote monitoring system. Both modules are provided with source code.

## 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.

For information about ordering antennas and other EMC test equipment, contact your Tektronix sales engineer.

In addition to the software described on these pages, Tektronix can also provide Technical Assistance Services for users requiring custom programming or applications assistance. Contact your Tektronix sales engineer for details.

## 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** **\$1,400**  
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** - IBM AT high-density disk (1.2 Mb, 5.25") **NC**  
**Opt. 1A** - IBM PC double-density disk (360 kb, 5.25") **NC**  
**Opt. 1B** - IBM PC microdisk (720 kb, 3.5") **NC**  
**Opt. 10** - GPIB interface for PC **+\$495**

**S26UT00 Software**  
**Opt. 10** - GPIB interface for PC **+\$495**

**S26RM01 Software**  
**Opt. 10** - GPIB interface for PC **+\$495**

**S26EM00 Software**  
**Opt. 09** - Source Code **+\$1,000**  
**Opt. 10** - GPIB Interface for PC **+\$495**

# SPECTRUM ANALYZER SYSTEMS

## 490P/2750P SPECTRUM ANALYZER

- 10 kHz to 21 GHz Frequency Range in Coax; up to 325 GHz with External Mixers
- Built-in Frequency Counter (most models)
- "Smart" Markers for Faster, More Accurate Measurements
- Nonvolatile Memory to Save Front Panel Settings and CRT Displays
- Fully Programmable Over the IEEE-488 Bus

## 2782 SPECTRUM ANALYZER

- 100 Hz to 33 GHz Coaxial Frequency Range; up 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
- High-resolution Color Display
- Built-in Automation (Macros)
- 2 IEEE-488 Ports

### ORDERING INFORMATION

#### 490P/2750P SYSTEMS

When ordering, use the model number and desired options of the 490P or 2750P Series spectrum analyzer plus one of these package options:

- Opt. 23** - GRASP (S26RF00), S3FG120 GPIB Interface Package (includes PC2A card\*), GPIB cable **+\$1,530**
- Opt. 27** - GRASP, PC2A\*, GPIB cable, Epson LT-386SX PC **†**
- Opt. 28** - GRASP, PC2A\*, GPIB cable, Compaq Deskpro 386S PC **†**

#### 2782 SYSTEMS

When ordering, specify the 2782 Spectrum Analyzer plus one of these package options:

- Opt. 20** - 2782 Utility software (S26UT00), S3FG120 GPIB Interface Package (includes PC2A card\*), GPIB cable **+\$1,530**
- Opt. 27** - S26UT00, PC2A\*, GPIB cable, Epson LT-386SX PC **†**
- Opt. 28** - S26UT00, PC2A\*, GPIB cable, Compaq Deskpro 386S PC **†**

\* National Instruments PC2A (GPIB) Interface Card

† Contact your local sales office.



The Tektronix 492BP Option 27 system is ideal for portable data logging applications.

## AUTOMATE YOUR MEASUREMENTS WITH TEK SPECTRUM ANALYZER SYSTEMS

Tektronix Spectrum Analyzer Packages are configured around Epson 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 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.

Option 23 (to the 490P/2750P-series) and Option 20 (to the 2782) are intended for users who already have a PC-compatible computer. Options 27 and 28 are turnkey systems designed for R&D, manufacturing test, and general RF automated testing. Option 27 includes a state-of-the-art laptop PC and is ideal for portable data logging applications. Option 28 includes a high-performance desktop PC and is designed for benchtop ATE applications.

Each of the PC systems includes DOS, GRASP or 2782 Utility Software, and a GPIB interface installed in the PC. A GPIB cable is also included. These computer systems are configured and checked out prior to shipment. Thus, you receive a turnkey system and will encounter minimal effort in configuring and running the system.

## 490P/2750P/PC SPECTRUM ANALYZER SYSTEMS

A choice of a laptop or desktop PC is available:

### EPSON LT-386SX (OPT. 27)

This Epson laptop computer features an 80386SX processor running at 16 MHz. It has a built-in VGA backlit LCD display, a removable 40 Mb hard drive, a 3.5" 1.44 Mb diskette drive, and 2 Mb of RAM. The LT-386SX has serial and parallel interfaces, plus jacks for an external keyboard and color VGA monitor. Tek's GRASP software (S26RF00) and a GPIB cable are included.

### DESKPRO 386S (OPT. 28)

The Compaq Deskpro 386S features an 80386SX processor running at 16 MHz. It includes a 40 Mb hard disk drive, a 1.2 Mb floppy disk drive, 2 Mb RAM, a VGA color monitor, and serial and parallel interfaces. Tek's GRASP software and a GPIB cable are included.

## 2782/PC SPECTRUM ANALYZER SYSTEMS

A choice of a laptop or desktop PC is available:

### EPSON LT-386SX (OPT. 27)

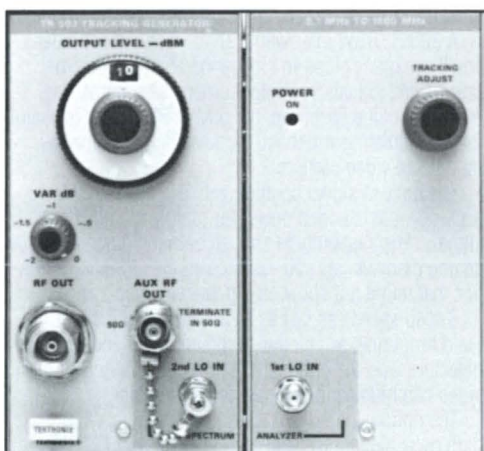
The contents of this computer package are the same as Option 27 described under 490P/2750P systems, except that Tek's 2782 Utility Software (S26UT00) is substituted for the GRASP software.

### DESKPRO 386S (OPT. 28)

The contents of this computer package are the same as Option 28 described under 490P/2750P systems, except that Tek's 2782 Utility Software (S26UT00) is substituted for the GRASP software.

# TRACKING GENERATOR TV SIDEBAND ADAPTER

TR 503/  
1405

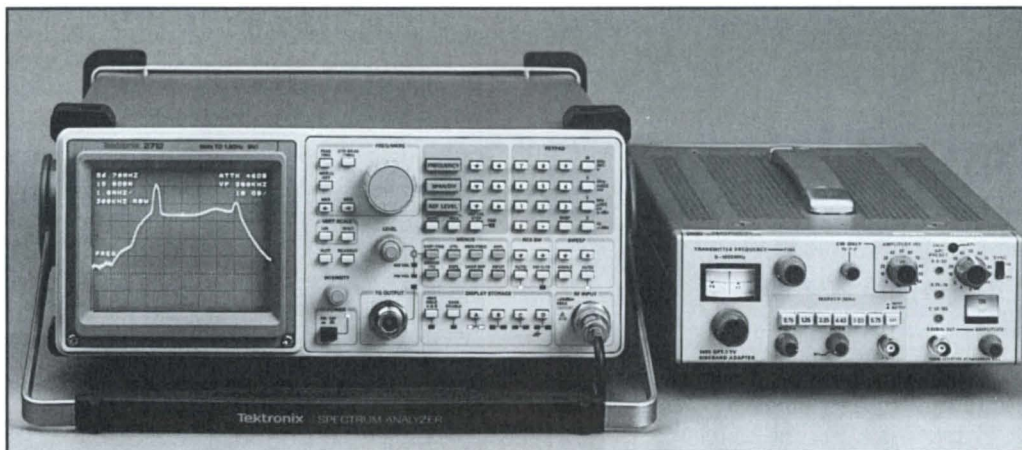


TR 503 Tracking Generator

## TR 503

### TRACKING GENERATOR

The TR 503 works with all 2750 and 490 Series spectrum analyzers to provide constant level, calibrated RF sources for swept frequency tests to 1.8 GHz. The tracking generator is a two-wide unit compatible with the TM 500 and TM 5000 Modular Instrument Series.



2712 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 271X Family, 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  $\pm 0.2$  dB, of the transmitter being tested.

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 zero span, 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.

## CHARACTERISTICS

### TR 503/ALL 490 AND 2750 SERIES

**Frequency Range** - 100 kHz to 1.8 GHz

**Output Level** - (Max) 0 dBm  $\pm 0.5$  dB

**Range** - 0 to 59 dB in 10 dB and 1 dB steps

**Flatness** - Within  $\pm 2.25$  dB Max from 100 kHz to 1.8 GHz (Typically  $\pm 1.5$  dB)

**Dynamic Range** -  $\geq 110$  dB

**Residual FM** - 50 Hz p-p

**Output Impedance** - 50  $\Omega$  Nominal, VSWR 2:1 or less to 1.8 GHz

**Auxiliary Output** - 0.1 V RMS into 50  $\Omega$  load  
7 dBm minimum

## 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 Frequency Counter Measurement Even of Signals at the Noise Floor

## ORDERING INFORMATION

**TR 503** Tracking Generator **\$7,080**  
Includes: Two 50  $\Omega$  coax cables (012-0649-00); N male to BNC female adapter (103-0045-00); retainer plug-in (343-0604-00); instruction manual (070-3526-00).

### OPTIONAL ACCESSORIES

**TM 503A** Power Module **\$395**  
**TM 504** Power Module **\$695**  
**Blank Panel** - Order 016-0195-05 **\$42**

## 1405

### TV Sideband Adapter

- Facilitates In-Service Testing of Transmitter
- Measure Transmitter Frequency Response to  $\pm 0.2$  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 **\$5,980**  
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 271X Spectrum Analyzer Family **NC**

**INTERNATIONAL POWER PLUG OPTIONS**  
**Opt. A1-A5** - Available **NC**  
See page 374 for description.

**RACKMOUNT CONVERSION KIT**  
**Standard 19-inch Rack** -  
Order 016-0489-00 **\$735**

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 271X Spectrum Analyzer Family with Option 03.

Call your local sales engineer for additional information.

## FEATURES

- **High Value, Low Cost**
- **Standard Features**
  - $5 \times 10^{-7}$  Frequency Accuracy
  - Sensitivity to  $-139$  dBm ( $-92$  dBmV) with Built-in Preamp
  - Internal Frequency Counter
  - Full Programmability
  - Real Time Clock
  - 124k of NV RAM
- **Ease of Use**
  - Dedicated Numeric Keypad Plus Logically Grouped Menu Keys
  - Powerful Built-in Measurement Routines
- **EMC Measurements with Optional Quasi-Peak Detector**
- **Swept Measurements to 1.8 GHz with Optional Internal Tracking Generator**

## NEW 2712 SPECTRUM ANALYZER

The NEW Tektronix 2712 Spectrum Analyzer provides an unprecedented range of features at an extremely affordable price. You get excellent RF performance, a built-in frequency counter, full programmability, digital and true analog displays, high portability, enough nonvolatile memory for 108 saved displays, and much more.

Its straightforward human interface, with conveniently-grouped, dedicated front-panel keys and simple, menu-driven functions makes the 2712 easy to learn and use. You can set frequency, span, and reference level directly from the front panel. A real-time clock provides an on-screen date and time display, plus date/time stamp capability for waveform printouts.

Frequency-corrected tuning and phaselock stabilization enhance the ability to resolve close-in signals and reliably demodulate narrowband signals. Sensitivity up to  $-127$  dBm ( $-80$  dBmV) at 300 Hz resolution bandwidth (RBW) lets you see weak signals. The built-in preamp can improve sensitivity another 12 dB, up to  $-139$  dBm ( $-92$  dBmV). 80 dB on-screen dynamic range ensures

visibility of weak signals in the presence of strong ones.

A 300 Hz RBW filter with a shape factor  $\leq 7:1$  means you'll see many close-in sidebands and spurious, or unexpected signals you might otherwise miss. At the other end of the spectrum, the 5 MHz RBW filter is useful for demodulating wideband signals such as actively-modulated video carriers.

The built-in signal counter, with 0.5 ppm  $\pm 10$  Hz accuracy, offers added power for rapidly identifying signals. The capability to choose between digital and true analog displays lets you examine signals for characteristics that might not show on digital-only displays.

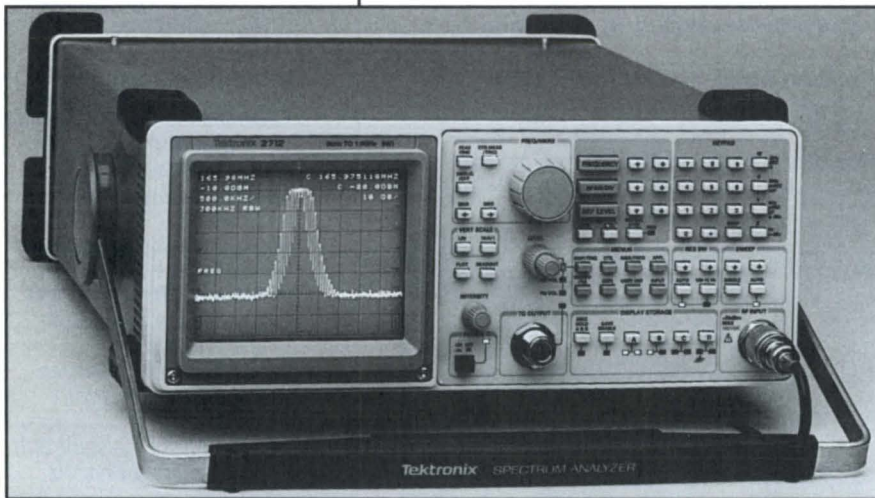
Sweep speeds as fast as 1  $\mu$ sec/div, TV Line and TV Field triggering, an internal audio amplifier and AM/FM detectors, and the optional Video Monitor Mode all make video communications measurements easier.

The optional internal tracking generator lets you make high dynamic range swept measurements to 1.8 GHz. Characterize filters, check duplexers or cables, make frequency response and SWR measurements, and much more, with at least 100 dB measurement dynamic range.

To help simplify your EMC measurements, the 2712 offers an optional quasi-peak detector, EMI resolution bandwidth filters, antennas, and fully-corrected E-field intensity measurements to assist in pre-qualification and troubleshooting.

Bandwidth, Carrier-to-Noise, Noise Power, Signal Search, and FM Deviation modes provide additional measurement power and convenience. Occupied Bandwidth Mode, with percent settable from 1 to 99%, aids in broadcast radio measurements.

The 2712's 124k Bytes of nonvolatile memory lets you store up to 108 displays, plus 36 front panel setups, large user-defined key programs, and antenna factor tables.



## ORDERING INFORMATION

**2712 Spectrum Analyzer.** Includes: Power cord (U.S. 115 V/60 Hz), operator's manual, front cover, 75/50  $\Omega$  min-loss pad, and N-to-BNC adapter.

**\$11,950**

## OPTIONS

- Opt. 04** – (cannot combine with Opt. 12 or 14) Add internal tracking generator, 100 kHz-1800 MHz, 0 dBm-48 dBm in 0.1 dB steps. **+\$3,150**
- Opt. 07** – Add 2704 Inverter and 2705 Battery Pack. Includes: Power cord (U.S. 115 V/60 Hz), operator's manual, mounting plate. **+\$1,350**
- Opt. 08** – Replace GPIB with RS-232-C interface. **NC**
- Opt. 10** – Video monitor mode. **+\$650**
- Opt. 12** – (cannot combine with Opt. 04 or 14) Add Quasi-peak Detector (built-in). Includes: 200 Hz, 9 kHz, and 120 kHz EMC filters; 1 kHz and 1 MHz RBW filters **+\$1,480**

**NOTE:** 200 Hz EMC filter replaces standard 300 Hz RBW filter.

**Opt. 14** – (cannot combine with Opt. 04 or 12) Add 1 kHz, 10 kHz, 100 kHz, and 1 MHz RBW filters. **+\$600**

**Opt. 15** – Tek 1405 TV Sideband Adapter interface. **+\$280**

**Opt. 20** – EMC antenna set plus tripod and coax suitable for tests to 1 GHz (contact Tek Sales Engineer for more information). **+\$3,290**

**Opt. 30** – Rackmount for 19-inch rack width, 5-inch height. **+\$250**

**Opt. 33** – Travel Line Package. **+\$100**

Includes: accessory pouch, carrying strap, vinyl rain cover.

**Opt. 34** – Portable-to-Rackmount Adapter for 19-inch rack width, 7-inch height. **+\$590**

## OPTIONAL ACCESSORIES

**Service Manual** – Order 070-8130-00 **\$135**

**Tekmate Mounting Hardware** – Order 016-1109-00 **\$70**

**NOTE:** See 2710 ORDERING INFORMATION for optional accessories common to both instruments.

## 2712 AND 2710 FEATURE COMPARISON

CAPABILITY	2712	2710
Frequency Range	9 kHz - 1.8 GHz	10 kHz - 1.8 GHz
$\pm 0.5$ ppm Freq. Accuracy	Std	Opt 01
Signal Counter	Std	Opt 02
GPIB Interface	Std	Opt 03
Internal Tracking Gen.	Opt 04	Opt 04
Inverter/Battery Pack	Opt 07	Opt 07
No Charge RS-232-C Interface (replaces GPIB)	Opt 08	N/A
Centronics Interface	N/A	Opt 09
Video Monitor Mode	Opt 10	Opt 10
EMC Pre-Qualification Measurements	Opt 12	N/A
TV Sideband Adapter Interface	Opt 15	Opt 15
Nonvolatile Memory	124k	28k
High Portability	Yes	Yes
Both Digital and True Analog Displays	Yes	Yes
Dedicated Numeric Keypad	Yes	N/A
Real-Time Clock	Yes	N/A

## 2710 SPECTRUM ANALYZER

The 2710 is a recognized value leader in spectrum analysis. This economical yet powerful instrument is well-suited to a wide variety of applications, such as checking CATV headend and distribution systems, maintaining industrial security, and teaching frequency domain concepts in the classroom.

The 2710 is highly configurable. Buy as much measurement power as you need or can afford initially, then upgrade as your situation warrants.

The standard 2710 shares many of the 2712's valuable features. Compact size, light weight (9.5 kg, about 21 lbs.), and available battery operation (refer to 2704 Inverter/2705 Battery Pack descriptions) means you can operate in almost any environment. Both instruments can also be quickly converted to rack operation with optional rackmount adapters.

Basic accuracy of  $1 \times 10^{-5}$  is provided, more than adequate for many applications. If you find you need more, Option 01 raises center frequency accuracy to  $5 \times 10^{-7}$  and adds a 300 Hz resolution bandwidth (RBW) filter.

Sensitivity is up to  $-117$  dBm ( $-70$  dBmV) at 3 kHz RBW. The built-in preamp can add another 12 dB, up to  $-129$  dBm ( $-82$  dBmV). 80 dB on-screen dynamic range helps see weak signals, even when strong ones are present.

True analog display capability, along with fast sweep speeds and TV Line and TV Field triggering provide convenient demodulation of video carriers for making depth-of-modulation checks or looking at special baseband data, VITS, and many other signals.

An internal audio amplifier and AM/FM detectors let you hear demodulated signals, using either the built-in speaker or headphone jack, for fast signal identification and troubleshooting in communications applications.

With the optional Video Monitor Mode installed, you can check signals on a remote basis or identify down-linked video transponders.

## 2712/2710 CHARACTERISTICS

The following characteristics apply to both the 2712 and 2710 after a 15-minute warmup period, unless otherwise noted. Items marked with an asterisk (\*) are supplemental characteristics giving typical but non-warranted performance parameters.

### FREQUENCY RELATED

**Frequency Range** – 2712: 9 kHz to 1800 MHz 2710: 10 kHz to 1800 MHz.

**Center Frequency Accuracy** – 2712:  $5 \times 10^{-7}$  of CF  $\pm 700$  Hz; 2710:  $1 \times 10^{-5}$  of CF  $\pm 5$  kHz; 2710 w/Opt 01: Same as 2712.

**Frequency Counter Accuracy (Std 2712, Opt 02 2710)** – 2712:  $5 \times 10^{-7}$  of CF  $\pm 10$  Hz,  $\pm 1$  LSB; 2710:  $1 \times 10^{-5}$  of CF  $\pm 10$  Hz,  $\pm 1$  LSB; 2710 w/Opt 01: Same as 2712.

**\*Dot Marker Frequency Accuracy** – CF Accuracy + 3% of span, typical.

**\*Typical Long-Term Drift** – 2712: 2 ppm/yr.; 2710: 10 ppm/yr.; 2710 w/Opt 01: Same as 2712.

**Short-Term Drift** – 2712:  $\leq 400$  Hz maximum drift between correction cycles; 2710:  $\leq 20$  kHz maximum drift between correction cycles; 2710 w/Opt 01: Same as 2712.

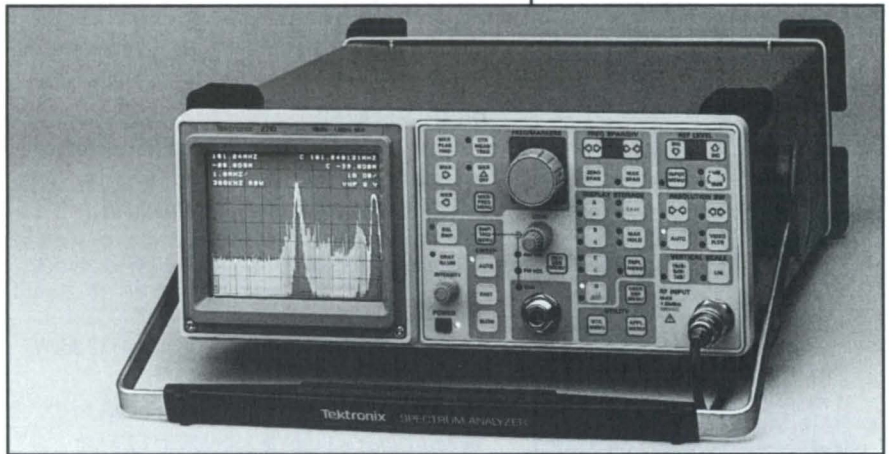
**Residual FM** – 2712:  $\leq 100$  Hz p-p/20 msec at  $\leq 20$  kHz span/div;  $\leq 2$  kHz p-p/20 msec at  $> 20$  kHz span/div; 2710:  $\leq 2$  kHz p-p/20 msec; 2710 w/Opt 01: Same as 2712.

**Resolution Bandwidth ( $-6$  dBm)** – 2712: 5 MHz, 300 kHz, 30 kHz, 3 kHz; 2710: 5 MHz, 300 kHz, 30 kHz, 3 kHz; 2710 w/Opt 01: Same as 2712; 2712/2710 w/Opt 14: Add 1 MHz, 100 kHz, 10 kHz, and 1 kHz.

**Resolution Bandwidth Shape Factor (60 dB/6 dB)** –  $\leq 7:1$

**Noise Sidebands** –  $\leq 70$  dBc at 30xRBW.

**Video Filter** – Approx. 1/100 (Auto) of RBW. Manual Selection: 3 Hz to 300 kHz in 1-3 sequence.



**Freq. Span/Div Range** – 2712 (2710 w/opt. 01): 180 MHz to 1 kHz. 2710: 180 MHz to 10 kHz selected in 1-2-5 sequence or 2 significant digits via menu.

**Span Accuracy** –  $\pm 3\%$  over the center eight divisions.

### AMPLITUDE RELATED

**Flatness** –  $\pm 1.5$  dB measured with 10 dB internal RF attenuation (preamp off).

**Vertical Display Modes** – 10, 5, 1 dB/div, Linear.

**Measurement Range** – 2712:  $-139$  (preamp on) to  $+20$  dBm ( $-92$  to  $+67$  dBmV); 2710:  $-129$  (preamp on) to  $+20$  dBm ( $-82$  to  $+67$  dBmV); 2710 w/Opt 01: Same as 2712.

**Display Dynamic Range** – 80 dB max (limited to 40 dB in optional 2712 Quasi-peak Detector mode).

**Reference Level Range** – LOG Mode:  $-70$  to  $+20$  dBm ( $-23$  to  $+67$  dBmV), or down to  $-90$  dBm with preamp on. LINEAR Mode: 8.8  $\mu$ V to 280 mV.

**Reference Level Steps** – LOG Mode: 1 dB or 10 dB. LINEAR Mode: 1-2-5 sequence.

**Mixer Level Input** – Automatically controlled by instrument for on-screen signals. Level selectable between  $-20$  to  $-50$  dBm ( $+27$  to  $-3$  dBmV).

Specifications continued on page 180.

### FEATURES

- Economical, Can Be Configured to Meet Most Budgets
- High Portability
- Can Be Upgraded Now or Later
  - Maximize Performance as Needed
  - Internal Tracking Generator Option
  - Video Monitor Mode Option
  - TV Sideband Adapter Option
  - GPIB or Centronics Interface Option
- Excellent Frequency Accuracy and Sensitivity
- 3-Control Operation for Most Measurements

### ORDERING INFORMATION

**2710 Spectrum Analyzer, \$8,750**  
Includes: Power cord (U.S. 115V/60 Hz), operator's manual, front cover, 75/50  $\Omega$  min-loss pad, and N-to-BNC adapter.

#### OPTIONS

**Opt. 01** – Add 300 Hz RBW filter, phaselock stabilization, and  $5 \times 10^{-7}$   $\pm 700$  Hz frequency accuracy. **+\$1,260**

**Opt. 02** – Add internal frequency counter with selectable 1 kHz/1 Hz readout resolution. **+\$630**

**Opt. 03** – (cannot combine with Opt. 09) GPIB interface **+\$630**

**Opt. 04** – (cannot combine with Opt. 14) Add internal tracking generator, 100 kHz-1800 MHz, 0 dBm-48 dBm in 0.1 dB steps. **+\$3,150**

**Opt. 07** – Add 2704 Inverter and 2705 Battery Pack. Includes: Power cord (U.S. 115 V/60 Hz), operator's manual, mounting plate. **+\$1,350**

Continued on page 180.

## ORDERING INFORMATION

2710 Ordering Information  
continued from page 179.

Opt. 09 – (cannot combine with Opt. 03) – Centronics interface.	+ \$480
Opt. 10 – Video monitor mode.	+ \$650
Opt. 14 – (cannot combine with Opt. 04) Add 1 kHz, 10kHz, 100 kHz, and 1 MHz RBW filters.	+ \$600
Opt. 15 – Tek 1405 TV Sideband Adapter interface.	+ \$280
Opt. 30 – Rackmount for 19-inch rack width, 5-inch height.	+ \$250
Opt. 33 – Travel Line Package. Includes: accessory pouch, carrying strap, vinyl rain cover.	+ \$100
Opt. 34 – Portable-to-Rackmount Adapter for 19-inch rackwidth, 7-inch height.	+ \$590

## OPTIONAL ACCESSORIES

Service Manual – (2710) Order 070-6024-01	\$135
Front Panel Cover – Order 200-2520-00.	\$10
Accessory Pouch – Mounts on top. Order 016-0677-02.	\$50
Viewing Hoods – (Collapsible) Order 016-0592-00	\$15
(Binocular) Order 016-0566-00	\$21
(Polarized) Order 016-0180-00	\$70
Carrying Strap – Order 346-0199-00.	\$20
Shipping Case – Order 016-0792-02.	\$415
Smoke Gray CRT Filter – Order 337-2775-02.	\$3.00

## INTERNATIONAL POWER PLUG OPTIONS

Opt. A1-A5 – Available. See page 374 for description.	NC
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## WARRANTY-PLUS SERVICE PLANS

Opt. M1 – Available.	+ \$710
Opt. M2 – Available.	+ \$1,190
Opt. M3 – Available.	+ \$1,430

**Display Amplitude Accuracy** – 10 dB/Div:  $\pm 1.0$  dB/10 dB to max. cum. error of  $\pm 2$  dB over 70 dB range;  $\pm 2.0$  dB/10 dB over 70-80 dB range. 5 dB/Div:  $\pm 1.0$  dB/10 dB to max. cum. error of  $\pm 2$  dB over 40 dB range. 1 dB/Div: 1 dB max. error over 8 dB range. Linear Mode:  $\pm 5\%$  of full scale.

**RF Attenuation Range** – 0 to 50 dB, 2 dB steps.

**Sensitivity** – 2712:  $-127$  dBm ( $-80$  dBmV) at 300 Hz RBW,  $-139$  dBm ( $-92$  dBmV) at 300 Hz RBW with preamp on (to 600 MHz); 2710:  $-117$  dBm ( $-70$  dBmV) at 3 kHz RBW,  $-129$  dBm ( $-82$  dBmV) at 3 kHz RBW with preamp on (to 600 MHz); 2710 w/Opt 01: Same as 2712.

## SPURIOUS RESPONSE (PREAMP OFF)

**Residual Spurious Response** –  $\leq -100$  dBm referenced to input of 1st mixer.

**3rd Order IM Distortion** –  $\leq -70$  dBc, from any two on-screen signals within any frequency span measured with 1st mixer input level of  $\leq -30$  dBm ( $+17$  dBmV).

**2nd Harmonic Distortion** –  $\leq -66$  dBc measured with 1st mixer input level of  $\leq -40$  dBm ( $+7$  dBmV).

## INPUT RELATED

**LO Emission** –  $\leq -70$  dBm with 0 dB RF attenuation.

**RF Input** – Type N connector, 50  $\Omega$

**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** –  $\geq -15$  dBm ( $+32$  dBmV) with 0 dB RF attenuation.

## SWEEP RELATED

**Sweep Times** – 1  $\mu$ sec to 2 sec/div in 1, 2, 5 seq. (7-decade range); AUTO SWEEP mode; MANUAL SWEEP select.

**Sweep Time Accuracy** –  $\pm 10\%$  over the center eight divisions.

**Trigger** – Free run, internal, external, line, TV field, TV line, single sweep, manual scan.

**Trigger Amplitude** – Internal: One division or more of signal. External: 1.0 V peak, min. (15 Hz to 1 MHz).

## INPUT/OUTPUT CHARACTERISTICS

**\*External Trigger** – BNC connector, 10 k $\Omega$  impedance, DC coupled 0.1  $\mu$ s min. pulse width. 35 V max.

**\*External Video Input** – DC coupled. 0-50 kHz, 0-1.4 V (175 mV/div typical) signal input for vertical deflection of CRT beam.

**Sweep Gate Out** – TTL level that is HI while CRT beam sweeps.

**Sweep Gate Out** – TTL level 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  $\leq 50 \Omega$ , load impedance  $\geq 10 \Omega$ .

**Video Output** – 0 to  $+1.6$  V of video signal, proportional to vertical display amplitude. 0 V is top of screen. 1 k $\Omega$  impedance.

## ENVIRONMENTAL SPECIFICATIONS

**Temperature** – Operating: 0° to 50° C (MIL-T-28800D). Nonoperating:  $-55^\circ$  to  $+75^\circ$  C.

**Humidity** – Nonoperating: Five cycles (120 hours) per MIL-T-28800D, Class 5.

**Vibration** – Meets MIL-T-28800D 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 eighteen shocks.

**Radiated and Conducted Emissions** – Meets FCC Part 15, Sub-part J, Class A and VDE 0871, Class B.

## GENERAL CHARACTERISTICS

**Power Requirements** – 90 W max. (1.2 A) at 115 V, 60 Hz. Operates 48 Hz to 440 Hz, 90 to 132 V ac, or 48 Hz to 63 Hz to 250 V ac. Battery power (Opt. 07) available.

**Weight** – 9.5 kg ( $< 21$  lb.) nominal for basic configuration.

**Dimensions (H,W,D) with Feet, Handle, and Front Panel Cover** – 137 x 361 x 445 mm (5.4 x 14.2 x 17.5 in.).

## OTHER CAPABILITIES

**Markers** – Single marker/delta marker; next right, next left peaks; next lower, next higher peaks; (highest) peak find; marker to CF.

**Nonvolatile Memory** – Lithium battery backup. 2712: 124 kBytes available; up to 108\* displays saved; 36\* front panel setups, large\* user-definable key routines, and antenna tables (\* exact number and size depends on NV RAM utilization). 2710: 28 kBytes available; Up to 18 displays saved and 9 front-panel setups, user-definable key routines, and antenna tables.

**Digital Storage Display** – Selectable acquisition modes of positive peak only, positive/negative peak. SAVE A, B, C and active D trace; up to 4 traces on screen; MAX HOLD A, B; MIN HOLD C; B, C minus A; WATERFALL display mode; digital storage off provides analog sweep.

**Ensemble Averaging** – Provides weighted averaging of display resulting in reduction of random noise.

**Internal Preamp** – Preamp can be switched in/out of circuit (degrades flatness above 600 MHz, provides approximately 12 dB sensitivity improvement).

**Alternative Reference Level Units** – dBm, dBmV, dBV, dB $\mu$ V, dB $\mu$ W, dB $\mu$ V/m.

**User-Definable Power-on Status** – Instrument powers up to user-definable state or supplied default settings.

**Center Measure** – Signal is centered with frequency and peak amplitude automatically read out (not a marker mode). The signal is counted in the 2712 or 2710 w/Opt. 02.

**Signal Track** – Drifting signal is kept at display center with correct frequency and peak amplitude displayed.

**Graticule Illumination** – For CRT photography.

**Direct Plot/Print** – Supports Epson FX-Series Printers and Tek HC100 Printer/Plotter via built-in GPIB interface (std 2712, 2710 Opt. 03), RS-232-C interface (Opt. 08, 2712 only), or Centronics interface (Opt. 09, 2710 only).

## 2704 INVERTER/2705 BATTERY PACK

The 2704 Inverter and 2705 Battery Pack can provide a minimum of one hour continuous operation for the 271X Family in locations where ac power is not available. These units mount directly on the Spectrum Analyzer 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 uninterrupted power source for the Spectrum Analyzer or other equipment. The 2704 includes a battery charger, and provides an auxiliary 18 volt output. The 2704 also accepts 12 volt input from other sources, such as car batteries. These units are described in more detail in Tektronix Specification/Ordering Information Sheet 26W-7061.

## CHARACTERISTICS

### 2704 INVERTER

**DC input** – (main & auxiliary) 10 VDC to 15 VDC.

**Battery Protection Shutdown** – 10 VDC  $\pm$  5%.

**Output Voltage** – 115 VAC RMS  $\pm$  10%.

**Output Frequency** – 60 Hz  $\pm$  5%.

**Output Waveform** – Quasi-sinusoid, 1.3 crest factor.

**Output Power** – 125 W continuous

**Battery Charger** – AC input voltage (90 VAC to 250 VAC, 50/60 Hz), (90 VAC to 125 VAC, 400 Hz). AC power consumption 70 Watts max.

**Auxiliary output for LNB Voltage** – 18 VDC  $\pm$  10%. Ripple, noise 100 mV pk-pk max. Maximum output current 1 A, (current limited).



2704 Inverter and 2705 Battery Pack.

### 2705 BATTERY PACK

**Type** – Sealed lead-acid, 12 V, 15 Amp-hr.

**Voltage Range** – 10 VDC to 14.4 VDC.

**Minimum Operating Time** – 1 hr at 10° C to 40° C, 45 minutes at 0° C to 10° C.

**Charging Time (using 2704)** – 6 to 8 hours for 1 battery pack, 10 to 12 hours for 2 battery packs, fully discharged state, 0° C to 40° C.

**Cycle Life** –  $\geq$ 150 charge/discharge cycles to 100%.

## 2710/PC (S26UT10) UTILITY SOFTWARE

Tek's 2710/PC Utility Software is designed to extend the storage capabilities as well as automate some of the



2710/PC Utility Software facilitates repetitive measurements for automated testing.

more common functions of the 2710/2712 Spectrum Analyzer. These include waveform acquisition, graphing, documentation, storing to disk, comparing, subtracting, recalling from disk, and sending to the analyzer. Both single traces and groups of related traces can be operated upon.

The software provides utility routines for operations such as TALK/LISTEN (sending commands and receiving responses), selecting the color of waveform graphs and annotation, and specifying the drive or path under which waveforms and other files will be stored.

The software includes an application category which can be supplemented with user specific applications. This category contains a waterfall application, an occupied bandwidth measurement application, and an application to save, recall and transfer User Defined Programs to other 2710s or 2712s equipped with a communications port.

The measurement category contains a program to measure harmonic distortion and a program to check swept frequency response. The latter utilizes the optional, fully programmable 2710/2712 tracking generator to measure peak-to-valley response within a specified frequency range.

## 2704 Inverter 2705 Battery Pack

- Easy Connection to Tektronix 271X Family Spectrum Analyzers
- 125 Watts of AC Power
- Up to 1 Hour's Operation Per Battery Pack
- Continuous Power Using Sequential Battery Packs
- Lightweight Single Package for Easy One-handed Carrying
- Automatic Charging of Two Battery Packs Simultaneously
- Auxiliary 18 VDC LNB Power
- Low Battery Warning

## ORDERING INFORMATION

<b>2704 Inverter</b>	<b>\$1,050</b>
Includes: Power cord (U.S. 115V, 60 Hz), Operator's Manual, Analyzer Mounting Plate.	
<b>2705 Battery Pack</b>	<b>\$310</b>
<b>1.5-Meter DC Power Cord</b> – 2704 inverter-to-automotive cigarette lighter plug. Order 118-8549-00	<b>\$43</b>
<b>1.5 Meter DC Power Cord</b> – 2704 inverter-to-alligator clips. Order 118-8550-00	<b>\$43</b>

### INTERNATIONAL POWER PLUG OPTIONS

Opt. A1-A5 – See page 374 for description.

## 2710/PC Utility Software (S26UT10)

- Extends the Storage Capabilities of the 2710/2712 Spectrum Analyzer
- Graphic Overlays of up to Four Waveforms
- Document Utility for any Waveform
- Built-in Graphics Driver Supporting DOT-MATRIX Printers
- User Defined Color Graphics for EGA/VGA Displays
- User Friendly Interface
- Performs Automated Spectrum Analysis Using PC-compatible Controllers

## ORDERING INFORMATION

<b>S26UT10 2710/PC Utility Software</b> (5.25" and 3.5" disks)	<b>\$575</b>
<b>Opt. 09</b> – (Source code on 5.25" and 3.5" disks)	<b>+\$1,000</b>
<b>Opt. 10</b> – (PC2A GPIB interface)	<b>+\$495</b>

## 2721/2722

- Non-interfering
- Full 5-600 MHz Range
- Full Alpha Keyboard for data entry
- LCD Display visible even in bright sunlight
- Lightweight, compact receiver
- Frequency-agile Telemetry
- 50-waveform NVRAM storage
- RS-232C downloads stored waveforms to Serial Printer or PC

## ORDERING INFORMATION

**2721** Non-interfering Sweep Transmitter Includes: 115 Vac Power Pack (119-3740-00) and two Precision Female-Female Type-F Adapters (103-0301-00). **\$6,900**

**2722** Non-interfering Sweep Receiver **\$7,900**

Includes: 115 Vac Power Pack (119-3740-00) Precision Female-Female Type-F Adapter (103-0301-00), Option Port Cover (200-3737-00), Voltmeter Lead Set (ALM03), RS-232C DB-9 Male-Female Interface Cable Assembly (174-1809-00) and User's Guide (070-7789-00).

## OPTION

**Opt. 01**—YT-1 Chart Recorder (2722) **+\$950**

## OPTIONAL ACCESSORIES

**Chart Paper** —  
(Single Roll) 006-7647-00 **\$6.50**  
(25 Roll) 006-7677-00 **\$155**

**Replacement Battery** —  
146-0080-00 **\$80**

**Precision Female-Female Type-F Adapter** — 103-0301-00 **\$20**

**Replaceable Type BNC Adapter** — 103-0310-00 **\$15.25**

**Padded Carrying Case** —  
016-1087-00 **\$150**

**Strand Hook** — 214-4367-00 **\$75**



The new lightweight 2722 receiver and rackmounted 2721 transmitter.

The Tektronix 2721/2722 Non-Interfering System Sweep provides the capability of high-resolution 5-600 MHz frequency response testing on CATV and other broadband operating systems, without the limitations of traditional system sweeps.

Using unique sync-detection, the 2721/2722 System Sweep actually monitors the CATV channels at the headend insertion point, and synchronizes the inserted sweep points to the specific channels, firing these pulses *only during the Vertical Blanking Period*. This allows the system to operate continuously, providing high-resolution frequency response measurements in the field, with no interference to the active video.

For complete 2721/2722 information, contact your local Tek Field Sales Office or request brochure #26W-7072-1.

## CHARACTERISTICS

The following specifications and features apply after a 15-minute warmup period unless otherwise noted.

## FREQUENCY RELATED

**Range** — 5 to 600 MHz  
**Accuracy** —  $10^{-5} \pm 15$  kHz  
**Step Size** — 1, 2 or 3 samples per channel, selectable at time of configuration.

## AMPLITUDE RELATED: 2721

**Input** — +5 to +15 dBmV per channel  
**Sweep Output** — +45 dBmV  
**Telemetry Output** — +40 dBmV  
**Pulse Duration** — 8  $\mu$ sec  
**Spurious** — >65 dBc

## AMPLITUDE RELATED: 2722

**Sensitivity** — Sweep mode -10 to +50 dBmV, SLM mode -40 to +60 dBmV (without pre-amp).

**Sweep Accuracy** —  $\pm 0.5$  dB at normalized point.

## CONNECTORS

**RF** — Replaceable Type-F, Impedance 75 $\Omega$  nominal, Return Loss >16 dB.

## POWER SUPPLY

**Line** — 90 to 130 Vac, 45 to 440 Hz with 120 Vac table top transformer.

**Battery** — Sealed, lead-acid battery, 12 Vdc. Nominal 4.5 hour continuous operation on a full charge. Recharge time 15 hours with supplied transformer.

## ENVIRONMENTAL

**Temperature** — Operating 15°C to 35°C (2721 Transmitter) 0°C to 50°C (2722 Receiver)

**Temperature** — Non-operating -40°C to +75°C

**Humidity** — <95% RH below 30°C, <75% RH between 30°C and 40°C, <45% RH above 40°C.

**Vibration** — Resonant searches of 0.013" on all three axes for 15 min. Dwell for 10 min. at major resonance or 33 Hz if none. Total vibration time is 75 min.

**Shock** — Three guillotine-type shocks of 30 g. One-half sine, 11 ms duration each direction along each major axis.



The smallest lightest sweep receiver on the market at 17 lbs., the Tektronix 2722 Receiver is usable for over 4 1/2 hours on battery power.



# SPECTRUM ANALYZER ACCESSORIES



2755AP and K217



494AP and K212

## ORDERING INFORMATION

**POWER SPLITTER**  
**75 Ω/50 Ω BNC Output, 50 Ω BNC Input –**  
 Order 067-1232-00 **\$275**

**CABLES, PADS AND ADAPTORS**  
**50 Ω Coaxial Cable – BNC to BNC 5.5 in.**  
 Order 012-0214-00 **\$60**  
**50 Ω Coaxial Cable – BNC to BNC Conn,**  
 18 in. Order 012-0076-00 **\$25**  
**50 Ω Coaxial Cable – BNC to BNC Conn,**  
 42 in. Order 012-0057-01 **\$25**  
**75 Ω Coaxial Cable – BNC to BNC Conn,**  
 42 in. Order 012-0074-00 **\$25**  
**75 Ω to 50 Ω Minimum Loss Adapter – With**  
 dc block, 5.7 dB loss. Order 011-0112-00 **\$70**  
**75 Ω to 50 Ω Matching Attenuator – With**  
 11.25 dB conversion factor from dBm to dBV  
 with dc block. Order 011-0118-00 **\$95**  
**"F" Female to BNC Male Adapter –**  
 Order 013-0126-00 **\$22**  
**BNC Female to "F" Male Adapter –**  
 Order 103-0158-00 **\$6.00**  
**"N" Female to BNC Male Adapter –**  
 Order 103-0058-00 **\$14.00**  
**BNC Female 75 Ω to N Male 50 Ω Adapter –**  
 Order 103-0273-00 **..**  
**75 Ω to 50 Ω Matching Transformer**  
 (0.5 dB loss, 50 kHz to 300 MHz)  
 Order 120-1883-00 **\$250**  
 Order 120-1884-00 **\$295**

**DC BLOCKS**  
**N(F) to N(M) – 10 kHz to 21 GHz, 50 V dc**  
 maximum. Order 015-0509-00 **\$345**  
 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 271X Family**  
 Order 016-0848-00 **\$18.00**

**GRATICULES, FILTERS**  
**CRT Light Filter – For 271X Family**  
 (Clear) Order 337-2775-01 **\$1.95**  
 (Gray) Order 337-2775-02 **\$3.00**  
**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 **\$95**

**CARTS**  
**K217 – Lab Cart (2750 Series) \$625**  
**K212 – Portable Instrument Cart (490 Series) \$385**

**PROBES AND SENSORS**  
 A variety of probes are available in varying  
 frequency and impedance ranges that can be  
 used with the 271X Family and all 2750/  
 490 Series spectrum analyzers. See page 294.

\*1 Contact your local sales office.

**FET Probe P6201 – DC to 900 MHz \$1,395**  
**FET Probe P6202A – DC to 500 MHz \$825**  
**1101A Probe Power Supply – For**  
 271X Family **\$500**  
**Conventional Probe P6156 – DC to**  
 3.5 GHz, 6 ft **\$255**  
**Current Probe P6022 – DC to 150 MHz \$570**  
 In addition to probes, a comprehensive line of sensor  
 products is also available for EMC diagnostics and  
 prequalification testing. Contact your Tektronix Sales  
 Representative for more information.

**CAMERAS**  
 A camera can greatly enhance the versatility of a  
 spectrum analyzer. Many different units are available.  
 However, the most popular unit for the 271X Family and  
 2750/490 Series spectrum analyzers is:  
**C-9 Camera – For 490/2750 Series**  
 and 271X Family. **..**

**CARRYING CASES**  
**Hard Case – Transit for the 2750 Series**  
 Order 016-0962-00 **\$495**  
**Hard Case – Transit for the 490 Series**  
 Order 016-0658-00 **\$990**  
**Soft Case – For the 490 Series**  
 Order 016-0659-00 **\$155**  
**Transit Case – For 271X Family**  
 Order 016-0792-02 **\$415**

**RACK ADAPTER**  
**19 inch Rack Adapter for the 490 Series – Order**  
 016-0844-01 **\$670**  
**19 inch Rack Adapter for the 2782 – Order**  
 016-1019-00 **\$825**

**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**

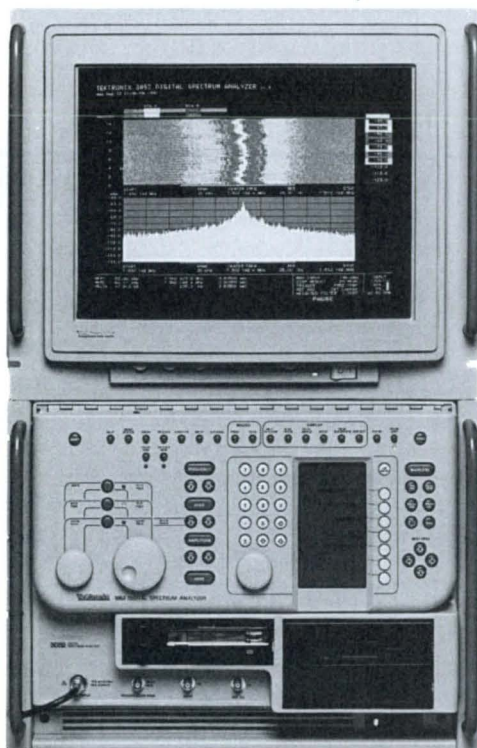
**WARRANTY-PLUS SERVICE PLAN**  
 Tektronix *Warranty-Plus* Offerings for the 2750 Series,  
 490 Series, and 271X Family Spectrum Analyzers  
 provide for both routine and remedial service, depending  
 on the plan selected. See pages 378 and 379.  
**Plan M1 – Provides two routine calibrations, one 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 calibra-**  
 tions, 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**  
**Accessory Pouch – For 271X Family**  
 Order 016-0677-02 **\$50**  
**Viewing Hood – For 271X Family**  
 Order 016-0566-00 **\$21**  
**Carrying Strap – For 271X Family**  
 Order 346-0199-00 **\$20**  
**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 **\$320**  
**Diplexer Assembly Cable – Required for**  
 use with Diplexer Assembly.  
 Order 012-0649-00 **\$41**  
**Cable – Required for use with WM782 Series**  
 Waveguide Mixers. Order 012-1346-00 **\$95**

## REAL TIME INPUT BANDWIDTH OF 10 MHz

### TYPICAL APPLICATIONS

- Communications, COMINT
- Signal Analysis, SIGINT
- Radar Signal Processing, ELINT
- SATCOM



### BENEFITS

- Wide Real Time Bandwidth Captures Elusive Transients
- Digital Interface Transfers Data Quickly (Option 10)
- System Flexibility Using Industry Standards

### FEATURES

- 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
- Can be Used with Receivers on Carrier Signals up to 325 GHz

The Tektronix 3052 Digital Signal Processing System introduces a nearly hundred-fold improvement in real time spectrum analysis—at much wider frequency spans. With a real time input bandwidth of 2 MHz, the 3052 updates its spectral output every 200  $\mu$ s. 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 and data output rates are 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.

The filters are reconfigurable, which allows the user to tailor the analysis characteristics to particular needs.

### DISPLAY

The 3052 features a high resolution, 16-inch color monitor that displays 801 frequency bins.\*1 Display formats include power versus frequency, phase versus frequency, Spectrogram, and Waterfall. One display can occupy the full screen or two displays can be presented on a split screen.

### KEY BOARD

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 keyboard 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 and the optional spectral event triggering, 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. Individual spectrums, blocks of spectrums, instrument setups, and keystroke macros can be stored on disk for later call up for display or off-

line processing by stored programs. Stored programs can be executed from the keyboard.

### 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 bandwidth: 1.7 :1

**Displayed Bins** – 801 for all spans

**Center Frequency Accuracy** –  $\pm$ CF x 10<sup>-7</sup>

**Signal Resolution With Standard Filter** – 3 bin widths (also, one signal at Reference Level and the other at 70 dBc)

**10 MHz Standard Drift** – 1 x 10<sup>-9</sup>/day and 1 x 10<sup>-7</sup>/year

### AMPLITUDE RELATED

**Reference Level Range** –  $\pm$ 33 to -140 dBm

**Accuracy** –  $\pm$ 0.2 dB 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 1 MHz: -65 dBc 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** – 70 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 801 bins are displayed, covering the selected span of the 3052. A bin width is considered to be 1/800th of the displayed span.

SYSTEM V/68™ 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<sup>m</sup>, 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.

**SPAN RELATED CHARACTERISTICS**

Span	Resolution Passband	Spectral Frame Output Interval	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 μs	-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: AC has 3 dB roll-off 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.

**Modes** – Single, continuous, start.

**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.

**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 keyboard 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.

**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 Signal Processing System** **\$99,500**  
Includes: Operator's, Service, and Programmers Manual and Operator's Guide.

**OPTIONS**

**Opt. 02** – GPIB (IEEE-488.2) Interface. Functions as a "listener/talker" or full controller **+\$2,995**

Includes: VME board and driver software.

**Opt. 10** – Real Time Interface **+\$9,950**

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 RGB II Color Screen Printer **+\$1,495**

Includes: Control cable and software.

**Opt. 12** – Removable Hard Disk Option **+\$4,900**

**Opt. 14** – Streaming Tape Drive **+\$2,495**

Some of the options are available in field-installable kits. Contact your Tektronix representative for more information.

**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**

**Rack** – Order 437-0398-00 **\$1,870**

**Reusable Transportation Containers** – One for Monitor, one for processor

016-1056-00 Monitor Case **1,530**

016-1057-00 Instrument Case **1,545**

**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.

**3052 SOFTWARE PRODUCTS**

**S2MG100** – Enhanced Frequency Measurements Software **\$5,000**

**S2MG160** – 2756P Controller Software **\$500**

## RF160/NEW RF162

## 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 Rigorous 3D Modulation Analysis on the Tektronix 3052 Digital Signal Processing System
- 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 Signal Processing System 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.

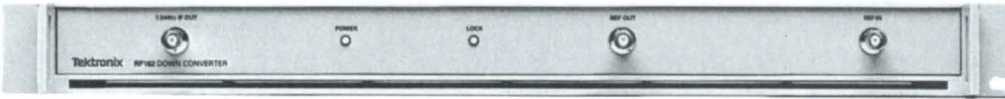
The RF160 works by taking the Intermediate Frequency (IF) output from a receiver or Tektronix spectrum analyzer, and mixing the signal to the analysis range of the 3052. The full capabilities of the 3052, at spans of 5 MHz and narrower, may then be used to analyze the signal. A microwave signal ranging 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 companion software product S2MG160 offers special control functions to simplify applications. The S2MG160 supports applications with the Tektronix 494AP or 2756P Microwave Analyzers. This product allows users to tune these analyzers remotely from the 3052 front panel, and facilitate fully integrated operation.



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.



The RF162 operates on the same principal as the RF160, except that it operates on the military IF frequency of 21.4 MHz, and optionally at 321.4 MHz. It permits users to redeploy existing spectrum analyzers and receivers with new 3052 Digital Signal Processing Systems to develop high-powered analysis systems.

## CHARACTERISTICS

### INPUT SIGNALS

**Acceptable IF Frequencies** – RF160: Standard is 160 MHz, 110 MHz; Opt. 25 is 25 MHz. RF162: Standard is 21.4 MHz; Opt. 03 is 321.4 MHz.

### SIGNAL INPUT (50 Ω REAR PANEL CONNECTOR)

**Optimum Input Power** – RF160: –30 dBm. RF162: Standard is –36 dBm; Opt. 03 is –30 dBm.

**Maximum Input Level Without Damage** – +20 dBm.

### FREQUENCY RELATED

**Flatness** – 1 dB p-p across the 5 MHz to 10 MHz output range. Excludes host analyzer flatness.

### AMPLITUDE RELATED

**Third Order Intermodulation Distortion** – Standard: –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.

**Noise Figure** – Standard: 15 dB. Option 25: 9 dB.

### 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
<b>Weight</b>	<b>kg</b>	<b>lb</b>
Net	4.2	9.25

## ORDERING INFORMATION

**RF160 Down Converter** **\$9,950**

(Standard 160, 110 MHz IF Input)  
Includes Instruction and Service Manual

**Opt. 25** – 25 MHz IF input exclusively **NC**

**RF162 Down Converter** **\$9,950**

(Standard 21.4 MHz IF input)  
Includes Instruction and Service Manual

**Opt. 03** – 321.4 MHz IF input **\$1,950**

### INTERNATIONAL POWER PLUG OPTIONS

**Opt. A1** – Universal Euro 220 V/16A, 50 Hz **NC**

**Opt. A2** – UK 240 V/13A, 50 Hz **NC**

**Opt. A3** – Australian 240 V/10A, 50 Hz **NC**

### WARRANTY

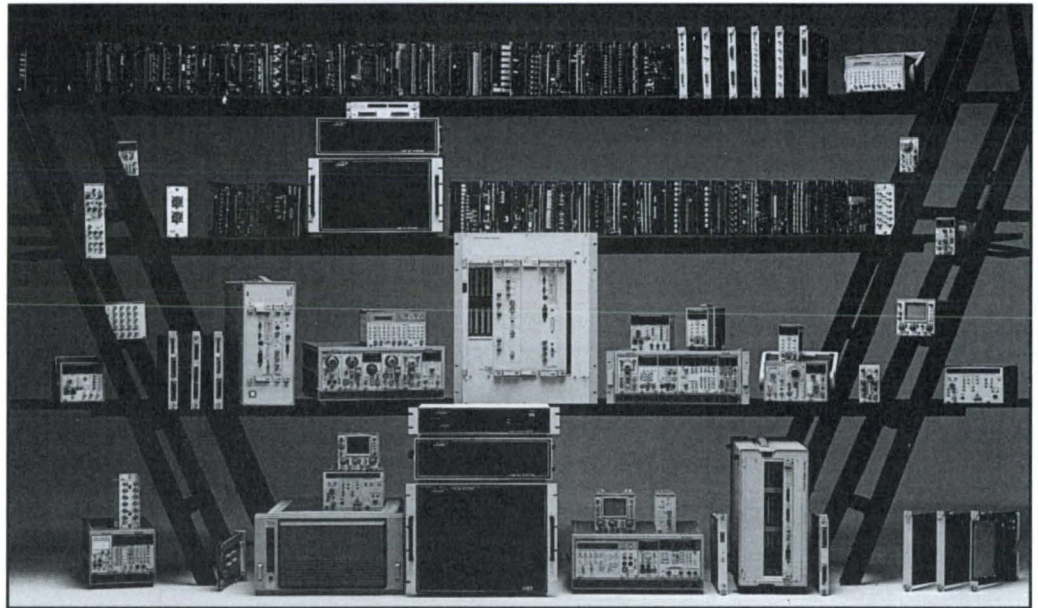
On-site, 90 days parts and labor.

### MAINTENANCE

**Calibration Period** – 1 year.  
**Service Support** – On-site assembly level board exchange, and at Tektronix designated service centers.

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## THE SOLUTION SOURCE

If you are involved in testing, you are being bombarded on one side with requirements from your customers for better, more reliable products that have more features, and from the other side with demands from your company for lower costs and higher throughput in order to be able to compete in today's marketplace. The good news is you have more tools to help you handle these problems than at any time in the past. However, the sheer variety of these tools brings with it its own set of confusion factors and questions.

Tektronix's Measurement System Division (MSD) was founded to come to grips with each of these areas and help provide the optimal solution. MSD's unique blend of expertise in five areas of systems oriented technology provides you with access to a variety of solutions-oriented tools that will ensure your success whether you are an experienced system user or are just moving into the world of automation. These five areas are:

- VXIbus— State of the art standard for modular instrumentation.
- CDSbus— Low cost alternative to VXI.
- TM 5000— Manual or automated GPIB (IEEE 488) modular test and measurement system.
- TSI— High performance switching systems.
- Systems— Complete or partial turnkey system solutions.

## VXIbus

The VXIbus Specification (VMEbus extensions for Instrumentation) allows the user to more easily utilize modular instrumentation in automatic test systems, and to use instruments from multiple manufacturers in a single instrument card cage.

Tektronix/Colorado Data Systems (wholly owned subsidiary) provides the widest range of VXI instrumentation and components, including mainframes, controllers, interface devices, stimulus and measurement instruments, scanners and switches, etc. Tek/CDS is dedicated to being the market leader who can supply VXI resources according to the system performance and functionality required by the application. Tektronix offers "C" and "D" size VXIbus products, support for generic VME cards, plus software and hardware tools for support of all levels of VXIbus implementation.

## CDSbus

CDSbus was originally developed in answer to the growing demand for reasonable cost solutions in automatic and production test applications. It has become the first family of modular plug-in instruments, literally encompassing the spectrum from DC to light.

The goals of CDSbus are many: create a flexible test environment that reduces system integration complexity, reduce the physical size of the test system, improve test



system reliability while reducing test system hardware costs, provide an avenue of growth for new technology insertion, and reduce the cost of user developed software through imbedded drivers within the instruments. The result is a test equipment environment elegant in its simplicity. Thousands of users are taking advantage of CDSbus in applications ranging from a grain elevators to nuclear reactors. With over 60 modules from single vendor, CDSbus offers a broad base of functionality from a single source. CDSbus offers cost effective instruments-on-a-card technology, with decreased cost per function while preserving a well-defined early growth path to VXIbus in the future.

## **TM 5000 TEST AND MEASUREMENT MODULAR INSTRUMENTS**

The TM 5000 family of instruments provide proven programmable instrumentation you can configure for the best balance of portability and performance with plug-in, pull-out convenience. You can choose from a variety of compact plug-ins to create multifunction packages for a wide range of applications. These modular instruments can function individually or as a part of a computer-controlled network. Unlike most systems, there is no uncabing, restacking or rebuilding required. Reconfiguring your systems takes seconds, not hours.

## **TEKTRONIX MODULAR AND CARD MODULAR INSTRUMENTATION**

Tektronix gives you fully deliverable, real-world solutions for automated test. Within our broad product offering you'll find everything from mainframes and controllers to stimulus and acquisition instruments built from the ground up to fit your testing needs. Tektronix also offers you complete test management software to control VXIbus, CDSbus and GPIB instrumentation with little or no programming.

With our help you can tailor a package based upon your present and future requirements, your budget, and the desired degree of continuity with your current equipment – including Tek's own GPIB instruments, CDSbus and VXIbus products, as well as complete test software.

## **TSI SWITCHING AND SCANNING**

The key component of most system applications is the switching to route the signals to the proper points of the Device Under Test. Tektronix' TSI family of off-the-shelf switching components can easily be configured to fit the vast majority of signal switching from DC to 18 GHz. These switching components have been designed with flexibility in mind. When a switching requirement changes, the switch arrangement can be easily reconfigured to fit the new need.

## **SYSTEMS**

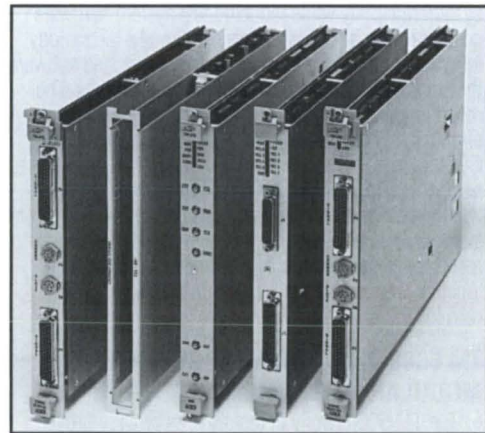
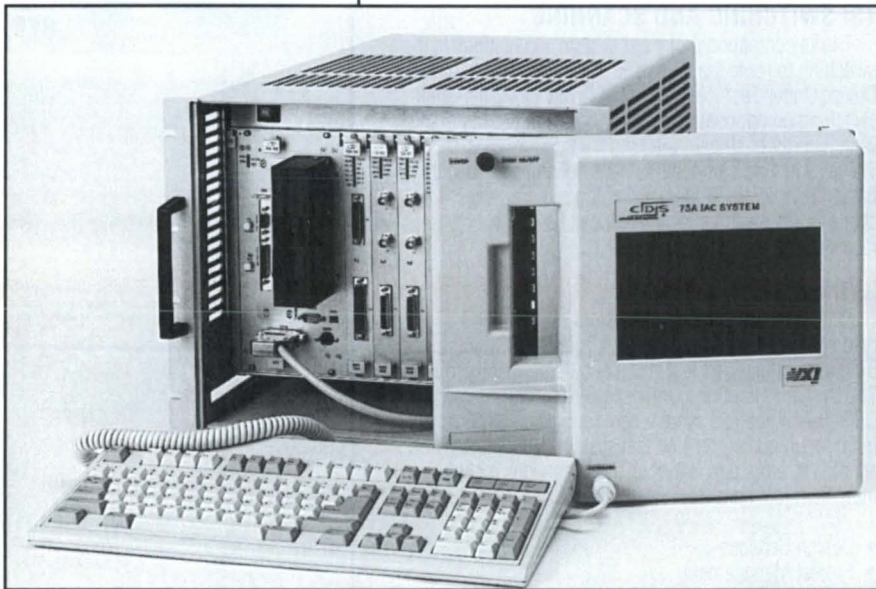
MSD offers help to manufacturers by becoming a resource extension and providing Total Test Systems Solutions for specific test and measurement problems. The Systems Solutions Unit uses GPIB-, VXIbus- or CDSbus-compatible system components as required to build a unique automated test system that can easily be adapted to other applications. These services include more than just hardware:

- Design Services
- Project Management
- Complete Documentation
- Software and Fixturing Development
- On-site Installation
- Maintenance and Repair Services
- Technical Support

The result is a totally integrated test system, built to fit your test application, that is manufactured with the same care and quality standards that have made Tektronix a leader in test equipment for over 40 years.

## **CONCLUSION – MSD THE SOLUTION STORE**

As you can see, whether you are looking for components and expertise necessary to build a test system, or a complete turnkey solution, Tektronix' Measurement Systems Division is the right place to come.



### WHAT IS VXIBUS?

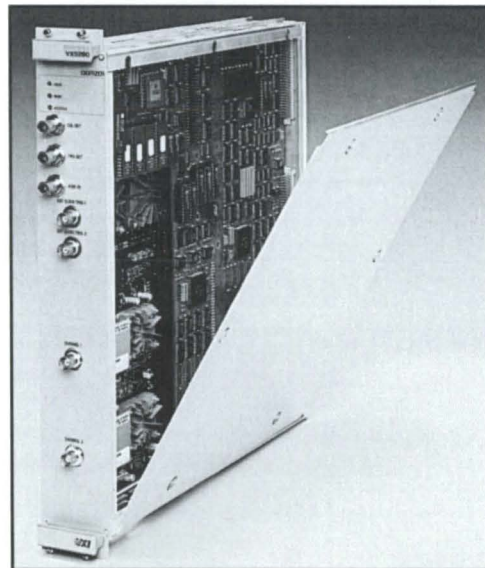
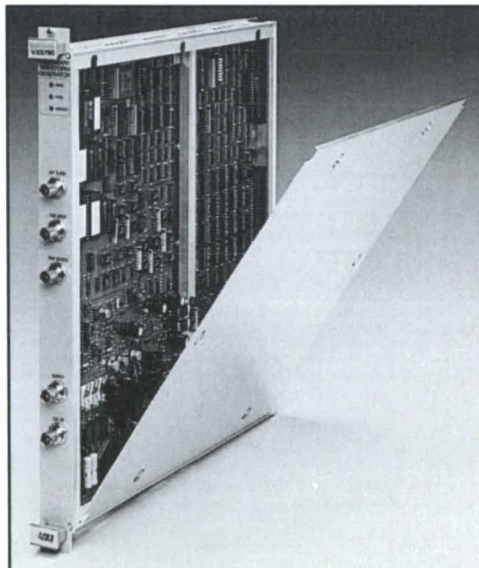
The VXibus Standard builds on the existing standard for VME (IEEE-1014). It specifies four different card sizes, designated by the standard as A, B, C, or D, drawn from the Eurocard standard. Depending upon the card size selected, these cards may utilize one, two, or three 96-pin DIN connectors. Tek/CDS design and manufacture both "C" and "D" size modules and mainframes.

Each additional connector and module size offers increased power and performance; all connectors are fully defined. The VXibus P1 connector definition conforms exactly to VME and uses this connector for command and control. VXibus uses rows A and C of P2, and all of P3, to define additional power and ground, local buses, additional clocks, trigger and sync signals, and a SUMBUS.

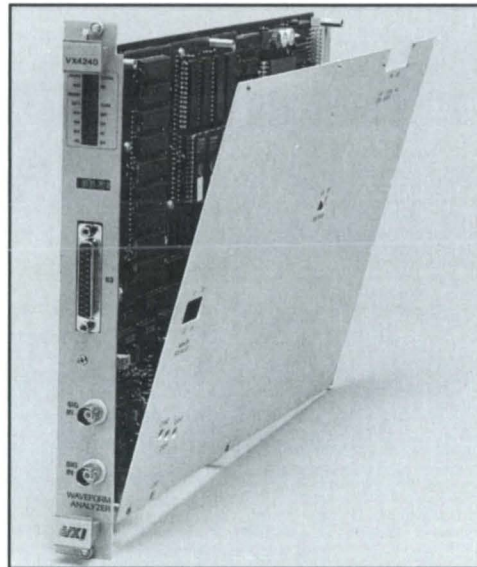
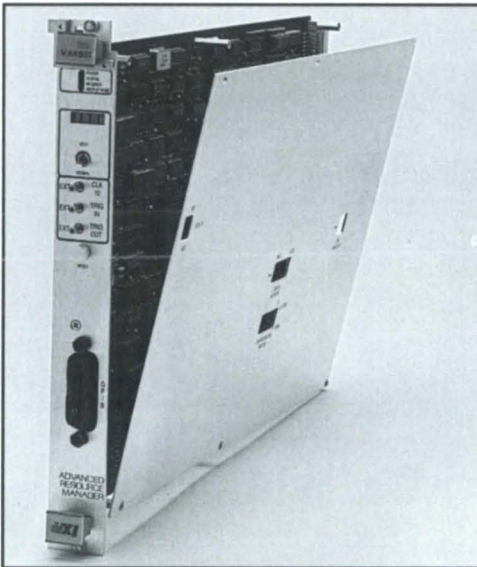
The VXibus architecture is extremely flexible and can accommodate almost any system hierarchy or topology. It defines a hierarchy of device types, with an automatic configuration protocol for all types. Through registers, the system can identify each device and its type, together with

The VXibus Specification (VMEbus eXtensions for Instrumentations) was announced in July 1987. Its purpose is to enhance the development of automatic test systems by allowing the user to more easily utilize modular instrumentation, and to provide a greater variety of available "Instruments on Cards."

VXibus, although technologically a very innovative concept, is an evolutionary rather than a revolutionary step. It allows users to select from a wide range of instruments, interface cards, and computers from different manufacturers, with full confidence these modules will operate together when used in a single test system. Test system designers who use the VXibus can tailor tests to actual needs, since they can design the equipment for the test rather than test for the equipment.







model and manufacturer, plus any additional memory requirements.

The simplest of these devices, "register based devices", are "dumb" devices. They typically do not contain local intelligence. Another class, "message based devices", is intended for use where higher levels of communication are desired, as in communication to other modules within the system. Message based devices are typically "smart" devices which can parse and interpret commands.

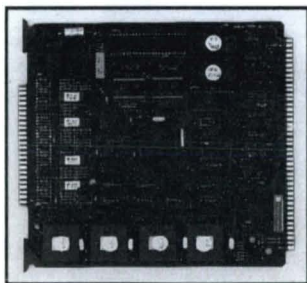
Fundamental communications within a VXIbus system is based upon a Word Serial protocol. A standardized communications protocol means VXIbus instrument

modules from multi-manufacturers can be configured in a wide variety of ways as required by the application.

One of the most exciting possibilities of having a number of instruments in a common, closely coupled environment is tighter time coordination. This leads to a higher level of system performance than ever before possible. Traditional rack and stack instruments connected via cables cannot match the control over signal characteristics and propagation delay that is possible in a well defined VXIbus backplane environment.

## PRODUCTS SUMMARY

MAINFRAMES		DIGITAL STIMULUS AND MEASUREMENT		SWITCHING AND SCANNING	
73A-021 "C" Size Mainframe	\$6,000	73A-342 Dual Programmable Resistor	\$2,000	73A-308 Relay Driver Module	\$1,400
VX1400 "C" Size Mainframe	\$7,000	73A-270 Pulse/Pattern Generator	\$3,500	73A-332 2-Wire Scanner Master Module	\$2,000
VX1405 "C" Size Mainframe	\$3,795	73A-541 Universal Digitizing Counter	\$2,400	73A-334 4-Wire Scanner Master Module	\$1,750
VX1500 "D" Size Mainframe	\$9,995	VX4223 160 MHz Universal Timer/Counter	\$3,495	73A-342 Dual Resistance Programming Module	\$2,000
VX1505 "D" Size Mainframe	\$7,150	VX4236 Digital Multimeter	\$3,795	73A-353 32-Channel Relay Switch (SPST)	\$1,500
SLOT 0 RESOURCE MANAGERS		VX4240 Waveform Digitizer/ Analyzer Module	\$8,000	73A-355 24-Channel Relay Switch (DPST/SPDT)	\$1,900
73A-151B Enhanced Slot 0 Module	\$1,800	VX5260 Waveform Digitizer	\$10,995	73A-356 20-Channel Relay Switch (DPDT)	\$1,950
73A-155 Advanced Resource Manager/ 488 Module	\$2,800	VX5790 Arbitrary Waveform Digitizer	\$8,500	73A-357 32-Channel Relay Switch (SPDT)	\$1,600
73A-156 MATE IAC Control Module (ICM)	\$2,800	DIGITAL STIMULUS AND MEASUREMENT		73A-372 2-Wire Scanner Module	\$1,500
VX4520 Slot 0/Resource Manager	\$2,000	73A-270 Arbitrary Serial Word Generator	\$3,500	73A-374 4-Wire Scanner Slave Module	\$1,400
VX4521 Advanced Slot 0/Resource Manager	\$3,000	73A-411 48-Channel Isolated Digital I/O	\$2,200	VX4440 Scanner Controller	\$3,295
VX5520 Slot 0/Resource Manager	\$4,250	73A-412 80-Channel Digital I/O	\$1,800	GENERAL TESTING	
EMBEDDED COMPUTERS		73A-541 Digitizing Counter with Time Tag	\$2,400	73A-451 Prototyping Module with Interface	\$1,000
73A-160B PC/286 Computer Subsystem	\$5,200	AEROSPACE		73A-452 Prototyping Module without Interface	\$550
73A-161 PC/286 Computer Subsystem	\$5,400	73A-425 Quad ARINC-429 Transmitter Module	\$4,500	73A-850 VXI Extender Board	\$535
VX4530 386 System Controller	\$11,995	73A-426 Quad ARINC-429 Receiver Module	\$4,500	73A-851 VME/VXI Adapter Module	\$1,000
VX4535 386 System Controller	\$16,995	73A-453 MIL-STD-1553A/B Bus Simulator Tester	\$3,600	73A-852 CDSbus to VXIbus Interface Module	\$650
VX5530 386 System Controller	\$18,000	73A-455 Dual Channel MIL-STD-1553A/B Bus Simulator Module	\$6,800	73A-853 Message Based CDSbus to VXIbus Interface Module	\$700
VX5535 386 System Controller	\$24,000	73A-575 Synchro Transceiver Module	\$3,900	73A-904 I/O Card for IBM or Compatible PC	\$525
ANALOG STIMULUS AND MEASUREMENT		73A-576 Resolver Transceiver Module	\$3,900	73A-931 Integral Display	\$1,700
73A-243 Arbitrary Waveform Generator Module	\$4,100	73S-456 MATE Compatible 8-Channel 1553 Tester	\$9,500	73A-932 Enhanced Keyboard	\$140
73A-256 12-Channel 16-Bit DAC	\$3,500			VX1421 Development Module	\$2,295
				VX1521 Development Module	\$2,495



**CDS**  
bus



## AN INTRODUCTION

CDSbus, one of the core elements in Colorado Data System's innovative 53 series of Instruments-on-a-Card (IAC) Systems, was originally developed when CDS found that rack and stack test systems were not satisfying the growing demand for smaller, less expensive solutions to automatic and production test problems. Therefore, while most of the test equipment industry was focusing on benchtop instruments (with the add-on interfaces), CDS was defining a new concept in automatic testing. CDSbus is the foundation of a family of modular plug-in instruments.

This modular architecture is designed to:

- Generate a flexible test environment that could reduce system integration complexity.
- Reduce the size of the test stand.
- Improve test system reliability.
- Provide an avenue of growth for new technology insertion.
- Reduce test equipment cost.
- Reduce software development costs.

The result—an ATE environment elegant in its simplicity. Thousands have used the CDSbus concept in applications ranging from aircraft to televisions, from

grain elevators to nuclear reactors. Users can select from a wide range of instruments, interface cards, and computers, with full confidence the modules will operate together in a single test system. Test systems can be tailored to actual needs, since instruments need only have the capability level required by the test at hand.

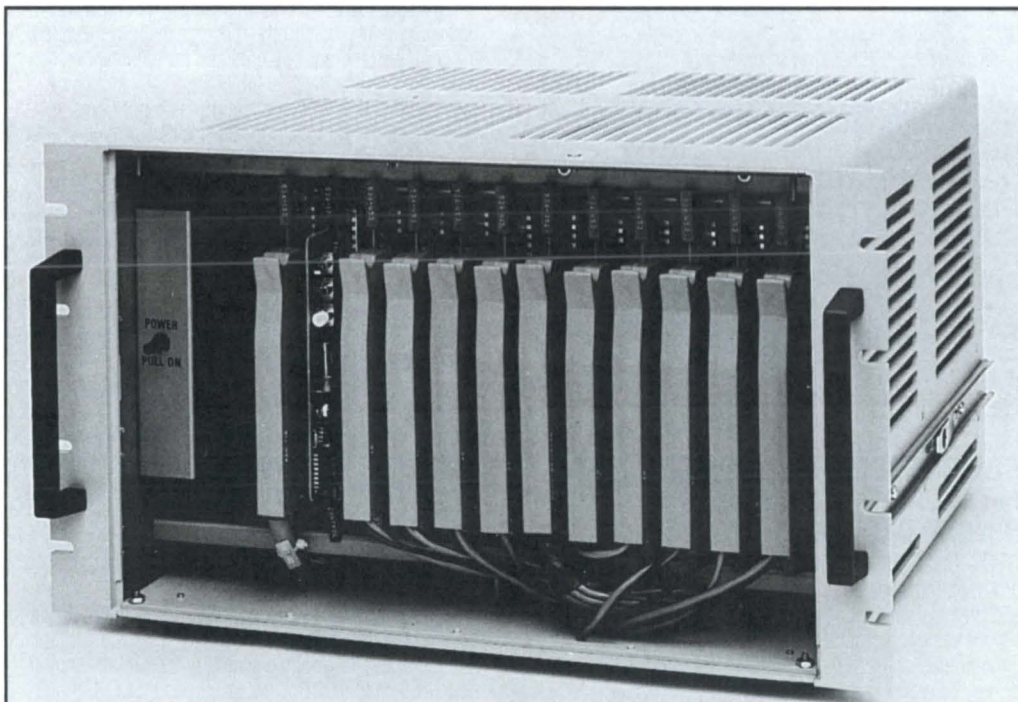
A CDSbus System provides up to 10 slots for instrument cards to be plugged into. Each instrument slot is identical to all other instrument slots. A high-speed protocol allows each instrument to determine the minimum time required to handshake the data for that instrument's needs.

Instrument control protocol is kept simple because:

- 1) a non-arbitrated bus improves system throughput, and
- 2) low cost instruments are not penalized by the cost and real-estate intensive interfaces associate with more complex I/O implementations. Each instrument is optimized for its own application.

The most important element in the instrument environment is the operator. For that reason, all CDSbus instruments include extensive self test and status reporting.

Each CDSbus chassis includes a cable tray and an optional connector mounting plate, allowing the entire CDSbus System to either operate stand-alone or in a rackmount configuration.



PRODUCTS SUMMARY

CONFIGURED SYSTEM (53B/63B/64B)

ACX Advanced Computer Instrument System	*1
CCX Chained Card Cage System	*1
IBX IEEE-488 Bus Instrument System	*1
MCX MATE Compatible Instrument System	*1
PCX Personal Computer Compatible Instrument System	*1
PIX Parallel Interface Instrument System	*1
RSX EIA-RS-232 Interfaced Instrument System	*1

SWITCHING AND SCANNING

53A-307 Relay Driver	\$650
53A-310 FET Scanner Master	\$1,070
53A-311 FET Scanner Slave	\$700
53A-322 RF Switch (250 MHz)	\$1,100
53A-323 RF Switch (650 MHz)	\$1,700
53A-324 Microwave Scanner (18 GHz)	\$2,400
53A-325 Triple 5-Port Transfer Switch (18 GHz)	\$3,600
53A-326 Microwave Scanner (18 GHz)	\$1,600
53A-331 4-Wire Scanner	\$535
53A-332 2-Wire Scanner with Readback	\$590
53A-333 3-Wire Scanner	\$750
53A-334 1-Wire Scanner	\$750
53A-336 Hi-Voltage Scanner	\$850
53A-339 Thermocouple Scanner	\$775
53A-342 Resistance Programming	\$750
53A-353 SPST Relay Switch	\$750
53A-354 Lo Thermal Relay Switch	\$1,100
53A-355 SPDT/DPST Relay Switch	\$450
53A-356 DPDT Relay Switch	\$450
53A-365 Matrix Relay	\$750

ANALOG STIMULUS AND MEASUREMENT

53A-220 Strain Gage Amplifier	\$1,700
53A-225 Thermocouple	\$1,800
53A-226 Thermocouple	\$1,350
53A-241 2 MHz Arbitrary Waveform Generator	\$1,700
53A-242 10 MHz Arbitrary Waveform Generator	\$2,200

53A-243 25 MHz Arbitrary Waveform Generator	\$3,200
53A-257 Hex D/A Output	\$1,200
53A-258 Eight-Channel D/A Output	\$1,400
53A-260 Pulse Burst Generator	\$535
53A-262 Programmable Rate Generator	\$535
53A-283 Hex Isolation Amplifier	\$1,900
53A-284 Hex Programmable Gain Amplifier	\$2,400
53A-285 Eight Channel Isolation Amplifier	\$1,700
53A-286 Hex Programmable Isolation Amplifier	\$3,500
53A-342 Dual Decade Resistance Programming	\$750
53A-516 Analog Comparator	\$950
53A-518 Transient Digitizer Subsystem	\$3,100
53A-519B Data Acquisition Subsystem	\$1,950
53A-522 Digital Multimeter	\$1,190
53A-525 Waveform Analyzer	\$3,800
53A-540B Quad Totalizing Counter	*1
53A-541 Universal Digitizing Counter	\$1,700

DIGITAL STIMULUS AND MEASUREMENT

53A-260 Pulse Burst Generator	\$535
53A-262 Programmable Rate Generator	\$535
53A-270 Arbitrary Serial Word Generator	\$1,600
53A-410 BCD/Binary Input	\$450
53A-414 BCD/Binary Output	\$450
53A-415 40-Bit Tri-State Output	\$450
53A-416 Hi Voltage Open Collector Output	\$535
53A-431 Quad UART	\$900
53A-488 IEEE-488 Controller/Analyzer	\$450
53A-509 Event Sense	\$600
53A-516 Digital Input	\$950
53A-540B Quad Totalizing Counter	*1
53A-541 Universal Digitizing Counter	\$1,700

AEROSPACE

53A-253 Gaussian Noise Generator	\$1,900
53A-420 ARINC-429 Receiver	\$1,100

53A-421 ARINC-429 Transmitter	\$1,600
53A-424 FDAU Receiver/Tester	\$1,700
53A-425 Quad ARINC-429 Transmitter	\$3,800
53A-426 Quad ARINC-429 Receiver	\$3,500
53A-427 ARINC-429/561 Converter	\$1,300
53A-453 MIL-STD-1553 Simulator/Tester	\$3,200
53A-454 MIL-STD-1553 Real Time RT Simulator/Tester	\$3,700
53A-457 MIL-STD-1553 Intelligent Bus Monitor	\$3,700
53A-570 Synchro to Digital Converter	\$1,900
53A-571 Synchro to Digital Converter	\$1,900
53A-572 Digital to Resolver Converter	\$1,900
53A-573 Resolver to Digital Converter	\$1,900
C2253 Bus Analyzer	\$9,000
C2555 RT Tester	\$24,000

RF/MICROWAVE

53A-322 RF Switch (250 MHz)	\$1,100
53A-323 RF Switch (650 MHz)	\$1,700
53A-324 Microwave Scanner (18 GHz)	\$2,400
53A-325 Triple 5-Port Transfer Switch (18 GHz)	\$3,600
53A-326 Microwave Scanner (18 GHz)	\$1,600
53A-561 2.5 Gigahertz Counter	\$2,100
53A-581 Power Meter	\$2,100

SPECIAL FUNCTIONS

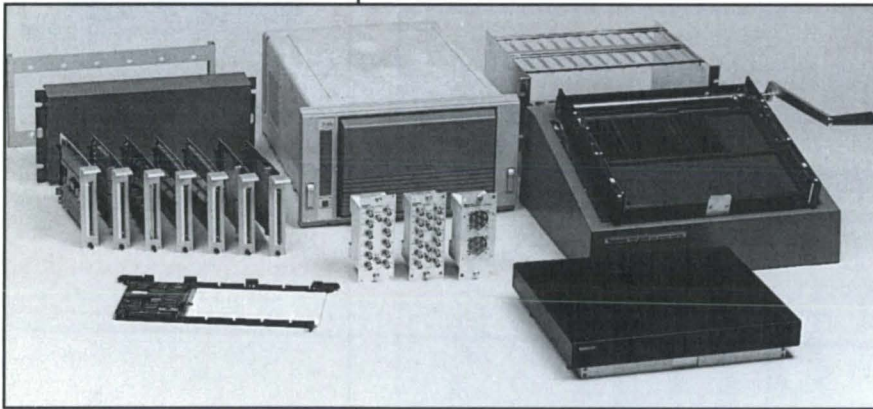
53A-260 Stepping Motor Controller	\$535
53A-530 Bit Error Rate Transmitter	\$1,000
53A-531 Bit Error Rate Receiver	\$1,000
C2240 Floppy Disk System	\$1,495
C2241 Floppy Disk	\$1,895

GENERAL TESTING

53A-450 Wire Wrap Card	\$325
53A-903 I/O Card for IBM or Compatible PC	\$375
53A-931 Integral LCD Display and Function Keyboard	\$1,000
53A-932 Full Keyboard	\$140

\*1 Contact your local sales office for pricing.

# SIGNAL SWITCHING/FIXTURING AND DUT INTERFACING PRODUCTS



TSI 8150 (center rear) and Family

## 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

### 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 <sup>7</sup> operations	10 <sup>5</sup> operations	10 <sup>5</sup> operations	10 <sup>5</sup> 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			

# SIGNAL SWITCHING/FIXTURING AND DUT INTERFACING PRODUCTS

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.

### TSI 8150 FAMILY SCANNER CARD SELECTION GUIDE

Features	TSS41	TSS42	TSS43	TSS48
Thermal Offset	Std: < 40 $\mu$ V differential (< 80 $\mu$ V with tree switch); Opt. 01: < 1 $\mu$ V (< 2 $\mu$ V with tree switch)	< 100 $\mu$ V	< 100 $\mu$ V	< 100 $\mu$ V
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 $\Omega$ (each wire)	< 150 m $\Omega$ < 250 m $\Omega$ <sup>*1</sup>	< 150 m $\Omega$	< 150 m $\Omega$ < 250 m $\Omega$ <sup>*1</sup>
Switch Life	10 <sup>8</sup> @ signal level 10 <sup>6</sup> @ rated load	10 <sup>9</sup> @ signal level 10 <sup>7</sup> @ rated load 10 <sup>8</sup> @ signal level <sup>*1</sup> 10 <sup>6</sup> @ rated load <sup>*1</sup>	3x10 <sup>7</sup> mechanical 10 <sup>5</sup> @ rated load	10 <sup>9</sup> @ signal level 10 <sup>7</sup> @ rated load 10 <sup>8</sup> @ signal level <sup>*1</sup> 10 <sup>9</sup> @ rated load <sup>*1</sup>
Switch Closures	20 3PST (high, low, and guard)	30 SPST	10 SPDT	30 SPST 32 SPST <sup>*2</sup>
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				

<sup>\*1</sup> Option 01 (and 03 for TSS48)

<sup>\*2</sup> Options 02 and 03

### ORDERING INFORMATION

<b>TSI 8150 Test System Interface</b> Includes: Rackmounting hardware; User's Manual; Configuration manual; Programmer's reference guide; Power cord.	<b>\$3,995</b>	<b>Opt. A4</b> - North American 240 V, 60 Hz <b>Opt. A5</b> - Switzerland 220 V, 50 Hz	<b>NC</b> <b>NC</b>	<b>Auxiliary HF Mounting Unit</b> - For TSS44, TSS45, and TSS46. Order 016-0862-00	<b>\$180</b>
<b>TSX 8140 Expansion Chassis</b> Includes: Rackmounting hardware; Instruction sheet; TSI 8150 interconnection cable and buffer board; Ground strap; Power cord.	<b>\$3,745</b>	<b>TSS41/TSS42/TSS43/TSS48</b> <b>Opt. 10</b> - Delete Front Panel (for installation in Auxiliary Card Rack)	<b>NC</b>	<b>Extension Cable Kit</b> - Incl. 30.5 m (100') of cable and 24 connectors. Order 198-5579-01	<b>\$440</b>
<b>TSA 8140 Test System Adapter</b>	<b>\$695</b>	<b>TSS41</b> <b>Opt. 01</b> - Substitute 1 $\mu$ V thermal differential relays	<b>+ \$425</b>	<b>Extension Cable Assembly</b> - Six 2-meter (6.5') extension cables. Order 198-5581-01	<b>\$330</b>
<b>016-0861-00 Auxiliary Card Mounting Rack</b>	<b>\$410</b>	<b>TSS42/TSS48</b> <b>Opt. 01</b> - Substitute dry-reed relays	<b>NC</b>	<b>Test Head Receiver</b> - Compatible with test fixtures from Virginia Panel. Order 021-0435-00	<b>\$3,745</b>
<b>016-0862-00 Auxiliary High-Frequency Mounting Unit</b>	<b>\$180</b>	<b>TSS44/TSS45</b> <b>Opt. 09</b> - Move output commons to rear panel	<b>NC</b>	<b>Interchangeable Test Adapters</b> - Full-size: Order 021-0434-00 Half-size: Order 021-0436-00 Extended-frame: Order 021-0441-00	<b>\$590</b> <b>\$670</b> <b>\$850</b>
<b>TSD42 32 bit General-Purpose Digital Interface Card</b>	<b>\$595</b>	<b>TSS45</b> <b>Opt. 01</b> - Substitute 75 $\Omega$ relays <b>Opt. 02</b> - Add back-termination	<b>+ \$150</b> <b>+ \$150</b>	<b>TSA F01: Rackmounting Hardware Kit</b> for TSA 8140	<b>\$210</b>
<b>TSS40 Scanner Control Assembly</b>	<b>\$395</b>	<b>TSS46</b> <b>Opt. 02</b> - Add back-termination	<b>+ \$550</b>	<b>TSA F09: Universal LF Quick Connect</b>	<b>\$530</b>
<b>TSS41 Low-Level Scanner Card</b>	<b>\$795</b>	<b>TSS48</b> <b>Opt. 02</b> - Substitute 2x16 matrix configuration <b>Opt. 03</b> - Substitute dry-reed relays in 2x16 matrix	<b>+ \$50</b> <b>+ \$50</b>	<b>TSA F11A: HF Quick Connect</b>	<b>\$450</b>
<b>TSS42 General-Purpose Scanner Card</b>	<b>\$795</b>	<b>OPTIONAL ACCESSORIES</b>		<b>ITA/Rcvr/Power Probe Scanner Kit</b> - Complete support kit. Order 021-0444-00	<b>\$400</b>
<b>TSS43 Power Switch Card</b>	<b>\$595</b>	<b>System Service Manual</b> - Order 070-5767-01	<b>\$70</b>	<b>ITA Probe Scanner Kit</b> - Support for additional ITAs. Order 021-0443-00	<b>\$145</b>
<b>TSS44 Coax Scanner Module</b>	<b>\$795</b>	<b>Card Extender (Service)</b> - Order 067-0162-00	<b>\$185</b>	<b>Virginia Panel Fixturing Kits</b> - Contact Tek Sales Representative for detailed descriptions.	
<b>TSS45 RF Scanner Module</b>	<b>\$1,195</b>	<b>Auxiliary Card Mounting Rack</b> - For TSD42, TSS41, TSS42, TSS43, TSS48, 021-0417-xx, and 021-0418-xx. Order 016-0861-00	<b>\$410</b>	<b>128-Ch. Bed-of-Nails Kit</b> - Order 021-0448-00	<b>\$240</b>
<b>TSS46 Microwave Scanner Module</b>	<b>\$2,295</b>			<b>Interface Tool Kit</b> - Order 021-0450-00	<b>\$1,925</b>
<b>TSS48 Matrix Switch Card</b>	<b>\$795</b>			<b>24-Ch. RF Kit</b> - Order 021-0454-00	<b>\$670</b>
<b>021-0417-00 High-Current Driver Card</b>	<b>\$495</b>			<b>8-Ch. Microwave Kit</b> - Order 021-0455-00	<b>\$2,380</b>
<b>021-0418-00 60 mA Driver Card</b>	<b>\$395</b>				
<b>OPTIONS</b>					
<b>INTERNATIONAL POWER PLUG OPTIONS</b>					
<b>Opt. A1</b> - Universal Euro 220 V, 50 Hz	<b>NC</b>				
<b>Opt. A2</b> - UK 240 V, 50 Hz	<b>NC</b>				
<b>Opt. A3</b> - Australian 240 V, 50 Hz	<b>NC</b>				

# MANUFACTURING TEST SYSTEMS

- Fully Integrated Functional Test Systems
- Cost Reduction Through Automation
- No Hidden Costs
- Fixed Price Quotes
- Manufacturing Deadlines Met
- Fixed Project Schedules
- Project Management to Provide Total Test Solutions

## MANUFACTURING TEST SYSTEMS

Tektronix provides flexible automated test solutions for manufacturing test. Tek offers relief to manufacturers facing this testing dilemma by becoming an extension to their resources and providing Total Test Systems Solutions for specific test and measurement problems. Tek's line of GPIB/VXI-compatible system components make it possible to build a unique automated test system (at a reasonable price) that can easily be adapted to other applications. But Tektronix provides more than just hardware.

After working with your Tek system specialist, a complete proposal outlining all elements of your final system solution is presented.

Then, with each system, Tek offers the following:

- Design Services
- Project Management
- Complete Documentation
- Software and Fixturing Development
- On-site Installation
- Maintenance and Repair Services
- Technical Support

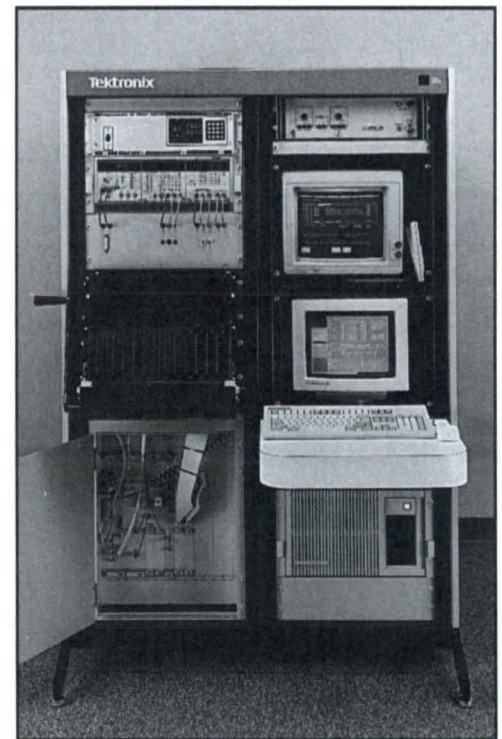
The result is a totally integrated system, built to fit your test application - a test system manufactured with the same care and quality standards that have made Tektronix a leader in test equipment manufacturing for over 40 years.

The Tektronix System Solutions Unit specializes in automated functional test for commercial and military sectors. Some of the manufacturing test systems Tek has manufactured and 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

Tektronix provides the total solutions approach freeing your staff from the burdensome task of system development with a full line of support services. From the first visit to final installation, you can select whatever level of Tektronix services that you require.

Initially, Tek specialists can help define a solution for your testing needs. Then, Tek can provide a development program that integrates the efforts of everyone involved to produce your system on time, with the capabilities you need, and with the required maintenance and system support firmly in place. Our goals are the same as yours—cost effective solutions that meet your deadlines, budgets and specifications.



*Combined Analog and Digital Video Test System*



*Tektronix Test System Manufacturing*



TM 500 and TM 5000 instruments provide the answers to a broad range of test and measurement needs. You can choose from over 50 compact plug-ins to create multifunction 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.

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. 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 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 5006A 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 5006A has six. All TM 5000 and many of the TM 500 instruments are UL listed.

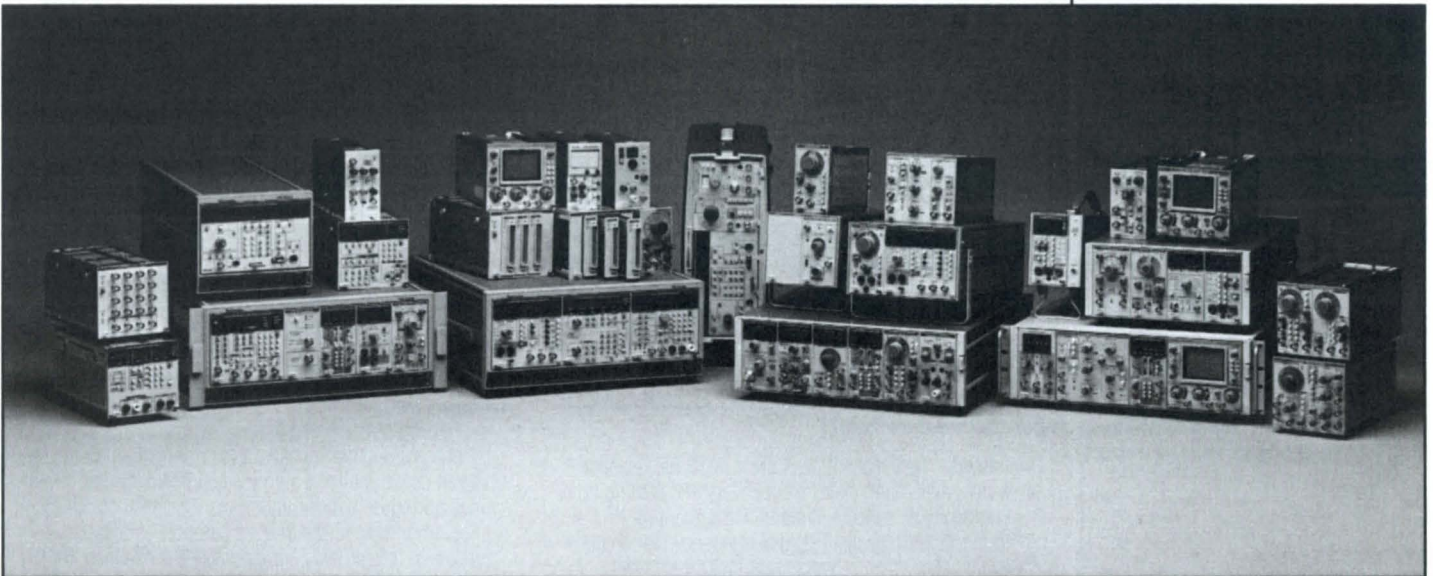
Adherence to standard form and fit means that any TM 500/TM 5000 instruments can be replaced in a system without the uncabling, unstacking, restacking, and recabling that is necessary with most instruments. Rebuilding the system for different tasks takes seconds, not hours.

The TM 500/TM 5000 line of modular instruments is designed so 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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## FUNCTION GENERATORS

Function generators stimulate devices and circuits under test by simulating typical waveforms. Stimulation can be applied to circuits ranging from a single logic device to a satellite communications system or a heart pacemaker. Waveforms simulated can range from a simple train of pulses to representations of spread-spectrum modulated RF signals or cardiac systole. All of them offer sine, triangle, and square-wave outputs. Many provide ramp and pulse outputs, obtained by varying the symmetry of triangle and square waves. That is, variable symmetry lets you take a triangle wave and increase the slew rate of its leading edge while decreasing the slew rate of its trailing edge, simulating the sweep functions used in raster-scan display devices. Varying the symmetry of square waves lets you emulate a pulse generator by giving you precise control over pulse width and duty cycle. The need for sines, ramps and pulses is easy to understand, but when do you need triangle and square waves? Triangle waves are used to characterize or verify tracking, detection, switching or trip points. They help determine the switching thresholds of comparators, Schmitt triggers, peak detectors, A-to-D converters, and hysteresis circuits. Square waves help characterize the switching response of amplifiers, gates, and level

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.

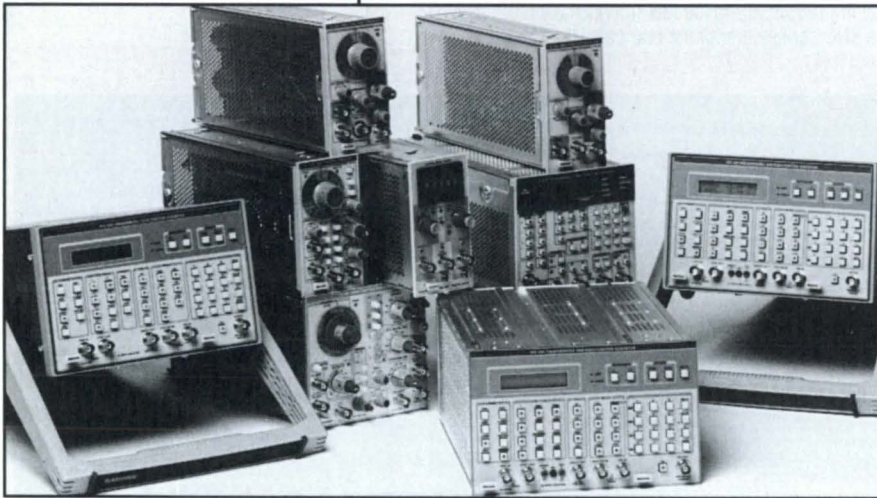
There are extensive applications for modulated signals. In addition to simulating buffer- and output-stage RF amplifiers, amplitude modulated signals can stimulate detectors and automatic gain and level control stages in receivers. With frequency modulation, driving the input with a binary digital signal 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.

## 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. Waveforms can be downloaded from a digital oscilloscope or created by 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 1 $\mu$ Hz to 1 MHz.



*TM 5000/TM 500 Arbitrary, Pulse and Function Generators*

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.





## PULSE/FUNCTION GENERATORS

Pulse/Function generators add pulse capabilities to all the features found in a function generator. Combining the performance of two products into one instrument makes a very economic solution.

## ARBITRARY WAVEFORM GENERATION SOFTWARE

WaveWriter™ is the new software support package for creating and modifying arbitrary waveforms for the Tektronix AFG 5101/AFG 5501 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 differential signal or identify a failure.

For more information on WaveWriter, please turn to page 262 in the Test and Measurement Software section of this catalog.



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.

## FUNCTION GENERATOR SELECTION GUIDE

	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)	0.002 to 2 M	0.1 to 11 M	1 to 3 M	0.001 to 40 M	0.002 to 20 M	0.012 to 12 M	0.012 to 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
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	≤0.5%, 10 to 50 k	≤0.5%, 1 to 30 k;	≤0.5%, 20 to 40 k	±0.5%, 20 to 19.99 k	<0.6%, 121 Hz to 120 k	<0.6%, 121 Hz to 120 k
Amplitude Modulation	No	No	No	Yes	Yes	Yes	Yes
IEEE STD 488.1 1987					Yes	Yes	Yes
Modules Size	1 wide	1 wide	1 wide	2 wide	2 wide	3 wide	3 wide
Price	\$1,095	\$1,250	\$790	\$3,695	\$4,495	\$3,695/\$4,395	\$3,295/\$4,195

# SIGNAL SOURCES



## AFG 5101/AFG 5501 Arbitrary/Function Generators

- Fully Programmable from Front Panel or GPIB
- Standard and Arbitrary Waveform Generation from 1  $\mu$ Hz 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

<b>AFG 5101</b> Programmable Arbitrary/ Function Generator (plug-in)	<b>\$3,695</b>
Includes: Instrument manual (070-6759-00); Reference guide; Instrument interfacing guide (070-6930-00).	
<b>AFG 5501</b> Programmable Arbitrary/ Function Generator (monolithic)	<b>\$4,395</b>
Includes: Instrument manual (070-6759-00); Reference guide; Instrument interfacing guide (070-6930-00).	
<b>OPTIONS</b>	
Opt. 02 – Adds a frequency lock synthesizer	<b>+\$350</b>
<b>ACCESSORY</b>	
Service Manual – 070-6760-00	<b>\$55</b>

## 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 5006A Power Module Mainframe. The AFG 5501 is the AFG 5101 mounted in a three-wide GPIB power module.

### 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. For Sine, Square, Triangle and DC specs, see common specifications on following page.

### OPERATING MODES

For Continuous, Triggered, Gated, Burst and Increment, see common specifications.

**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 selected.

**Modulation** – The analog generator can be frequency and amplitude modulated. Arbitrary waveforms can be amplitude modulated only.

### 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).

For Accuracy, Jitter, Stability specifications, see common specifications.

### OUTPUT

For specs on Amplitude Range, Amplitude Resolution, Amplitude Accuracy, Repeatability, Amplitude Flatness, Offset Range, Offset Resolution, Output Impedance and Output Protection, see common specifications.

### WAVEFORM

For specs on Sine Distortion, Square Wave Symmetry, Triangle Linearity, DC Range and DC Accuracy, see common specifications.

### 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** –  $\pm 2.5\% \pm 20$  mV of programmed p-p amplitude when arbitrary data point peak values are  $\pm 2047$  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  $\pm 20\%$ .

2 – Typically 100 kHz  $\pm 20\%$ .

3 – Typically 11 kHz  $\pm 20\%$ .

4 – Typically 1.3 kHz  $\pm 20\%$ .

**Internal Trigger** – see common specifications.

### FREQUENCY SWEEP

**Sweep Types** – Linear, logarithmic, arbitrary.

For specs on Sweep Time, Sweep Width, Sweep Ranges, see common specifications.

For specs on Inputs, Outputs and Synthesizer Option, see common specifications.

### GENERAL

**Environmental** – Operating: 0 to 50°C.

Non-operating:  $-55$  to  $+75^\circ\text{C}$ .

**Power Consumption** – 50 VA maximum, limited by internal fuse.

**Power Dissipation** – AFG 5101: 30 W, AFG 5501: 90 W.



## CHARACTERISTICS

### AFG 5101/AFG 5501 AND PFG 5505/ PFG 5105 COMMON SPECIFICATIONS

**Waveforms** – Sine, square, triangle, 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.

**Gated** – Same as triggered mode except waveform is executed for the duration of the gated signal.

**Burst** – Same as triggered mode for programmed number of cycles from 1 to 9999.

**Sweep** – Linear, programmable start frequency, stop frequency, and rate. Sweeps can be continuous, triggered, gated, or burst.

**Modulation** – Frequency and amplitude.

**Increment** – Frequency, amplitude, offset, rate, width, delay, and NBurst can be manually incremented/decremented by a settable INCREMENT delta.

#### 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** –  $\pm 0.2\%$  of reading from 121 Hz to 5 MHz in continuous mode.  $\pm 0.5\%$  of reading from 5 to 12 MHz in continuous mode;  $\pm 5\%$  of reading from 0.1 to 120 Hz in continuous mode.

**Jitter** –  $< 0.1\%$  to 5 MHz.

**Stability** –  $\pm 0.2\%$  in continuous mode for all time intervals.  $\pm 0.5\%$  for 24 hours in other modes.

#### OUTPUT CHARACTERISTICS

**Amplitude Range** – 10 mV to 9.99 V p-p into 50  $\Omega$  (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  $\Omega$ ; 1 mV from 0.1 to 0.999 V p-p into 50  $\Omega$ ; 1 mV from 10 to 99 mV p-p into 50  $\Omega$ .

**Amplitude Accuracy** –  $\pm 2.0\%$   $\pm 20\%$  mV of programmed value for 1.0 to 9.99 V output at 20 to 30°C;  $\pm 5\%$   $\pm 5$  mV for 10 to 999 mV output, specified for a sine, square, or triangle wave output at 1 kHz.

**Amplitude Flatness** – 0.5 dB from 0.012 Hz to 120 kHz,  $\pm 2$  dB to 1.2 MHz,  $\pm 3$  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  $\Omega$ ; 0.499 V from 0.1 to 0.999 V into 50  $\Omega$ ; 0.049 V from 0.01 to 0.099 V into 50  $\Omega$ .

**Offset Resolution** – 3 digits; 1 mV when p-p amplitude is  $< 999$  mV; 10 mV when p-p amplitude is  $> 1$  V, (into 50  $\Omega$ ).

**Offset Accuracy** –  $\pm 0.6\%$   $\pm 20$  mV (into 50  $\Omega$ ).

**Output Impedance** – 50  $\Omega$

#### 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;  $\pm 1\%$  0.012 kHz to 1.200 MHz;  $\pm 5\%$  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  $\pm 20$  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** –  $\pm 10$  mV to  $\pm 4.99$  Vdc from 50  $\Omega$  (into 50  $\Omega$ ).

**DC Accuracy** –  $\pm 0.6\%$   $\pm 20$  mV in DC function only, (into 50  $\Omega$ ).

#### INTERNAL TRIGGER ANALOG FUNCTIONS ONLY

**Range** – Repetition rate 100 ns to 999.9 sec.

**Resolution** – 4 digits, 1 ns maximum.

**Accuracy** – 0.01%.

#### FREQUENCY SWEEP

**Sweep Type** – Linear only.

**Sweep Time** – 100 ns to 999.9 s per point. 1 ns max 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 to 12 Hz.

#### INPUTS AND OUTPUTS

**VCF Input** – 5 V p-p for a 500:1 minimum frequency change.

**Trigger IN** – TTL compatible. Nominal impedance: 10 k $\Omega$ . Maximum rate: 6 MHz. Minimum width: 20 ns.

**AM Input** – Input resistance: 10 k $\Omega$  nominal. 5 V p-p (0 to  $\pm 5$  V dc) for 100% modulation. Bandwidth: dc to 20 kHz minimum.

**Sync Output** – TTL level squarewave at programmed frequency.

**Sweep Output** – Source resistance 600  $\Omega$ ; same waveshape as selected sweep. Amplitude depends on start and stop frequency and a 5 V limit.

#### SYNTHESIZER OPTION

**Range** – 12.1 Hz to 12 MHz.

**Resolution** – Frequency resolution (LSD of display) is 10 Hz on lowest range and 1 kHz on highest frequency range (4.5 digits, or 12,000 counts).

**Accuracy** –  $\pm 50$  ppm averaged measurement.

**Stability** –  $\pm 10$  ppm/°C or better.

**Setting time** – Typically less than 2 s plus 100 cycles.

**Jitter** –  $\pm 0.1\%$  from 12.1 Hz to 12 MHz.

## AFG 5101/AFG 5501 Arbitrary/Function Generator

## PFG 5105/PFG 5505 Pulse/Function Generator

## Common Function Generator Specifications

# SIGNAL SOURCES



## PFG 5105/PFG 5505 Pulse/Function Generators

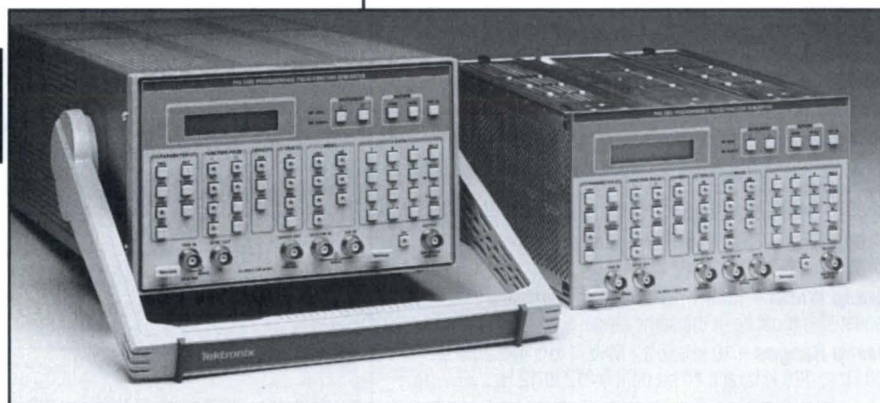
- 0.012 Hz to 12 MHz;  
Accuracies to 0.005% with  
Synthesizer Option
- Programmable Width and  
Delay
- 10 mV to 9.99 V p-p Into  
50 Ohms
- Continuous, Triggered,  
Gated and Burst, AM, VCF  
and Linear Sweep Modes
- Non-Volatile Storage for 99  
Front Panel Settings

### 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.



PFG 5505/5105 Pulse Function Generators.

**GPIB**  
IEEE-488

\*The PFG 5105/PFG 5505 comply with IEEE Standard 488.1-1987 and with Tektronix Standard Codes and Formats

### ORDERING INFORMATION

**PFG 5105** Function Generator **\$3,295**

Includes: Instrument manual (070-7331-00); Reference guide; Instrument interface guide (070-7329-00).

**PFG 5505** Function Generator **\$4,195**

Includes: Instrument manual (070-7331-00); Reference guide; Instrument interface guide (070-7329-00).

#### OPTION

**Opt. 02** – Adds a frequency lock synthesizer **+\$350**

#### ACCESSORY

**Service Manual** – 070-7332-00 **\$50**

### CHARACTERISTICS

**Waveforms** – Sine, square, triangle, pulse, double pulse, and dc.

For Sine, Square, Triangle and DC specifications, see common specification on facing page.

### OPERATING MODES

**Continuous** – Continuous, Triggered, Gated, Burst, Sweep, Modulation, and Increment, see common specifications.

### 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** –  $\pm 0.01\%$  for pulse modes with internal triggering. For other Accuracy, Jitter and Stability specifications, see common specifications.

**Output** – For specifications on Amplitude Range, Amplitude Resolution, Amplitude Accuracy, Repeatability, Amplitude Flatness, Offset Range, Offset Resolution, and Output Impedance, see common specifications.

**Waveforms** – For specifications on Sine Distortion, Square Wave Symmetry, Triangle Linearity, DC Range and DC Accuracy, see common specifications.

**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  $\pm 20$  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.

**Pulse Width and Delay** – 40 ns to 99.9 ms.

**Resolution** – 3 digits, 10 ns maximum.

**Accuracy** –  $\pm 5\%$  of programmed value,  $\pm 10$  ns.

**Repeatability** –  $\pm 1\%$ ,  $\pm 5$  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.

**Internal Trigger** – See common specifications.

**Frequency Sweep** – See common specifications.

**Inputs and Outputs** – See common specifications.

**Synthesizer Option** – See common specifications.

### GENERAL

**Environmental** – Operating: 0 to 50°C.

Non-Operating:  $-55$  to  $+75$ °C.

**Power Consumption** – 50 VA maximum limited by internal fuse.

**Power Dissipation** – PFG 5105: 30W, PFG 5505: 90 W.

### 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

The PFG 5105/PFG 5505 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.

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.



## 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  $\pm$  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  $\pm 7.5$  V in 10 mV steps.

## CHARACTERISTICS

**Frequency Range** – 0.002 Hz to 20 MHz.

**Accuracy** – Continuous mode,  $\pm 0.1\%$ ; Trigger, Gate, Burst Modes, Frequency  $\leq 200$  Hz,  $\pm 0.1\%$ ; frequency  $> 200$  Hz,  $\pm 5.0\%$ .

**Resolution** – Continuous mode, 4 digits; Trigger, Gate, Burst modes, Frequency  $\leq 200$  Hz, 4 digits; Frequency  $> 200$  Hz, 3 digits.

**Frequency Stability** –  $\leq 0.05\%$  of full scale for 1 hour,  $\leq 0.05\%$  of full scale for 24 hours.

**Amplitude** – Range: 20 mV to 20 V p-p into open circuit, 10 mV to 10 V p-p into 50  $\Omega$ .

**Triangle Amplitude Flatness** –  $\pm 2\%$ , 0.002 Hz to 1 kHz;  $\pm 3.5\%$ , 1 kHz to 100 kHz;  $\pm 4\%$ , 100 kHz to 1 MHz;  $+4\%$ ,  $-5\%$ , 1 to 5 MHz;  $+4\%$ ,  $-20\%$  5 to 20 MHz.

**Square Amplitude Flatness** –  $\pm 2\%$ , 0.002 Hz to 1 kHz;  $\pm 3.5\%$ , 1 kHz to 1 MHz;  $\pm 5\%$ , 1 to 10 MHz;  $\pm 10\%$ , 10 to 20 MHz.

**Sinewave Amplitude Flatness** –  $\pm 3\%$ , 0.002 Hz to 1 kHz;  $\pm 3.5\%$ , 1 kHz to 1 MHz;  $\pm 5\%$ , 1 to 5 MHz;  $+5\%$ ,  $-10\%$ , 5 to 20 MHz.

**Offset** – Range:  $\pm 10$  mV to  $\pm 7.5$  V open circuit;  $\pm 5$  mV to  $\pm 3.75$  V into 50  $\Omega$  load. Maximum peak signal plus offset is  $\pm 15$  V open circuit,  $\pm 7.5$  V into 50  $\Omega$  load. Accuracy:  $\leq \pm 1\%$  of the selected offset,  $+2\%$  of the signal p-p amplitude,  $+20$  mV. Resolution: 10 mV open circuit, 5 mV into 50  $\Omega$  load. 0 V is also provided.

**Output Impedance** – 50  $\Omega$ .

**Sinewave Distortion** – 20 Hz to 19.99 kHz,  $\leq 0.5\%$ ; 20.0 kHz to 99.99 kHz,  $\leq 1.0\%$ ; 100 kHz to 20.0 MHz,

harmonics  $>30$  dB down. Valid from  $+15^\circ\text{C}$  to  $+35^\circ\text{C}$  into 50  $\Omega$  load with 0 V offset, continuous mode, 50% symmetry, and AM, FM, VCF, and Complement off.

**Square Wave Response** –  $\leq 10$ -ns rise/fall;  $\leq \pm(5\% + 20$  mV) aberrations.

**Symmetry** – 10 to 90%, 1% steps,  $\pm 2\%$  accuracy. Range above 4 MHz is limited by 25 ns minimum triangle transition time (decreases to 50% at 20 MHz).

**Triangle Linearity** –  $>99\%$  to 100 kHz;  $>98\%$  to 2 MHz;  $>90\%$  to 20 MHz.



**Trigger Output** – 0  $\pm 100$  mV to  $\geq 2$  V from 50  $\Omega$  into an open circuit.

**TRIG, GATE, BURST, AND PH LOCK INPUT**  
**Trigger Input** – 1 M  $\Omega$ /50  $\Omega$  selectable; 0.0 V/0.5 V selectable.

**Amplitude Sensitivity** –  $\leq 250$  mV p-p.

**Maximum Input Amplitude** –  $\pm 5$  V peak into 50  $\Omega$ ,  $\pm 20$  V peak into 1 M  $\Omega$ .

**Burst Range** – 1 to 9999 cycles.

**Amplitude Modulation** – 100% with 5 V p-p, DC to  $\geq 100$  kHz,  $< 2\%$  distortion to 2 MHz at 70%,  $< 4\%$  to 20 MHz at 70%. Max. Amp.  $\pm 20$  V.

**Frequency Modulation** – DC to  $\geq 100$  kHz,  $\leq 2\%$  distortion, Max. Amp.  $\pm 20$  V.

**VCF Modulation** – 0 to 10 V produces  $>1000:1$  Frequency change, DC to  $\geq 100$  kHz,  $\geq 0.063$  V/ $\mu\text{s}$  slew rate, Max. Amp.  $\pm 20$  V.

**Output Holdmode** – 0.002 to 200 Hz

**Phase Range** –  $\pm 90^\circ$  to 1 MHz,  $\pm 47^\circ$  to 20 MHz. Resolution  $1^\circ$ .

**Phase Lock Range** –  $\pm 90^\circ$  to 10 MHz,  $\pm 50^\circ$  to 20 MHz. Resolution  $1^\circ$ .

## GENERAL

**Environmental** – Operating: 0 to  $50^\circ\text{C}$ .

Non-operating:  $-55$  to  $+75^\circ\text{C}$ .

**Power Consumption** – 60 W.

## FG 5010 Programmable Function Generator

- 0.002 Hz to 20 MHz
- Up to 20 V p-p From 50  $\Omega$
- 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** **\$4,495**  
Includes: Instruction manual (070-3467-01); Instrument Interfacing Guide (070-4613-00); Reference Guide (070-3561-00).

**GPIB\***  
IEEE-488

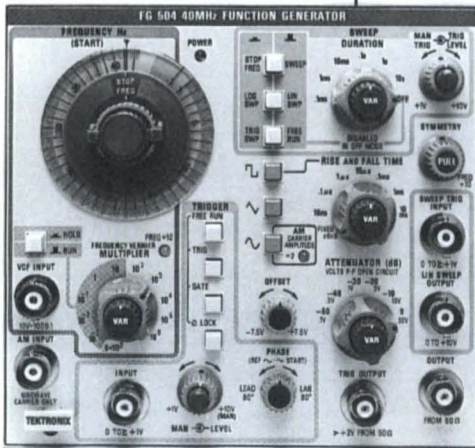
\*The FG 5010 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# SIGNAL SOURCES



## FG 504 Function Generator

- 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



### FG 504

The FG 504 provides the three basic waveforms of sine, square and triangle plus a wide range of shaping with variable rise/fall times and symmetry controls. Pulses and ramps are easily generated.

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  $\pm 7.5$  V offset range with small signals. The FG 504 output can be swept, or amplitude or frequency modulated by external signals. In addition, the FG 504 can supply internally generated linear- or logarithmic-swept frequencies of up to a 1000:1 range with convenient control of start and stop frequencies.

The FG 504 also provides trigger output, external voltage-control input, and sweep output.

### CHARACTERISTICS

**Frequency Range** – 0.001 Hz to 40 MHz, to 4 MHz with variable symmetry.

**Symmetry Range** – 7% to 93% variable.

**Dial Accuracy** –  $\leq 3\%$  to 4 MHz,  $\leq 6\%$  to 40 MHz.

**Custom Frequency Change** – Includes cap. for 20 Hz to 20 kHz.

**Frequency Stability** –  $\leq 0.05\%$  for 10 min.,  $\leq 0.1\%$  for 1 hour,  $\leq 0.5\%$  for 24 hours, constant temperature.

**Amplitude** – 30 V p-p into open circuit, 15 V p-p into 50  $\Omega$ .

**Attenuator in 10 dB Steps** – 0 to -50 dB.

**VAR Control** – Variable control provides up to -20 dB additional attenuation.

**Offset** –  $\pm 7.5$  V into open circuit,  $\pm 3.75$  V into 50  $\Omega$ .

**Amplitude Flatness** – Sinewave and Triangle –  $\pm 0.5$  dB to 40 kHz,  $\pm 2$  dB to 40 MHz. Square –  $\pm 0.5$  dB to 20 MHz,  $\pm 2$  dB to 40 MHz.

**Sinewave Distortion** –  $\leq 0.5\%$ , 20 Hz to 40 kHz.

**Square-Wave Response** –  $\leq 6$  ns rise/fall fixed, 10 ns to 100 ms variable;  $\leq 5\%$  p-p + 30 mV aberrations.

**Triangle Linearity** –  $\geq 99\%$ , 10 Hz to 400 kHz;  $\geq 98\%$ , 400 kHz to 4 MHz.  $\geq 90\%$ , 4 MHz to 40 MHz.

**Trigger Output** – +2 from 50  $\Omega$ .

**External Trigger Input** – Impedance  $\geq 10$  k $\Omega$ ; Sensitivity  $\leq 1$  V p-p; Trigger level; -1 to +10 V.

**Phase Lock** – 100 Hz to 40 MHz  $\pm 80^\circ$  phase range.

**Internal Sweep** – Logarithmic or Linear. Separate Start/Stop Dials.

**Duration** – 0.1 ms to 100 s, in six decades.

**Ramp Output** – 0 V to 10 V from 1 k $\Omega$ .

**Amplitude Modulation** – 100% with  $\approx 5$  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.

**VCF** – Up to 1000:1 Frequency change with 10 V external signal. Slew rate  $\geq 0.3$  V/ms.

**Environmental** – Operating: 0 to 40°C (Forced air required for 40 to 50°C). Non-operating: -40 to +75°C.

### ORDERING INFORMATION

FG 504 40 MHz Function Generator **\$3,695**  
Includes: Instruction manual (070-2655-00).

## FG 503 Function Generator

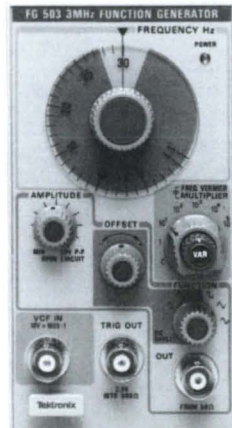
- 1.0 Hz to 3 MHz
- Three Waveforms
- Up to 20 V p-p Output
- Up to  $\pm 7.5$  V Offset
- VCF

### ORDERING INFORMATION

FG 503 3-MHz Function Generator **\$790**  
Includes: Instruction manual (070-1727-01).

### 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  $\Omega$  load (20 V peak-to-peak open circuit). Selectable offset up to 3.75 V dc across 50  $\Omega$  (7.5 V dc open circuit) is also featured.

### CHARACTERISTICS

**Frequency Range** – 1 Hz to 3 MHz (0.01 Hz to 5 MHz usable).

**Symmetry** – 50% fixed.

**Dial Accuracy** –  $\pm 5\%$  of F.S 1 Hz to 3 MHz.

**Custom Frequency Range** – With user installed cap.

**Frequency Stability** –  $\leq 0.05\%$  to 10 mins.  $\leq 0.1\%$  for 1 hour,  $\leq 0.5\%$  for 24 hours, constant temperature.

**Amplitude** – 20 V p-p into open circuit, 10 V p-p into 50  $\Omega$ .

**Offset** –  $\pm 7.5$  V into open circuit,  $\pm 3.75$  V into 50  $\Omega$ .

**Amplitude Flatness** – Within  $\pm 2$  dB referenced at 10 kHz.

**Sinewave Distortion** –  $\leq 0.5\%$  to 30 kHz,  $\leq 1\%$  to 300 kHz,  $\leq 2.5\%$  to 3 MHz.

**Square Wave Response** –  $\leq 60$  ns rise/fall;  $\leq 3\%$  p-p aberrations. (50  $\Omega$  load).

**Triangle Linearity** – Typically  $\geq 99\%$ , 1 to 100 kHz;  $\geq 95\%$ , 100 kHz to 3 MHz.

**Trigger Output** – +2.5 to 600  $\Omega$  load.

**VCF** – Up to 1000:1 frequency change with 10 V external signal. Slew rate  $\geq 0.3$  V/ms.



## 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** – 0.1 Hz to 11 MHz.

**Symmetry Range** – 5%, 50%, 95% fixed.

**Dial Accuracy** –  $\leq 3\%$  to 1 MHz,  $\leq 5\%$  to 10 MHz.

**Frequency Stability** –  $\leq 0.05\%$  for 10 min.,  $\leq 0.1\%$  for 1 hour,  $\leq 0.5\%$  for 24 hours, constant temperature.

**Amplitude** – 10 V p-p into open circuit, 5 V p-p into 50  $\Omega$ .

**Offset** –  $\pm 5$  V into open circuit,  $\pm 2.5$  V into 50  $\Omega$ .

**Amplitude Flatness** – Sinewave,  $\leq \pm 1.5$  dB referenced at 10 kHz; Triangle and squarewave,  $\pm 3$  dB referenced to sinewave.

**Sinewave Distortion** –  $\leq 0.5\%$  to 50 kHz; Harmonics  $\leq -30$  dB at all other frequencies.

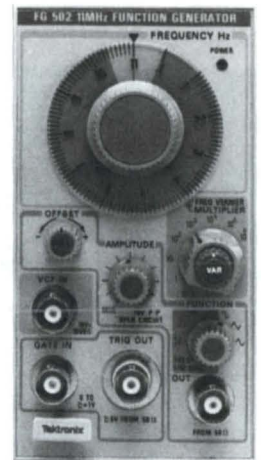
**Square Wave Response** –  $\leq 20$  ns rise/fall;  $\leq 3\%$  p-p aberrations.

**Triangle Linearity** – Typically  $\geq 99\%$ , 0.1 to 110 kHz  $> 97\%$ , 100 kHz to 1.1 MHz;  $\geq 95\%$ , 1 to 11 MHz.

**Trigger Output** –  $+ 2.5$  to 50  $\Omega$  load.

**External Input** – Impedance  $\approx 1$  k $\Omega$ ;  $\geq + 2$  V gate signal required.

**VCF** – Up to 1000:1 frequency change with 10 V external signal. Slew rate  $\geq 0.3$  V/ms.



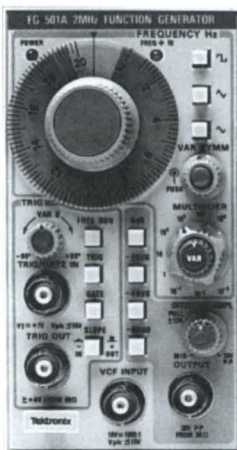
## FG 502 Function Generator

- 0.1 Hz to 11 MHz
- Five Waveforms
- VCF and Gated Burst

## 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  $\pm 13$  V of offset from a 50  $\Omega$  source. Waveform triggering and

gating are provided with a variable phase control to permit up to  $\pm 90^\circ$  of phase shift for generating haversines, sine pulses, and havers 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  $\leq 25$  ns. Audio sine-wave distortion is  $\leq 0.25$  and audio amplitude flatness is within 0.1 dB.



## CHARACTERISTICS

**Frequency Range** – 0.002 Hz to 2 MHz.

**Symmetry Range** –  $\leq 5\%$  to  $\geq 95\%$  variable.

**Dial Accuracy** –  $\leq 3\%$ , 20 to 2 on dial.

**Frequency Stability** –  $\leq 0.05\%$  for 10 min.,  $\leq 0.1\%$  for 1 hour,  $\leq 0.5\%$  for 24 hours, constant temperature.

**Amplitude** – 30 V p-p into open circuit, 15 V p-p into 50  $\Omega$ .

**Offset** –  $\pm 13$  V into open circuit,  $\pm 6.5$  V into 50  $\Omega$ .

**Attenuator (dB) in 20 dB Steps** – 0 to  $-60$ .

**Attenuator with AMPL Control** –  $> 20$  dB additional.

**Amplitude Flatness** – Sinewave,  $\pm 0.1$  dB 20 Hz to 20 kHz;  $\pm 0.5$  dB to 1 MHz;  $\pm 1$  dB to 2 MHz. Triangle,  $\pm 0.5$  dB 20 Hz to 200 kHz;  $\pm 2$  dB to 2 MHz. Square wave,  $\pm 0.5$  dB 20 Hz to 2 MHz.

**Sinewave Distortion** –  $\leq 0.25\%$  20 Hz to 20 kHz;  $\leq 0.5\%$  to 100 kHz; Harmonics,  $\leq -30$  dB to 2 MHz.

**Square Wave Response** –  $\leq 25$  ns rise/fall;  $< 3\%$  p-p aberrations.

**Triangle Linearity** –  $\geq 99\%$ , 20 Hz to 200 kHz,  $\geq 97\%$  to 2 MHz.

**Trigger Output** –  $\geq + 4$  V from 50  $\Omega$ .

**External Input** – Impedance  $\approx 2$  k $\Omega$ ;  $+ 1$  V  $\pm 20\%$  gate signal required.

**VCF** – Up to 1000:1 frequency change with 10 V external signal. Slew rate  $\geq 0.3$  V/ms.

## ORDERING INFORMATION

FG 502 11-MHz Function Generator	\$1,250
Includes: Instruction manual (070-1706-01).	

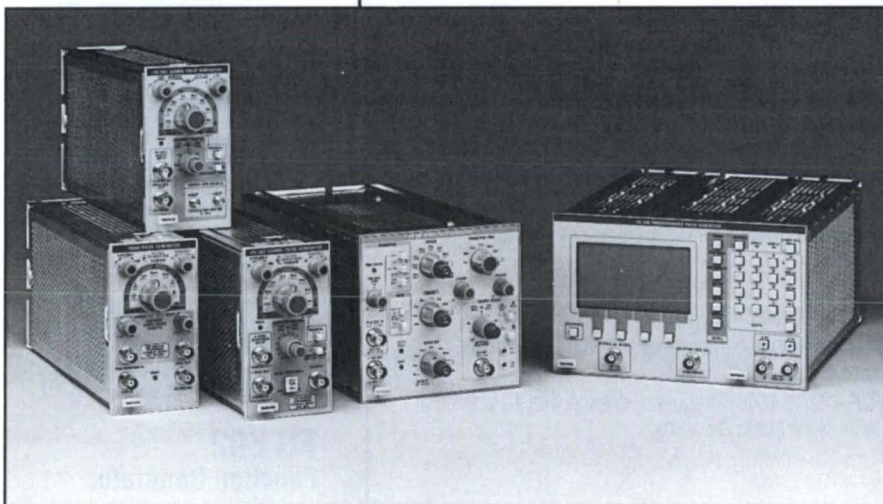
## FG 501A Function Generator

- 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
- $\leq 0.25\%$  Sine-Wave Distortion
- $\leq 25$  ns Rise/Fall

## ORDERING INFORMATION

FG 501A 2 MHz Function Generator	\$1,095
Includes: Instruction manual (070-2957-00).	

# SIGNAL SOURCES



PG 501, PG 502, PG 503, PG 508 and PG 5110 Pulse Generators.

## PULSE GENERATORS

Whether testing wide-band systems, simulating data transmission signals, or driving a laser, the TM 500/TM 5000 series Pulse Generators have the required capabilities to meet your needs.

The selection guide below shows the broad line of products offered, from the very versatile PG 5110 Programmable 50 MHz Pulse Generator to the fast PG 503 250 MHz 200 ps Manual Pulse Generator. The product line also has a low cost PG 501 50 MHz Manual Pulse Generator and a combination Pulsed/Function Generator, the PFG 5101.

Paired pulses can be generated at selected repetition rates with delay control capability available for

determining the time between the two pulses – a useful means by which to evaluate a circuit's ability to differentiate between two closely spaced pulses.

Pulse shaping capabilities is another requirement found in many applications. For example, typical rise and fall times vary widely between logic families and in order to accurately simulate logic transactions, variable rise and fall times are necessary.

Faster-than-specified drive signals can cause problems through capacitive coupling to adjacent circuitry. Conversely, slower-than-specified drive signals to a CMOS gate will cause its dissipation to increase greatly during each transition. Adjustable rise and fall times make it possible to avoid these undesirable conditions.

Controllable rise and fall times are also useful in determining the characteristics of edge-triggered devices.

Tek PG 5110 meets an impressive range of pulse generation requirements from 0.1 Hz to 50 MHz – single or dual channel, on the bench or in a system, and under either local or programmable control. With its easily mastered, menu-driven interface, the PG 5110 delivers maximum functionality – in the hands of a line technician or design engineer.

The general purpose, yet versatile PG 508 features independently variable rise and fall times for close approximations of real world events. The PG 503 offers fast 200 ps transition times for testing the new high-speed ECL and GaAs logic families. The PFG 5105/5505 offers pulse and function capability in a GPIB programmable instrument. These multipurpose generators can also be used for stimulus of high-impedance MOS, HTL, and CMOS logic circuits.

In 50 Ω systems, the repetition rates, amplitudes, and transition times of the PG 501 and PG 502 are designed to be compatible with common TTL, DTL, and ECL circuits.

### PULSE GENERATOR SELECTION GUIDE

	PG 5110	PFG 5105/5505	PG 508	PG 501	PG 502	PG 503
Pulse Period	20 ns to 10 s 50 MHz to 0.1 Hz	83 ns to 83.3 s 12 MHz to 0.01 Hz	≤ 20 ns to ≥ 200 ms 50 MHz to 5 Hz	≤ 20 ns to ≥ 200 ms 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	10 ns to 10 s	40 ns to 99.9 ms	≤ 10 ns to ≥ 100 ms	≤ 10 ns to ≥ 100 ms	≤ 2 ns to ≥ 50 ms	≤ 2 ns to ≥ 50 ms
Square-Wave Mode	•	•	•	•	•	•
Duty Factor	1 to 99%	Up to 85%	≥ 70% to 0.2 μs period ≥ 50% at 20 ns period	≥ 70% to 0.2 μs period ≥ 50% at 20 ns period	≥ 50%	≥ 50%
Pulse Delay	0 ns to 10 s	40 ns to 99.9 ms	≤ 5.5 ns to ≥ 100 ms	Fixed, 8 ns	Fixed, 17 ns	
Double Pulse	•	•	•	•	•	•
Transition Times	≤ 6 ns to 10 ms variable	Fixed < 15 ns At Full Output	< 5.5 ns ≥ 50 ms, variable	Fixed, ≤ 3.5 ns	Fixed, ≤ 1 ns	Fixed, ≤ 200 ps (20 to 80% @ 1 V range)
Aberrations	≤ 5% + 50 mV into 50 Ω	< 8% ± 20 mV from 3.4 V to 9.99 V output	≤ 5% + 50 mV into 50 Ω	± 3.5% into 50 Ω	± 5% (duration ≥ 5 ns)	± 8% at 1 V steps
Amplitude (Vp-p into 50 Ω source impedance)	10 V, ± 10 V window	9.99 V	≥ 10 V, ± 10-V window	≥ 5 V	5 V, ± 5-V window	2.5 V, ± 2.5 V window
IEEE STD 488.1 1987	YES	YES				
Module Size	3 wide	3 wide	2 wide	1 wide	1 wide	1 wide
Price	\$5,200	\$3,295/\$4,195*1	\$2,895	\$995	\$3,495	\$5,250

\*1 For more information on PFG 5105/5505, see pages 201 and 202.





## NEW PG 5110

The PG 5110 is a fully programmable pulse generator with pulse outputs from 0.1 Hz to 50 MHz in single or dual channel versions. The easily mastered menu-driven front panel, with storage for 99 settings, provides real benefits to either a test technician or design engineer.

The majority of the parameters can be varied independently for each output channel. Pulse widths can vary from 10 ns to 10 s and delays from 0 ns to 10 s, both with up to 6 digits of resolution. For worst case testing and characterization, transitions can be varied from 6 ns to 10 ms.

Predefined levels for TTL, CMOS or ECL are provided as well as adjustable levels from -10 V to +10 V with a 10 V amplitude pulse. Extremely good timing accuracies are achieved through internal calibration which is performed every time the parameter setting is changed. Operating modes include continuous, triggered, gated, and burst from 2 to 999,999 cycles.

The blank panel version (option 01) makes it ideal for systems applications. A TM 5000 mainframe is required.

## CHARACTERISTICS

### PERIOD (Common to both channels)

**Single Pulse Range** - 20 ns-10 s (50 MHz-0.1 Hz repetition rate).

**Double Pulse Range** - 40 ns-10 s in Paired Pulse per period mode (25 MHz-0.1 Hz repetition rate).

**Resolution** - 6 digits limited to 0.1 ns.

**Accuracy** -  $\pm 1\%$  of setting  $\pm 1$  ns.

**Jitter** -  $\leq$  (0.1% of setting + 50 ps) on fastest range.

### WIDTH (Independent for each channel)

**Range** - 10 ns-9.99999 s

**Resolution** - 6 digits limited to 0.1 ns.

**Accuracy** -  $\pm 2\%$  of setting  $\pm 2$  ns.

**Jitter** -  $\leq$  (0.1% of setting + 50 ps) decreasing to 0.005% on slowest range.

### DELAY (Independent for each channel)

**Range** - 0 ns-9.99999 s.

**Resolution** - 6 digits limited to 0.1 ns.

**Accuracy** -  $\pm 2\%$  of setting  $\pm 2$  ns.

**Jitter** -  $\leq$  (0.1% of setting + 50 ps), decreasing to 0.005% on slowest range.

### DUTY CYCLE PERFORMANCE (Independent for each channel)

**Range** - 1-99%.

**Resolution** - 0.1% (3 digits). Square Wave is not selectable directly as a mode; use DUTY = 50%.

**Accuracy** - Limited by width and pulse accuracy.

### TRANSITION TIMES (Independent for each channel)

**Transition Time** - 6 ns-10 ms (variable), measured at +5 V to +2 V and -5 V to -2 V. Leading edge and trailing edge settable separately.

**Resolution** - 3 digits, limited to 0.1 ns.

**Accuracy** -  $\pm 5\%$  of setting  $\pm 2$  ns.

**Linearity** - Less than 5% deviation from a straight line.

### AMPLITUDE (Independent for each channel)

**High Level Range** - -9.49 V-+10 V, into 50  $\Omega$  load (typically -18.98 V-+20 V into open circuit).

**Low Level Range** - -10 V-+9.49 V, into 50  $\Omega$  load (typically -20 V-+18.98 V, into open circuit).

**Pulse Amplitude Range** - 0.5 V minimum to 10 V p-p maximum into 50  $\Omega$  load (1 V minimum to 20 V p-p maximum into open circuit).

**Resolution** - 3 digits limited to 10 mV.

**Accuracy** -  $\pm 1\%$  of level setting  $\pm 2\%$  of p-p amplitude  $\pm 50$  mV into 50  $\Omega$  load.

**Aberrations** -  $\leq 5\%$  + 50 mV into 50  $\Omega$  load for pulse levels between  $\pm 5$  V.

**Setting Time** - 50 ms + transition time.

**Output Source Resistance** - 50  $\Omega$   $\pm 2.5$   $\Omega$ .

### TRIGGERING/ GATING INPUT

**Sensitivity** - 150 mV p-p minimum, dc - 50 MHz.

**Minimum Input Pulse Width** - 10 ns; 250 mV amplitude required for triggering.

**Maximum Repetition Rate** - 50 MHz.

**Input Impedance** - 1 M $\Omega$   $\pm 5\%$ ;  $\approx 30$  pf.

**Maximum Input Voltage** -  $\pm 10$  V dc plus peak ac.

### THRESHOLD

**Range** -  $\pm 9.99$  V.

**Resolution** - 3 digits (10 mV).

**Accuracy** -  $\pm 5\%$  of setting  $\pm 25$  mV.

**Slope Selection** - Positive (+) slope for triggering and positive-true for gating; Negative (-) slope for triggering, negative-true for gating.

**Counted Burst** - 2-999,999 cycles per burst.

### INTERNAL TRIGGER

**Repetition Rate Range** - 100 ns-999.99 s.

**Resolution** - Up to 4 digits, limited to 100 ns.

**Repetition Rate Accuracy** -  $\pm 0.01\% \pm 1$  ns.

**Jitter** -  $\leq$  (0.1% of setting + 50 ps).

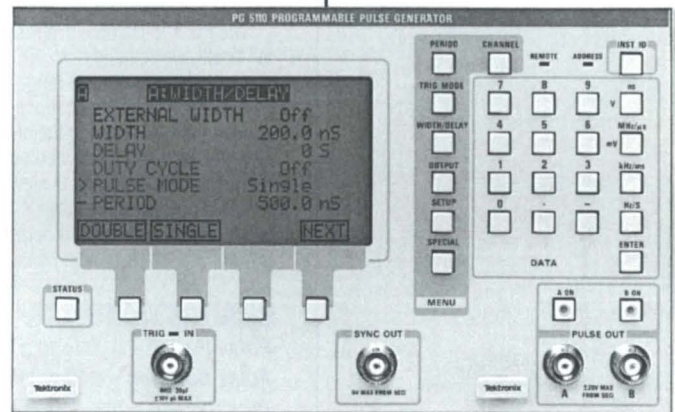
### GENERAL

**Environmental** - Operating: 0 - 50°C. Non-operating: -20 to +60°C.

**Power Consumption** - 130 W total.

## NEW PG 5110 Programmable Pulse Generator

- Two Independent 50 MHz Output Channels
- Repetition Rates from 0.1 Hz to 50 MHz (periods from 20 ns to 10 s)
- Variable Transitions from 6 ns to 10 ms
- Clear Large Graphic Display for Convenient Operation
- 99 Stored Front-panel Settings Capability with Non-volatile Memory



**GPIB\***  
IEEE-488

## ORDERING INFORMATION

**PG 5110 50 MHz Programmable Pulse Generator** \$5,200  
Includes: Instruction Manual (070-7740-00), Reference Guide (070-7743-00), Instrument Interface Guide (070-7742-00).

**OPTIONAL ACCESSORIES**  
Service Manual (070-7741-00), Rear Interface Cable Set (118-8569-00).

**INSTRUMENT OPTIONS**  
**Opt. 01** - Blank Front Panel -\$450  
**Opt. 02** - Adds Channel B, converting the PG 5110 to a dual-channel instrument. +\$3,050

\*The PG 5110 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.

# SIGNAL SOURCES



## PG 508 Pulse Generator

- 5 Hz to 50 MHz
- Independently Variable Rise and Fall Times to 5 ns
- 20 V Output in a  $\pm 20$  V Window, 10 V into 50  $\Omega$
- Normal or Complement Output
- Wide Choice of Trigger Capabilities

### ORDERING INFORMATION

PG 508 50 MHz Pulse Generator \$2,895  
Includes: Instruction manual (070-2044-01).

## 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

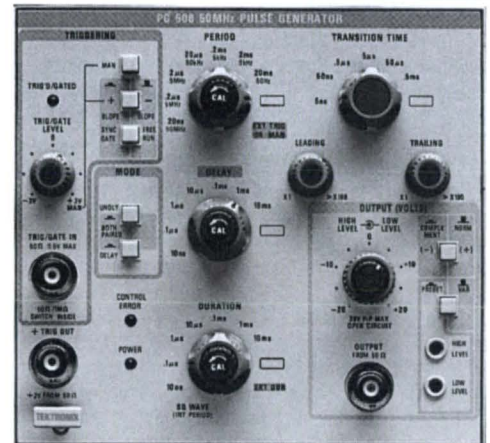
**Pulse Period** —  $\leq 20$  ns to  $\geq 200$  ms (50 MHz to 5 Hz).

**Pulse Duration** —  $\leq 10$  ns to  $\geq 100$  ms

**Duty Cycle** —  $\geq 70\%$  to 0.2  $\mu$ s period,  $\geq 50\%$  at 20 ns period.

**Pulse Delay** —  $\leq 10$  ns to 100 ms.

**Transition Times** —  $< 5.5$  ns to  $\geq 50$  ms, independently variable up to 100:1.



PG 508 Pulse Generator

**Aberrations** —  $\leq 5\%$  + 50 mV into 50  $\Omega$  for pulse levels between  $\pm 5$  V, 10% + 50 mV above this.

**Amplitude** —  $\geq 10$  V p-p into 50  $\Omega$ ,  $\pm 10$  V window.

**Trigger Level** — +3 V to -3 V, 80 mV p-p sensitivity to 10 MHz, 250 mV p-p to 50 MHz.

**Slope** — + or -.

**Trigger Output** —  $\geq +2$  V from 50  $\Omega$ .

**Square Wave Mode** — Yes.

**Double Pulse** — Yes.

**Normal/Complement** — Yes.

**Manual Trigger** — Yes.

**Duration Mode** — Yes.

**Gate Mode** — Yes.

## PG 501 Pulse Generator

- 5 Hz to 50 MHz
- Simultaneous Plus and Minus Outputs
- 5 V and 3.5 ns into 50  $\Omega$
- Independent Period and Duration Controls
- Trigger Out
- Optional Manual Trigger Generator

### ORDERING INFORMATION

PG 501 50 MHz Pulse Generator \$995  
Includes: Instruction Manual (070-1361-01).

## PG 501



PG 501 Pulse Generator

The PG 501 is a 50 MHz Pulse Generator featuring simultaneous plus and minus outputs, a wide range of pulse-period durations and duty factors, trigger output, and external trigger/duration input. Its performance and ease of operation make it well-suited to basic digital and analog applications.

An optional remote manual trigger generator is available, part number 016-0597-00.

### CHARACTERISTICS

**Pulse Period** —  $\leq 20$  ns to  $\geq 200$  ms (50 MHz to 5 Hz).

**Pulse Duration** —  $\leq 10$  ns to  $\geq 100$  ms

**Duty Cycle** —  $\geq 70\%$  to 0.2  $\mu$ s period,  $\geq 50\%$  at 20 ns period.

**Transition Times** —  $\leq 3.5$  ns fixed,  $\leq 4$  ns above 5 V.

**Aberrations** — Within 3.5% p-p at 5 V p-p.

**Amplitude** —  $\leq 0.5$  V to  $\geq 5$  V p-p into 50  $\Omega$ .

**Pulse Coincidence** —  $\leq 1$  ns at 50% amplitude.

**Trigger Level** — +1 V.

**Slope** — + only.

**Trigger Output** —  $\geq +2$  V from 50  $\Omega$ .

**Square Wave Mode** — Yes.

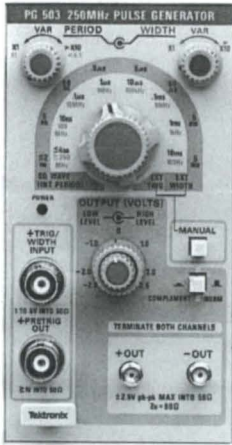
**Complementary Outputs** — Yes.

**Duration Mode** — Yes.



## 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 main-frames. 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  $\pm 2.5$  V window. The fast risetime makes the PG 503 ideal for testing the new high-speed ECL and GaAs logic families.



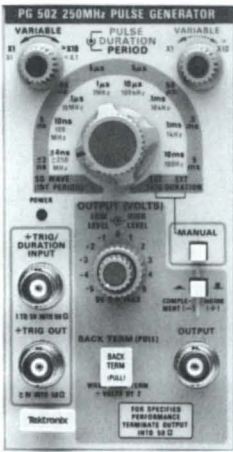
PG 503 Pulse Generator

## CHARACTERISTICS

- Pulse Period** –  $\leq 4$  ns to  $\geq 100$  ms (250 MHz to 10 Hz).
- Pulse Duration** –  $\leq 2$  ns to  $\geq 50$  ms.
- Duty Cycle** –  $\geq 50\%$ .
- Transition Times** –  $< 200$  ps fixed (20% to 80%).
- Aberrations** –  $\leq 150$  mV p-p for voltages  $\leq 1.25$  V p-p,  $\leq 10\%$  p-p for voltages  $\geq 1.25$  V p-p.
- Amplitude** –  $\geq \pm 2.5$  V p-p into  $50 \Omega$ ,  $\pm 2.5$  V window.
- Trigger Level** –  $+1$  V.
- Slope** – + only.
- Trigger Output** –  $\geq \pm 1$  V from  $50 \Omega$ .
- Square Wave Mode** – Yes.
- Complementary Outputs** – Yes.
- Normal/Complement** – Yes.
- Manual Trigger** – Yes.
- Duration Mode** – Yes.

## PG 502

The PG 502 is a 250 MHz Pulse Generator with rise and fall times of less than 1 ns. It has a single output with independent controls of the top and bottom pulse levels to control pulse amplitude and offset. A wide range of pulse period and pulse duration settings are provided through independent controls. Front panel switches are provided for normal output or complement and back termination of  $50 \Omega$ . The fast repetition rate makes the PG 502 ideal for design and testing of fast logic and switching circuits.



PG 502 Pulse Generator

## CHARACTERISTICS

- Pulse Period** –  $\leq 4$  ns to  $\geq 100$  ms (250 MHz to 10 Hz).
- Pulse Duration** –  $\leq 2$  ns to  $\geq 50$  ms
- Duty Cycle** –  $\geq 50\%$ .
- Transition Times** –  $< 1$  ns fixed.
- Aberrations** – Within 5% p-p at 5 V p-p.
- Amplitude** –  $\geq 5$  V p-p into  $50 \Omega$ ,  $\pm 5$  V window.
- Trigger Level** –  $+1$  V.
- Slope** – + only.
- Trigger Output** –  $\geq +2$  V from  $50 \Omega$ .
- Square Wave Mode** – Yes.
- Normal/Complement** – Yes.
- Manual Trigger** – Yes.
- Duration Mode** – Yes.

## 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.

## 50 OHM PRECISION COAXIAL CABLE

The PG 502, PG 506A, and SG 503 are internally calibrated for use with this 3-ft,  $50 \Omega$ , coaxial cable into a  $50 \Omega$  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.

## PG 503 Pulse Generator

- 10 Hz to 250 MHz
- $\leq 200$  ps Rise Time
- 2.5 V Output,  $\pm 2.5$  V Window
- Independent Pulse Top and Bottom Level Controls
- Complementary Outputs
- Manual Trigger Button

### ORDERING INFORMATION

**PG 503 250 MHz Pulse Generator \$5,250**  
Includes: Instruction Manual (070-7935-00), Two SMA to BNC Adapters (015-1018-00), One SMA  $50 \Omega$  Termination (015-1022-00)

## PG 502 Pulse Generator

- 10 Hz to 250 MHz
- 1 ns Rise Time
- 5 V Output,  $\pm 5$  V Window
- Independent Pulse Top and Bottom Level Controls
- Selectable Internal Reverse Termination
- Manual Trigger Button

### ORDERING INFORMATION

**PG 502 250-MHz Pulse Generator \$3,495**  
Includes: Instruction manual (070-1598-01).

### ORDERING INFORMATION

**50  $\Omega$  Cable** – Order 012-0482-00 **\$35**  
**Trigger Generator** – Order 016-0597-00 **\$360**  
**Rise Time Limiter** – Order 015-0249-00 **\$200**

### RECOMMENDED PROBES

See Probes section.  
**P6062B** – 1X/10X, dc to 100 MHz **\$220**  
**P6108A** – 10X, dc to 100 MHz **\$114**  
**P6122** – 10X, dc to 100 MHz **\$80**

# POWER SUPPLIES



## 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.

Dual output supplies, such as the PS 5010, let you select independent series or parallel connections automatically, and, if you choose, will cause the output voltages of supplies connected in series to track together.

Critical specifications are voltage and current range, accuracy and resolution. Accuracy depends on source effect, load effect and temperature. Source effect deals with variations in line voltage. It may be specified as a percent of output or as a percent plus or minus a certain value. Load effect is the same as load regulation – the ability of the supply to maintain a constant voltage or current in the face of changes in loading. It is specified in terms of the maximum voltage change for given change in load current. Temperature effects are specified in terms of percents or parts per million/°C. 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, or milliamps.

### POWER SUPPLIES SELECTION GUIDE

	PS 503A	PS 5004	PS 5010
# of Supplies	3	1	3
Max Voltages	-20 to +20 V, +5	0 to 20 V	+ and -32 V Logic (+4.5 to 5.5 V)
Max Amps	1 A	305 mA	1.6 A, 3A
IEEE-488 Interface		•	•
Module Size	1 wide	1 wide	2 wide
Price	\$995	\$2,150	\$3,450

## PS 5010 Power Supply

- **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**

### ORDERING INFORMATION

**PS 5010** Power Supply **\$3,450**  
Includes: Instruction manual (070-3391-00); Instrument interfacing guide (070-4610-00); Reference guide (070-3402-00).



\* The PS 5010 complies 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

#### CONSTANT VOLTAGE MODE

**Voltage Range** – 0 to +32 V, 0 to -32 V.

**Voltage Accuracy** – Overall (total effect)  $\pm(0.5\% + 20 \text{ mV})$ , Source Effect (line regulation)  $\pm(0.01\% + 2 \text{ mV})$

**PARD (Ripple and Noise)** – 10 mV p-p, 20 Hz to 20 MHz.

**Load Effect (load regulation)** – 10 mV for a 1 A change in load current.

**Temperature Coefficient (typical)** –  $<(0.01\% + 0.1 \text{ mV})/^\circ\text{C}$

**Step Size Accuracy** – 10 mV  $\pm 10 \text{ mV}$  to 10.0 V  
100 mV  $\pm 40 \text{ mV}$  above 10.1 V

### CONSTANT CURRENT MODE

**Range** – 50 mA to 0.75 A (1.60 A at 15 V and below) in high-power compartment; 50 mA to 400 mA (0.75 A at 15 V and below) in two standard-power compartments.

**Overall Accuracy** –  $\pm(5\% + 20 \text{ mA})$ ; Source Effect (line regulation)  $\pm 1 \text{ mA}$ ; Load Effect:  $\pm 10 \text{ mA}$ ; Output impedance is typically 5 k $\Omega$  shunted by 10  $\mu\text{F}$ .

**PARD (Ripple and Noise)** – 10 mA p-p, 5 mA (RMS), 20 Hz to 20 MHz.

**Resolution** – 50 mA  $\pm 15 \text{ mA}$ .

**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

**Voltage Range** – +4.5 to +5.5 V, ground referenced.

**Overall Accuracy** –  $\pm 50 \text{ mV}$

**Source Effect (line regulation)** – 1 mV

**Load Effect (load regulation)** – 10 mV for a 1 A change in load current.

**Temperature Coefficient (typical)** –  $< 500 \mu\text{V}/^\circ\text{C}$

**Step Size Accuracy** – 10 mV  $\pm 10 \text{ mV}$

**PARD (Ripple and Noise)** – 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  $< 1.5 \text{ A}$ ).

**Overall Accuracy** –  $\pm(5\% + 20 \text{ mA})$

**Resolution** – 100 mA  $\pm 30 \text{ mA}$

**Scaled Output** – 10 mA = 1 mV  $\pm(2\% + 2 \text{ mV})$  available at rear interface (not ground referenced).

**Overvoltage Protection** – SCR crowbar typically trips at 6 to 7 V.

### GENERAL

**Power Consumption** – 250 VA maximum.



## 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  $\mu\text{V}$  resolution without the necessity of changing ranges. Setability resolution over the GPIB is also 500  $\mu\text{V}$ . The supply output is supplied at the rear interface and the front-panel terminals. Overall accuracy is  $\pm 0.01\%$   $\pm 2$  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  $\Omega$  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)  $\pm(0.01\% + 2\text{mV})$  from +15°C to +30°C, derating to  $\pm(0.035\% + 3\text{mV})$  at 0°C and +50°C

**Source Effect (line regulation)** –  $\leq 0.5$  mV.

**Load Effect (load regulation)** –  $\leq 1$  mV.

**Temperature Coefficient (typical)** –  $\leq(30\text{ ppm} + 100\text{ }\mu\text{V})/\text{ }^\circ\text{C}$ .

**Step Size Accuracy** – 500  $\mu\text{V}$ ,  $\pm 0.2$  mV.

**PARD (Ripple and Noise)** –  $\leq 1$  mV p-p 10 Hz to 1 MHz;  $\leq 3$  mV p-p, 10 Hz to 5 MHz.

### CONSTANT CURRENT MODE

**Range** – 10 mA to 305 mA in 2.5 mA steps.

**Overall Accuracy** –  $\pm(2\% + 5\text{ mA})$ .

**Isolation** – 42 V (DC + peak AC).

### GENERAL

**Power Consumption** – 35 VA maximum.

## PS 503A

The PS 503A provides dual floating variable 20-V supplies, plus a fixed 5-V, 1-A supply. The PS 503A features superior tracking, over-voltage protection, and remote resistance programming of voltage. When operated in the high-power compartment of a TM 504, TM 506A, RTM 506, or TM 5006A mainframe, the PS 503A can provide up to 1 A from both of the 20 V supplies. A 0 to 40 V variable supply with up to 1 A of current can be configured by grounding one of the two outside terminals of the variable supplies. The two variable supplies can be set individually, then varied in a tracked mode with a single control. In addition, the plus and minus floating outputs can be programmed remotely, by either voltage programming or resistance programming via the rear interface.

## CHARACTERISTICS

### $\pm 20\text{V}$ FLOATING SUPPLIES

**Range** – 0 to +20 V, 0 to –20 V. 0 to 40 V DC across + and – terminals.

**Stability** – Typically 0.1% + 5 mV or less drift in 8 hrs of constant line, load and temperature

**Isolation** – 350 V (DC + peak AC)

**Current Limit High-Power Compartment** – <100 mA to 1 A

**Standard** – <100 mA to 400 mA

**Line regulation** –  $\leq 5$  mV for a  $\pm 10\%$  line voltage change.

**Load regulation** –  $\leq 3$  mV for a 1 A load change

**Temperature Coefficient (typical)** –  $<0.025\%/^\circ\text{C}$

**Step Size Accuracy** – 50 mV

**PARD (Ripple and Noise)** – 3 mV p-p

### +5 V SUPPLY

**Range** – +4.75 to +5.25 Vdc.

**Current Limit** – 1 A

**Load regulation** –  $\leq 50$  mV for a  $\pm 10\%$  line change.

**Line regulation** –  $\leq 100$  mV for a 1 A load change.

**PARD (Ripple and Noise)** – 5 mV p-p

## PS 5004 Power Supply

- 0 to 20 V Floating Output
- 0.01% Accuracy
- 500  $\mu\text{V}/0.1$  mA Resolution
- Constant Voltage or Constant Current With Autocrossover
- Voltage- and/or Current-Monitoring Display
- Remote Sensing

## PS 503A Power Supply

- Independent Controls
- Dual Tracking Voltage Control
- 0 to +20 V and 0 to –20 V at 1 A
- Fixed Output 5 V at 1 A
- Remote Resistance Programming

## ORDERING INFORMATION

<b>PS 5004</b> Precision Power Supply Includes: Instruction manual (070-4442-00); Instrument interfacing guide (070-4789-00); Reference guide (070-4596-00).	<b>\$2,150</b>
<b>PS 503A</b> Power Supply Includes: Instruction manual (070-1834-01).	<b>\$995</b>



TM 5000/TM 500 Power Supplies

\* The PS 5004 complies with IEEE Standard 488.1-1987, and Tektronix Standard Codes and Formats



## DIGITAL MULTIMETERS

The Tektronix TM 5000/TM 500 Modular Digital Multimeter selection includes the single-wide, programmable DM 5110 as well as the manual DM 511, the high-performance DM 5120/DM 5520 and the economical DM 504A. Now there exists a broad selection of performance, size and price to match most applications.

The DM 5110 represents the optimum choice for programmability, small size, performance, features, and competitive price. The DM 511 extends the capabilities over the DM 504A by offering dBV, dBm, and rear interfacing with a new easy-to-use front panel.

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.

## 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 ( $0.707/0.637 = 1.11$ .)

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.

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.

## 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.

## dB MEASUREMENTS AND 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. 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.

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.

DIGITAL MULTIMETER SELECTION GUIDE

	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)	•
Module Size	1 wide	1 wide	3 wide
Mainframe Compatibility	TM 500 or TM 5000	TM 500/5000 for DM 511 TM 5000 for DM 5110	TM 5000 (DM 5120 Only)
Price	\$645	DM 511 - \$795 DM 5110 - \$895	DM 5120 - \$995 DM 5520 - \$1,295



## DM 504A

The DM 504A Autoranging Digital Multimeter extends the functionality of the Tektronix TM 500 line of modular, digital multimeters with true RMS measurements, a "beeper" mode for indication of short circuits, and diode testing capability. The DM 504A also provides standard ac/dc voltage and current, and resistance measurements, and will operate in any compartment of a TM 500 or TM 5000 power module.

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  $\Omega$  mode is selected, indicating that a beeper will sound a continuous tone for measurements less than 10  $\Omega$ . In the 2 M $\Omega$ , 200 k $\Omega$  and 2 k $\Omega$  ranges a diode measurement indicator will illuminate on the display, indicating that V max is adequate for diode testing.

## CHARACTERISTICS

### DC Volts

**Ranges** – 200 mV, 2 V, 20 V, 200 V, 1000 V.

**Accuracy**<sup>\*1</sup> – For automatic or manual ranging 18 to 28°C: All ranges  $\pm(0.05\%$  of reading  $\pm 0.02\%$  of full scale).

**CMMR** – (Within 1 k $\Omega$  unbalanced) 100 dB at dc, 80 dB at 50/60 Hz.

**NMMR** – 60 dB at 50/60 Hz ( $\pm 0.2$  Hz).

**Max. Resolution** – 10  $\mu$ V.

**Step Response Time** –  $< 1$  s.

**Input Resistance** – 10 M $\Omega \pm 0.5\%$ .

**Max. Input Voltage** – 1000 V peak.

### TRUE RMS AC VOLTS

**Ranges** – 200 mV, 2 V, 20 V, 200 V, 500 V.

**Accuracy**<sup>\*1</sup> – 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  $\pm(0.6\%$  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  $\pm(0.6\%$  of reading  $+ 0.1\%$  of full scale).

40 Hz to 60 Hz  $\pm(1\%$  of reading  $+ 0.1\%$  of full scale)

**CMMR** – (With 1 k $\Omega$  unbalance) – 60 dB at 50 or 60 Hz.

**Max. Resolution** – 10  $\mu$ V.

**Response Time** –  $< 2$  s.

**Input Impedance** – 10 M $\Omega \pm 0.5\%$  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).

### RESISTANCE

**Accuracy**<sup>\*1</sup> – for automatic or manual ranging 18° to 28°C.

Range	% of Reading + % Full Scale	Source	Vmax full-scale
200 $\Omega$ (beeper)	$\pm(0.05\% + 0.05\%)$	1.0 mA	0.2 V
200 $\Omega$	$\pm(0.05\% + 0.02\%)$	1.0 mA	0.2 V
2 k $\Omega$	$\pm(0.05\% + 0.01\%)$	1.0 mA	2.0 V
20 k $\Omega$	$\pm(0.05\% + 0.02\%)$	10 $\mu$ A	0.2 V
200 k $\Omega$	$\pm(0.05\% + 0.01\%)$	10 $\mu$ A	2.0 V
2 M $\Omega$	$\pm(0.1\% + 0.02\%)$	0.1 $\mu$ A	0.2 V
20 M $\Omega$	$\pm(0.1\% + 0.01\%)$	0.1 $\mu$ A	2.0 V

### DC CURRENT/AC CURRENT

**Ranges** – 200  $\mu$ A, 2 mA, 20 mA, 200 mA, 2 A.

**Accuracy**<sup>\*1</sup> – DC current: for automatic or manual ranging 18° to 28°C.  $\pm(0.1\%$  of reading  $+ 0.01\%$  of full scale). AC Current: for automatic or manual ranging 18° to 28°C.  $\pm(0.6\%$  of reading  $+ 0.6\%$  of full scale.)

**Response Time** – DC Current:  $< 1$  s. AC Current:  $< 2$  s.

### Input Resistance

Range	Resistances	
	DC current	AC current
200 $\mu$ A	1.0 k $\Omega$	1.0 k $\Omega$
2 mA	100.0 $\Omega$	100 $\Omega$
20 mA	10.2 $\Omega$	10.2 $\Omega$
200 mA	1.2 $\Omega$	1.2 $\Omega$
2000 mA	0.28 $\Omega$	0.4 $\Omega$

**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.

### TEMPERATURE

**Range** –  $-62^\circ$  to  $+230^\circ$ C.

**Accuracy** – Using Tektronix P6602 Temperature Probe: 18° to 28°C ambient. Probe calibrated to instrument (probe/DMM calibration performed at 0°C).  $\pm 0.6^\circ$ C from  $-62^\circ$  to  $150^\circ$ C.  $\pm 1.6^\circ$ C from  $150^\circ$  to  $230^\circ$ C. Any probe:  $\pm 3.5^\circ$ C from  $-62^\circ$  to  $150^\circ$ C.  $\pm 1.6^\circ$ C from  $150^\circ$  to  $230^\circ$ 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).

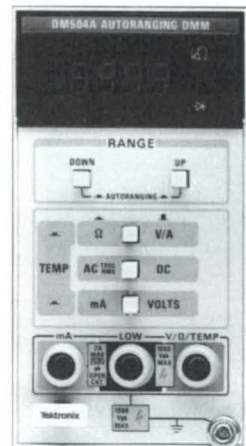
**Dimensions** – Single TM 500/TM 5000 compartment.

**Weight** – 0.93 kg (2.04 lb).

<sup>\*1</sup> Valid for six months or 1000 hours, whichever occurs first.

## DM 504A Digital Multimeter

- 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
- Diode Test and Audible Continuity (Beeper) Modes



## ORDERING INFORMATION

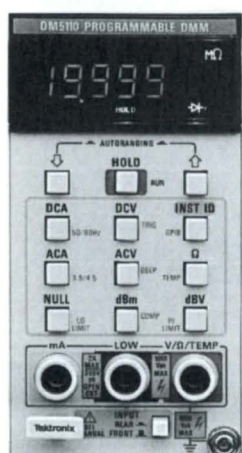
DM 504A Digital Multimeter	\$645
Includes: Instruction manual (070-6945-00); one set of test leads.	
Opt. 02 – Adds P6602 Temperature Probe calibrated for use with DM 504A.	\$260
<b>OPTIONAL ACCESSORIES</b>	
Service Manual – 070-7135-00	\$25

# MEASUREMENT INSTRUMENTS



## DM 5110/DM 511 Digital Multimeters

- 4 1/2 Digit Autoranging
- Fast (3 1/2 Digit) Mode
- AC/DC Voltage, AC/DC Current, Resistance and (optional) Temperature Measurement
- AC dBm and dBV Calculations
- True RMS AC Functions
- Null and Hold Modes
- Hi/Lo/Pass Limit Testing and Compare Mode with Beeper
- Standard IEEE-488 Interface (DM 5110 only)
- Front and Rear Interfacing



**GPIB**  
IEEE-488

### DM 5110/511

The DM 5110/DM 511 offers exceptional functionality and the highest performance available in a low-cost, single-width plug-in module.

The DM 5110 is fully programmable over the IEEE-488 interface, while the DM 511 is designed for manual operation only; the units are otherwise identical. The DM 5110 occupies one slot in any TM 5000 Mainframe, and the DM 511 can be operated in either a TM 500 or TM 5000 Mainframe.

### 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  $\mu$ V to be resolved; a 3 1/2 digit mode provides for faster test throughput. Basic accuracy is  $\pm 0.05\%$ . 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  $\pm$  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  $-62^{\circ}$  to  $240^{\circ}$ C.

## ELECTRICAL CHARACTERISTICS

### DC VOLTS

**Accuracy** – (4 1/2 digits, auto or manual ranging, front or rear input):

Range	% of Reading + % of Full Scale	
	18°–28°C	0°–18°C 28°–50°C
200 mV	$\pm (0.05\% + 0.015\%)$	$\pm (0.15\% + 0.04\%)$
2V	$\pm (0.015\% + 0.01\%)$	$\pm (0.1\% + 0.02\%)$
20 V	$\pm (0.05\% + 0.015\%)$	$\pm (0.15\% + 0.025\%)$
200 V	$\pm (0.05\% + 0.01\%)$	$\pm (0.1\% + 0.02\%)$
1000 V	$\pm (0.05\% + 0.02\%)$	$\pm (0.1\% + 0.02\%)$

**CMRR (with 1 k $\Omega$  unbalance)** –  $\geq 100$  dB @ dc,  $\geq 80$  dB @ 50/60 Hz.

**NMRR** –  $\geq 50$  dB @ 50/60 Hz ( $\pm 0.2$  Hz).

**Max. Resolution** – 10  $\mu$ V.

**Step Response Time** –  $< 50$  msec to 0.05% of step.

**Input Resistance** – 10 M $\Omega$   $\pm 0.5\%$ .

**Max. Input Voltage** – Front panel, LOW to GND and V/ $\Omega$ /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** – (4 1/2 digits, auto or manual ranging, front or rear input, 200 mV to 500 V range):

Input Frequency	% of Reading + % of Full Scale	
	18°–28°C	0°–18°C, 28°–50°C
20 Hz to	$\pm (0.8\%$	$\pm (1.1\%$
100 Hz: <sup>*1</sup>	$+ 0.05\%)$	$+ 0.075\%)$
100 Hz to	$\pm (0.3\%$	$\pm (0.6\%$
10 kHz: <sup>*1</sup>	$+ 0.05\%)$	$+ 0.075\%)$
10 kHz to	$\pm (0.6\%$	$\pm (0.9\%$
20 kHz: <sup>*2</sup>	$+ 0.05\%)$	$+ 0.05\%)$
20 kHz to	$\pm (1.0\%$	$\pm (1.3\%$
50 kHz: <sup>*3</sup>	$+ 0.05\%)$	$+ 0.075\%)$

<sup>\*1</sup> For inputs  $> 200$  counts, 200 mV to 200 V ranges;  $> 50$  counts, 500 V range.

<sup>\*2</sup> For inputs  $> 500$  counts, 200 mV to 200 V ranges;  $> 250$  counts, 500 V range.

<sup>\*3</sup> For inputs  $> 2000$  counts, 200 mV to 200 V ranges;  $> 500$  counts, 500 V range.

**CMRR (with 1 k $\Omega$  unbalance)** –  $\geq 60$  dB @ 50/60 Hz.

**Max. Resolution** – 10  $\mu$ V.

**Step Response Time** –  $< 0.3$  sec to 1% of step.

**Input Impedance** – 2 M $\Omega$   $\pm 0.1\%$ , paralleled by  $< 50$  pF.

**Max. Input Voltage** – Front panel, V/ $\Omega$ /Temp to LOW: 500 V rms or 600 Vdc. Front panel, V/ $\Omega$ /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.

\*The DM 5110 complies with IEEE Standard 488.1-1987 and Tektronix Standard Codes and Formats





## dB (TRUE RMS AC VOLTAGE)

**Accuracy** – (4 1/2 digits, auto or manual ranging, front or rear input):

Range, dBV	Range, dBm	0° – 18°C		Frequency
		18° – 28°C	28° – 50°C	
-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 by < 50 pF.

### Max. Input Voltage –

Front panel, V/Ω/Temp to LOW: 500 V rms or 600 V dc. 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.

## DC AMPS

**Accuracy** – (4 1/2 digits, auto or manual ranging, front panel only):

Range	% of Reading + % of Full Scale	
	18° – 28°C	0° – 18°C, 28° – 50°C
200 μA, 2 mA, 20 mA	± (0.1% + 0.01%)	± (0.3% + 0.025%)

**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** – 250 V pk, mA to LOW.

**Max. Input Current** – 2 A any range.

**Max. Floating Voltage** – 1000 V pk, mA or LOW inputs to GND

**Max. Resolution** – 10 nA

## AC AMPS

**Accuracy** – (4 1/2 digits, auto or manual ranging, front panel only, all ranges):

Frequency	% of Reading + % of Full Scale	
	18° – 28°C	0° – 18°C, 28° – 50°C
20 Hz to 100 Hz (input > 200 counts)	± (0.8% + 0.05%)	± (1.1% + 0.075%)
100 Hz to 10 kHz (input > 200 counts)	± (0.3% + 0.05%)	± (0.6% + 0.075%)

**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** – 250 V pk, mA to LOW.

**Max. Input Current** – 2 A any range.

**Max. Floating Voltage** – 1000 V pk, mA or LOW inputs to GND.

## OHMS

**Accuracy** – (4 1/2 digits, auto or manual ranging, front or rear input):

Range	% of Reading + % of Full Scale		Source Current	Vmax
	18° – 28°C	0° – 18°C, 28° – 50°C		
200 Ω	± (0.05% + 0.02%)	± (0.25% + 0.04%)	1.0 mA	0.2 V
2 kΩ	± (0.05% + 0.01%)	± (0.25% + 0.03%)	1.0 mA	2.0 V
20 kΩ	± (0.05% + 0.02%)	± (0.25% + 0.04%)	10 μA	0.2 V
200 kΩ	± (0.05% + 0.01%)	± (0.25% + 0.03%)	10 μA	2.0 V
2 MΩ	± (0.1% + 0.02%)	± (1.0% + 0.04%)	0.1 μA	0.2 V
20 MΩ	± (0.1% + 0.01%)	± (1.0% + 0.03%)	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.

## TEMPERATURE

**Accuracy** – (4 1/2 digits, front panel, input only):

Measurement Range	0° – 18°C		Probe Status
	18° – 28°C	28° – 50°C	
-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).

## PHYSICAL CHARACTERISTICS

**Temperature** – Operating: -0° to +50°C;

Non-Operating: -55° to +75°C.

## ORDERING INFORMATION

<b>DM 5110</b> Programmable Autoranging Digital Multimeter Includes: Operators Instruction Manual (070-7478-00); Instrument Interfacing Guide (070-7560-00); Reference Guide (070-7559-00); Meter Leads, Set (196-3212-00).	<b>\$895</b>
<b>DM 511</b> Autoranging Digital Multimeter. Includes: Operators Instruction Manual (070-7478-00); Instrument Interfacing Guide (070-7560-00); Reference Guide (070-7559-00); Meter Leads, Set (196-3212-00). <b>Opt. 02</b> – Adds a Tektronix P6602 Temperature Probe that has been calibrated with the DM 5110/DM 511.	<b>\$795</b> <b>+\$260</b>
<b>OPTIONAL ACCESSORIES</b>	
<b>Service Manual</b> – Order 070-7479-00	<b>\$50</b>
<b>Temperature Probe</b> – P6602	<b>\$320</b>
<b>High Voltage Probe</b> – Order 010-0277-00	<b>\$230</b>
<b>RF Probe</b> – P6420	<b>\$195</b>

# MEASUREMENT INSTRUMENTS



## DM 5120/DM 5520 Programmable Digital Multimeters

- 6 1/2 Digit, Fully Autoranging (100 nV, 100  $\mu\Omega$ , 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



DM 5120 Programmable Digital Multimeter



## 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. 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.

A fast autoranging feature permits the shortest possible test setup time, as well as dramatically increased throughput on your production line.

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.

## 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 instrument'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.

## CHARACTERISTICS

### DC VOLTS

**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  $\pm$  (0.05%) with a 1 k $\Omega$  unbalance in either lead.

**NMRR** – >60 dB at 50 or 60 Hz  $\pm$  (0.05%).

**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  $\mu$ V.

### TRUE RMS AC VOLTS

**Ranges** – 300 mV, 3 V, 30 V, 300 V.

**Accuracy** – 5 1/2 digits, 1 year 18°–28°C.

For sinewave inputs greater than 2000 counts – 20 to 50 Hz  $\pm$  (2% of reading + 100 counts).

50 to 200 Hz  $\pm$  (0.3% of reading + 100 counts).

200 Hz to 10 kHz  $\pm$  (0.15% of reading + 100 counts).

10 to 20 kHz  $\pm$  (0.4% of reading + 200 counts).

For sinewave inputs greater than 20,000 counts – 20 Hz to 100 kHz  $\pm$  (1.5% of reading + 300 counts), 300 mV range  $\pm$  (2% rdg + 300 counts).

**Crest Factor** –  $\leq$ 3:1.

**Nonsinusoidal Measurement Accuracy** –

For fundamental frequencies <1 kHz, crest factor <3. 300 mV, 3V,  $\pm$  (0.25% of rdg) 30V, 300V,  $\pm$  (0.6% of rdg).

**Maximum Resolution** – 1  $\mu$ V.

**Input Impedance** –

Hi to Lo: 1 M $\Omega$  shunted by <120 pF.

Lo to GND: >1000 M $\Omega$  paralleled by <400 pF.

**CMRR** – >60 dB at 50 or 60 Hz ( $\pm$ 0.05%) with 1 k $\Omega$  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<sup>7</sup> V-Hz product, whichever is less. Lo to GND: 350 V (dc + peak ac) or 5 x 10<sup>5</sup> V-Hz product, whichever is less.

## DC VOLTS

Range	Resistance	Accuracy (6-1/2 digits) $\pm$ (% of reading + counts)		Temperature Coefficient
		90 Days 18° to 28°C	1 Year 18° to 28°C	$\pm$ (% rdg+cnt)/C 0°–18°C to 28°–50°C
300 mV	>1 G $\Omega$	0.005 + 20	0.008 + 20	0.0006 + 10
3 V	>1 G $\Omega$	0.003 + 20	0.0038 + 20	0.0004 + 1
30 V	11 M $\Omega$	0.006 + 20	0.008 + 30	0.0013 + 3
300 V	10.1 M $\Omega$	0.009 + 20	0.009 + 30	0.0013 + 1

\*The DM 5120 and DM 5520 comply with IEEE Standard 488.1-1987 and with Tektronix Standard Codes and Formats.



## dB (AC VOLTAGE)

### Accuracy –

1 year, 18-28°C – 34 to 49 dB (20 mV to 300 V);  
20 Hz to 20 kHz, ± 0.2 dB; 20 kHz to 100 kHz, ± 0.4 dB;  
–54 to –34 dB (2 mV to 20 mV); 20 Hz to 20 kHz  
± 1.1 dB; 20 kHz to 100 kHz ± 3 dB typical.

**Maximum Resolution** – 0.01 dB.

**Reference Level (default)** – 1 V rms = 0 dB.

## DC AMPS

**Accuracy** – 5 1/2 digits

Range	1 Year, 18 to 28°C
300 µA	± (0.09% of reading + 20 counts)
3 mA	± (0.05% of reading + 10 counts)
30 mA	± (0.05% of reading + 10 counts)
300 mA	± (0.05% of reading + 10 counts)
3 A	± (0.09% of reading + 10 counts)

## AC CURRENT (TRUE RMS)

**Accuracy** – 5 1/2 digits

		1 Yr 18 to 28°C
3 mA	20 to 45 Hz	± (2% of reading + 100 counts)
30 mA	45 Hz to 10 kHz	± (0.6% of reading + 100 counts)
300 mA		
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 DC and AC.

**Maximum Voltage Burden DC and AC**

300 mA	0.4 V
3 mA	0.4 V
30 mA	0.4 V
300 mA	0.5 V
3 A	2.0 V

**Settling Time** – 1 second within 0.1% of change in reading DC and AC.

**Maximum Input** – 3 A (250 V) [fuse protected].

## dB (AC 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.

## OHMS

Range	Accuracy (6 1/2 digits) ± (reading + counts)		Temperature Coefficient
	90 Days 18 to 28°C	1 Year 18 to 28°C	± (%rdg + cnts)/C 0-18°C & 28-50°C
300 Ω <sup>1</sup>	0.008 + 20	0.01 + 20	0.001 + 7
3 kΩ	0.005 + 20	0.007 + 20	0.001 + 1
30 kΩ	0.005 + 20	0.007 + 20	0.001 + 1
300 kΩ	0.02 + 20	0.021 + 20	0.004 + 1
3 MΩ	0.02 + 20	0.021 + 20	0.004 + 1
30 MΩ	0.1 + 50	0.1 + 50	0.03 + 1
300 MΩ <sup>2</sup>	2.0 + 5	2.0 + 5	0.3 + 1

**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.

**Maximum Input Voltage** – 300 V RMS or 425 V peak,  
whichever is less.

### MAXIMUM READING RATES<sup>3</sup>

DCV, DCA, ACV, ACA Readings/Second

Resolution	Continuous into Internal Buffer	
	Off	On
AUTOCAL		
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

Resolution	Continuous into Internal Buffer	
	Off	On
AUTOCAL		
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		9.5 (7.5)

## ELECTRICAL

**Warm-Up Time** – 2 hours to rated accuracy.

**Power Consumption** – 11 W, DM 5120; 120 W,  
DM 5520.

## 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)

<sup>1</sup> When properly zeroed.

<sup>2</sup> Resolution 5 1/2 digits

<sup>3</sup> For on scale readings with internal filter off; for  
3 V, 3 kΩ and 3 mA ranges. 5 1/2 and 6 1/2  
digit rates are for 60 Hz operation.  
Parentheses show 50 Hz operation.

## 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.



## DIGITAL COUNTER/TIMERS

### A COUNTER FOR EVERY PURPOSE

The TM 500/TM 5000 family of modular instruments includes six 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 5010 and DC 5009 are GPIB programmable; this capability can be added to the 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.

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 504A features autorange, period and width averaging, an internal 100X multiplier to provide high resolution of low frequency signals.

### 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 aberrations, such as ringing. Some instruments will automatically measure risetimes and falltimes.

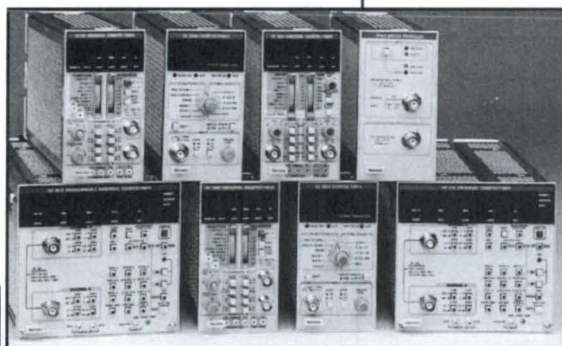
Using both input channels, you can make the time  $A \geq B$  measurement, which is used for propagation delays. You can also measure the number of events occurring on channel B during an interval on channel A.

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.

### Accuracy and Resolution

Accuracy describes how closely a measurement agrees with a standard. It depends on time base and trigger slew and jitter errors. To minimize time base errors, all 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, 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.



### DIGITAL COUNTER SELECTION GUIDE

	DC 510/DC 5010	DC 509/DC 5009	DC 503A	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
IEEE Standard 488.1-1987	DC 5010 only	DC 5009 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
Module Size	2 wide	1 wide	1 wide	1 wide
Price	\$3,995/\$4,150	\$2,450/\$2,250	\$1,825	\$845



## DC 504A

The easy-to-use 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 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  $\pm 2$  V and the selectable 5X attenuator provide a triggering range of up to  $\pm 10$  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.

## 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 M  $\Omega$ , paralleled by  $\approx 25$  pF. Rear Interface, 1X, 5X: 50  $\Omega$   $\pm 10\%$  at dc.

**Dynamic Range** – 1X: 2.0 V p-p signal within a  $\pm 2$  V dc window. 5X: 10 V peak,  $\pm 10$  V dc.

**Trigger Level Range** –  $\pm 2.0$  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:  $\leq 4$  V peak.

### FREQUENCY TO 100 MHz

**Gate Time (Resolution)** – 10 ms to 10 s (1 kHz to 1 Hz), selectable in decade steps; or autoranging (10 ms to 1 s only).

**Accuracy** –  $\pm 1$  Count  $\pm$  Time Base Error x Freq.

**Prescale Factor** –  $\times 10$ .

### 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** –

$$\pm \frac{100 \text{ ns}}{N} \pm \text{Time Base Error} \times \text{Period} \\ \pm 1.4 \times \left( \frac{\text{Trigger Jitter Error}}{N} \right)$$

### WIDTH AVERAGE

**Range** – DC Coupled: 200 ns to  $< 10$  sec. AC Coupled: 200 ns to 100 ms

**Resolution** – 100 ns /  $\sqrt{N}$

**Events Averaged (N)** –  $10^0$  to  $10^3$ , selectable in decade steps; or autoranging ( $10^0$  to  $10^2$  only).

**Accuracy** –

$$\frac{100 \text{ ns}}{\sqrt{N}} \pm \text{Time Base Error} \times \text{Width}$$

$$\pm \frac{\text{Start Trigger Jitter Error}}{\sqrt{N}} \pm \frac{\text{Stop Trigger Jitter Error}}{\sqrt{N}}$$

+ (Stop Slew Rate Error – Start Slew Rate Error)  $\pm 10$  ns.

### TOTALIZE

**Frequency Range** – DC Coupled:  $> 0$  Hz to 10 MHz. AC Coupled: 10 Hz to 10 MHz. Overflows above 999,999. Display update Run/Hold will hold display while counter continues to advance. Releasing Run/Hold will update display to new value.

### TIME BASE

**Frequency (At Calibration)** – 10 MHz  $\pm 1 \times 10^{-7}$

**Temperature Stability** –  $\pm 5 \times 10^{-6}$  ( $\pm 5$  ppm), 0 to  $+50^\circ\text{C}$ .

**Adjustment Resolution** –  $\pm 5 \times 10^{-8}$

**Aging Rate** –  $\leq 1 \times 10^{-6}$ /year ( $\leq 1$  ppm/year).

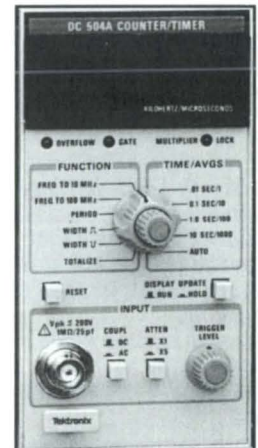
**External Time Base Input** – 10 MHz.

### RESOLUTION AND ACCURACY DEFINITIONS

Same as DC 503A except DC 504A has 100 MHz bandwidth and input hysteresis  $\approx 30$  mV p-p typical.

## DC 504A Counter/Timer

- DC to 100 MHz
- Period and Period Averaging
- Width and Width Averaging
- Autoranging
- 100X Resolution Multiplier



## ORDERING INFORMATION

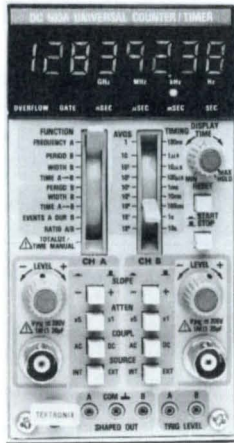
**DC 504A Counter/Timer. \$845**  
Includes: Instruction manual (070-4291-00).

**OPTIONAL ACCESSORIES**  
See page 221.



## DC 503A Universal Counter/Timer

- 125 MHz Both A and B Channels
- 10 ps Resolution in Time-Interval Average with 10<sup>8</sup> Averages
- Measurement Functions include:  
Frequency; Period and Period Average; Width and Width Average; Time A-B; Time A-B Average; Events A During B Average; Totalize; Time Manual; Ratio A/B Average
- 40 MHz Rep Rate in Time-Interval Average
- Trigger-Level Outputs for Accurate Trigger Setting
- Shaped Outputs for Ease of Triggering
- Designed for True Probe Compatibility
- High Stability Oven Time Base



## DC 503A

The DC 503A offers a broad range of measurement features at an affordable price. The instrument has two input channels, A and B, each with 125 MHz capability. Each channel has separate triggering level, triggering slope, attenuator, and coupling mode controls. Eight measurement functions are available with the DC 503A, and an averaging feature allows averaging of 1 to 10<sup>8</sup> 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** – 1X: ≤ 200 V peak; ≤ 400 V p-p from dc to 50 kHz, ≤ 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<sup>8</sup> 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<sup>-15</sup>) to 100 ns in decade steps.

**Events Averaged (N)** – 1 to 10<sup>8</sup>.

**Accuracy** –

$$\pm \frac{100 \text{ ns}}{N} \pm \text{Time Base Error} \times \text{Period B}$$

$$\pm \frac{1.4 \times \text{Channel B Trigger Jitter Error}}{N}$$

**Frequency Range** – 0 to ≤ 125 MHz.

## RATIO A/B

Averaged over 1 to 10<sup>8</sup> 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<sup>8</sup> 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** –

$$100 \text{ ns} / \sqrt{N}$$

**Events Averaged (N)** – 1 to 10<sup>8</sup> in decade steps.

**Accuracy** –

$$\pm \frac{100 \text{ ns}}{\sqrt{N}} \pm \text{Time Base Error} \times \text{Time A} \rightarrow \text{B}$$

$$\pm \frac{\text{Channel A Trigger Jitter Error}}{\sqrt{N}}$$

$$\pm \frac{\text{Channel B Trigger Jitter Error}}{\sqrt{N}}$$

+ (Channel B stop Trigger Slew Error – Channel A start Trigger Slew Error) ± 4 ns



## EVENTS A DURING B (AVERAGE)

**Maximum A Frequency** – ≤ 125 MHz.

**Minimum B Pulse Width** – 5 ns

**Events Averaged (N)** – 1 to 10<sup>9</sup> in decade steps.

**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<sup>9</sup> 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** – 100 ns / √N

**Events Averaged (N)** – 1 to 10<sup>8</sup> 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<sup>9</sup> 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) –

$$\sqrt{(e_{n1})^2 + (e_{n2})^2} (V)$$

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) –

Input Hysteresis (V)/2

Input Slew Rate at set Trigger Point (V/μs)

Where: Input hysteresis = 20 mV p-p typical.

## OTHER CHARACTERISTICS HIGH STABILITY STANDARD TIME BASE

**Crystal Frequency** – 10 MHz.

**Temperature Stability** – < ±2 x 10<sup>-7</sup> after warm-up,  
0 to +50°C.

**Warmup Time** – Within 2 x 10<sup>-7</sup> of final frequency in  
< 10 minutes when cold started at 25°C.

**Aging Rate** – 1 x 10<sup>-8</sup>/day at time of shipment 4 x 10<sup>-9</sup>/  
week after 30 days of continuous operation, 1x 10<sup>-9</sup>/year  
after 60 days of continuous operation.

**Setability** – Adjustable to within 2 x 10<sup>-8</sup>

## REAR INTERFACE

**Inputs** – Direct count input to 50 MHz, (50 Ω )  
impedance, resistor may be removed for 1 M Ω  
impedance, remote start/stop, reset; external time base.

**Outputs** – BCD serial-by-digit, decimal point overflow,  
scan clock; trigger level; time base reference.

## ORDERING INFORMATION

**DC 503A Universal Counter/Timer** \$1,825  
Includes: Instruction manual  
(070-2971-00).

### OPTIONAL COUNTER ACCESSORIES

**Power Divider GR, 50 Ω –**  
Order 017-0082-00 \$885

**Adapters –**  
(GR to BNC female) \$\*  
Order 017-0067-00

(GR to BNC male) \$115  
Order 017-0064-00

**Cable Adapters –**  
(BNC to tip jack)

DC 503A, DC 509, DC 5009 \$55  
Order 175-3765-01

(BNC to RF) DC 510, DC 5010. \$55  
Order 012-0532-00

**RECOMMENDED PROBES**

**P6101A** – 1X, dc to 34 MHz \$65

**P6106A** – 10X, dc to 300 MHz \$180

**P6201** – FET, dc to 900 MHz \$1,395

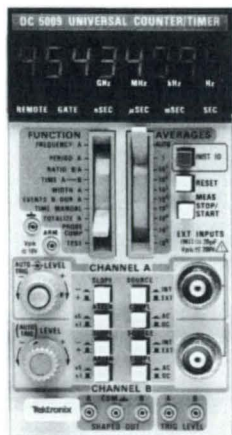
**P6230** – Bias/Offset, dc to 1.5 GHz \$525

\*1 Contact your local sales representative.



## DC 5009/DC 509 Universal Counter/Timers

- 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<sup>9</sup> in All Modes
- Duty - Cycle Independent Autotrigger
- Shaped A and B Channel Outputs
- Probe Compensation
- High Stability Oven Time Base



**GPIB <sup>\*</sup>**  
IEEE-488

\*The DC 5009 complies with IEEE Standard 488.1-1987 and with Tektronix Standard Codes and Formats.

## 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 10<sup>9</sup> 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 extends frequency measurements to 1.3 GHz.

## CHARACTERISTICS

### 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, ≤15 V p-p at 135 MHz. 5X: ≤200 V peak; ≤400 V p-p from dc to 5 MHz, ≤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<sup>-7</sup> to 10<sup>8</sup> (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 -

$$\pm \text{LSD} + \frac{1}{\sqrt{N}} \left( \pm \text{A Trigger Jitter Error} \right) \left( \pm \text{B Trigger Jitter Error} \right)$$

**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<sup>-7</sup> to 10<sup>8</sup>.

**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 -

$$\pm \text{LSD} + \frac{\text{Freq. B}}{\sqrt{N}} \left( \pm \text{Trig. Jit. Error CH A start edge} \right) \left( \pm \text{Trig. Jit. Error CH A stop edge} \right)$$

**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 -

$$\pm \text{LSD} + \frac{1}{\sqrt{N}} \left( \pm \text{Start Trigger Jitter Error} \right) \left( \pm \text{Stop Trigger Jitter Error} \right)$$

**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** –  $\pm$ LSD (100 ms).

**Accuracy** –  $\pm$ Resolution  $\pm$ (Time Base Error x Time).

## TOTALIZE A

**Range** – 0 to 1.09 x 10<sup>12</sup> counts. Extended with GPIB.

**Repetition Rate** – > 0 to  $\geq$ 135 MHz.

## RESOLUTION AND ACCURACY: DEFINITIONS

For Trigger Jitter Error and Slew Rate Error definitions, see DC 503A.

*N* = Number of Events Averaged.

The minimum number of averages is selected by the averages control in decade steps from 1 to 10<sup>6</sup>. At channel A repetition rates above  $\approx$ 250 Hz, the number of events averaged will be:

$$N = [\text{Frequency A (Hz)} \times 4 \text{ ms}] + \text{Averages.}$$

*N* = Averages setting (below 250 Hz).

In the Auto mode, the counter measures with a fixed measurement time of about 300 ms.

$$N = \text{Frequency A (Hz)} \times 0.3 \text{ s. (N is always } \geq 1).$$

**Time Base Error** – The sum of all errors specified for the time base used.

## STANDARD HIGH STABILITY TIME BASE

**Crystal Frequency** – 10 MHz.

**Temperature Stability** –  $\pm 2 \times 10^{-7}$  0 to +50°C after warm-up.

**Warm-up Time** –  $+2 \times 10^{-7}$  of final frequency in 10 minutes when cold started at 25°C.

**Aging Rate** –  $\leq 1 \times 10^{-8}$ /day at time of shipment,  $4 \times 10^{-8}$ /week after 30 days of continuous operation,  $1 \times 10^{-6}$ /year after 60 days of continuous operation.

**Stability** – Adjustable to within  $\pm 2 \times 10^{-6}$ .

## REAR INTERFACE

**Inputs** – Channel A and Channel B input to 50  $\Omega$  (50  $\Omega$  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** –  $\approx$ 10 readings/s maximum (DC 5009 only).

## ORDERING INFORMATION

**DC 5009** Programmable Universal Counter/Timer **\$2,250**

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 **\$2,450**

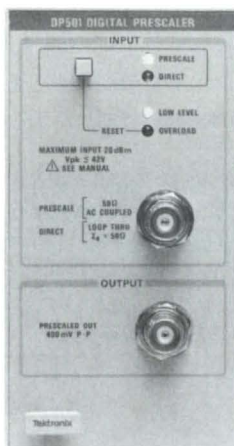
Includes: Instruction Manual (070-3464-00).

**CONVERSION KIT (DC 509)**

**IEEE Standard 488 Capability** – Order 040-0957-05 **\$450**

**OPTIONAL ACCESSORIES**

See page 221.



## 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.

## CHARACTERISTICS

### PRESCALE MODE INPUT

**Frequency Range** –  $\leq$  100 MHz to  $\geq$  1.3 GHz.

**Sensitivity** – 100 MHz to 1 GHz is  $\leq$  20 mV RMS ( $-21$  dBm). 1 to 1.3 GHz is  $\leq$  30 mV RMS ( $-17$  dBm).

**Impedance** – 50  $\Omega$ , ac coupled; vswr  $\leq 2.2:1$ .

**Output** – Amplitude into 50  $\Omega$  is  $\leq$  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  $\Omega$ ; nonterminated capacitance  $\approx$ 20 pF (no connection to output).

**Output** – Connected directly to input.  $<$  1 dB insertion loss up to 350 MHz. Powers up in direct mode.

## GENERAL

**Overload Protection** – Prescale: Input disconnects when input signal exceeds +20 dBm  $\pm$ 5 dBm.

**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.

## DP 501 Digital Prescaler

- Extends Counter Frequency – Measurement Capability to 1.3 GHz
- Compatible with Most TM 500 and TM 5000 Counters
- AGC
- Low-Level Indicator
- GPIB Programmability with DC 5009 and DC 5010

## ORDERING INFORMATION

**DP 501** Digital Prescaler **\$995**

Includes: Instruction manual (070-4332-00).



## DC 5010/DC 510

### Universal Counter/Timers

- 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  $10^8$  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. The pseudo-random, phase-modulated time base provides increased accuracy by eliminating synchronous errors in the time interval and width averaging modes.

Auto trigger senses the applied signal and sets trigger levels to the optimum points. In the DC 5010, trigger levels, the minimum and maximum signal voltage levels, and the trigger voltage are available over the GPIB, and can be viewed on the 9-digit display.

Other features include an arming input that allows measurement of selected inputs from complex waveforms, hysteresis compensation and probe compensation for attenuator type probes.

## CHARACTERISTICS

### CHANNEL A AND CHANNEL B INPUT

**Frequency Range** – 50  $\Omega$  termination:

> 0 to  $\geq$  350 MHz dc coupled.

100 kHz to  $\geq$  350 MHz ac coupled.

1 M $\Omega$  termination > 0 to  $\geq$  300 MHz dc coupled.

16 Hz to  $\geq$  300 MHz ac coupled.

**Sensitivity** – 50  $\Omega$  termination dc:  $\leq$  25 mV RMS

sinewave to 350 MHz  $\leq$  70 mV p-p pulse 1 M $\Omega$

termination. DC/AC  $\leq$  25 mV RMS to 200 MHz. 42 mV

RMS to 300 MHz.

**Attenuation Selectable** – 1X, 5X.

**Impedance** – 1 M $\Omega$  paralleled by 23 pf  $\pm$  2.2 pF (10%) or 50  $\Omega$   $\pm$  3% dc.

**Dynamic Range** – 70 mV p-p to 4 V p-p (x attenuation).

**Trigger Level Range** –

$\geq$  +2 V to  $\leq$  -2 V with 4 mV resolution (X1).

$\leq$   $\pm$ 10 V to  $\leq$  -10 V with 20 mV resolution (X5).

**Trigger Level Accuracy** –  $\pm$  1% of F.S. trigger level range, plus  $\pm$  2% of reading for a dc input V,  $\pm$  40 mV X Attenuator.

**Autotrigger Frequency Range** – 10 Hz to  $\leq$  350 MHz.

**Independent Controls** – Slope, Attenuation 1X/5X, Couple ac/dc, Impedance 1 M $\Omega$ /50  $\Omega$ .

**Maximum Input Voltage (1 M $\Omega$  input impedance)**

**1X:**  $\pm$  42 V (dc + peak ac) to 200 kHz;

$\pm$  2 V (dc + peak ac) 2 to 250 MHz.

**5X:**  $\pm$  42 V (dc + peak ac) to 1 MHz;

$\pm$  10 V (dc + peak ac) 1 to 250 MHz.

In 50  $\Omega$  Input Impedance: Signals  $>$   $\pm$  2 V x attenuator will cause input protection circuitry to switch input to 1 M $\Omega$ .

**Shaped Out** – Shaped replica of signal being measured aids proper triggering on complex waveforms ( $\leq$  100 mV typically to 350 MHz into 50  $\Omega$  load).

**Arming Input** – Permits measurements of complex waveforms. A TTL high allows averaging of selected events within a measurement.

### FREQUENCY A

**Range** –  $\leq$  36  $\mu$ Hz to  $\geq$  350 MHz.

**Resolution** –

$$\pm \text{LSD} \pm 1.4 \left( \frac{\text{A Trigger Jitter Error}}{N} \right) (\text{Frequency A})^2$$

**Accuracy** –

Resolution  $\pm$  (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** – ( $\pm$  Time Base Error x Period A)

### RATIO B/A

**Range** –  $10^{-8}$  to  $10^9$  (Frequency Range:  $\leq$  36  $\mu$ Hz to  $\geq$  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 $\rightarrow$ B

**Range** – 2.0 ns to 7.6 hrs.

**Minimum Dead Time** – 12.5 ns (stop to start).

**Resolution** –

$$\pm \text{LSD} + \frac{1}{\sqrt{N}} \times \left( \begin{array}{l} \pm \text{Trig. Jit. Error CH A start edge} \\ \pm \text{Trig. Jit. Error CH A stop edge} \end{array} \right)$$

**Accuracy** – Resolution  $\pm$  (Time Base Error x TI)

$\pm$  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** –  $\geq$  350 MHz.

**Maximum A Frequency** –  $\geq$  80 MHz.

**Maximum A Pulse Width** –  $\leq$  4.0 ns.

**Minimum Time Between A Pulses** –  $\leq$  8.5 ns.

**Minimum Dead Time Between Pulses** –  $\leq$  8.5 ns.

**Resolution** –

$$\pm \text{LSD} + \frac{\text{Freq. B}}{\sqrt{N}} \times \left( \begin{array}{l} \pm \text{Trig. Jit. Error CH A start edge} \\ \pm \text{Trig. Jit. Error CH A stop edge} \end{array} \right)$$



## 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<sup>4</sup> s (≈ 8 hrs).

**Resolution** – ± LSD 100 ms.

## TOTALIZE A, A + B

**Range** – 0 to 10<sup>9</sup> counts.

**Repetition Rate** – 0 to ≥ 350 MHz.

## TOTALIZE A – B

**Range** – -1 x 10<sup>9</sup> to 10<sup>12</sup> (either A > 10<sup>12</sup> or B > 10<sup>12</sup> 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 V<sub>p-p</sub> 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%).

## RESOLUTION AND ACCURACY DEFINITIONS

### Trigger Jitter Error (Seconds RMS) –

$$\sqrt{(e_{n1})^2 + (e_{n2})^2} \text{ (Volts RMS)}$$

Input Slew Rate at Trigger Point (V/s)

Where: e<sub>n1</sub> = 140 μV RMS typical counter input noise for 1 MΩ filter on; 240 μV RMS typical for 1 MΩ, filter off and 340 μV RMS typical for 50 Ω and e<sub>n2</sub> = RMS Noise Voltage of input signal at trigger point measured with 350 MHz bandwidth.

### Slew Rate Error (Seconds) =

Trigger Level Error (V)<sup>-1</sup>

Input Slew Rate at Trigger Point (V/s)

### \*1Trigger level error =

All functions except Width and Events B During A	Positive Slope	Trigger accuracy X attenuation factor
Width A	Negative Slope	(Trigger accuracy ± 10 mV) X attenuation factor
	Start Edge	Trigger accuracy X attenuation factor
	Stop Edge	(Trigger accuracy + hyst) X attenuation factor
	Start Edge	(Trigger accuracy + hyst) X attenuation factor
	Stop Edge	Trigger accuracy X attenuation factor

Events B Same as Width, except each number is multiplied by (Frequency B)

Note: Input hysteresis is typically 50 mV p-p 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<sup>9</sup>. 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.

## STANDARD HIGH STABILITY TIME BASE

**Crystal Frequency** – 10 MHz.

**Temperature Stability** – ± 2x10<sup>-7</sup> 0 to + 50°C after warm-up.

**Warm-Up Time** – + 2x10<sup>-7</sup> of final frequency in 10 minutes when cold started at 25°C.

**Aging Rate** – ≤ 1x10<sup>-9</sup>/day at time of shipment, 4x10<sup>-9</sup>/week after 30 days of continuous operation, 1x10<sup>-6</sup>/year after 60 days of continuous operation.

**Stability** – Adjustable to within ± 2x10<sup>-8</sup>.

## REAR INTERFACE

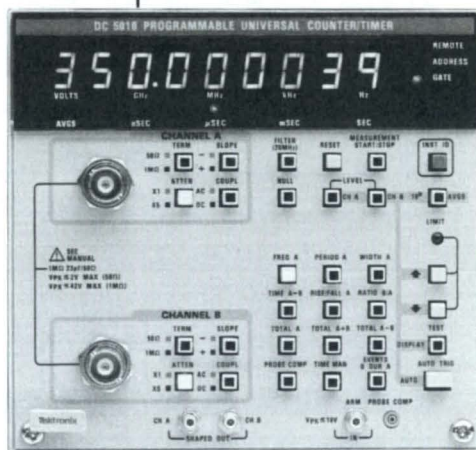
**Inputs** – Arming; reset; external time base (1, 5, or 10 MHz), prescale.

**Outputs** – 10 MHz clock.

## OTHER CHARACTERISTICS

**Power Consumption** – 19.3 W.

**GPB Data Output Rate** – ≈ 10 readings/s maximum (DC 5010 only).



**GPB\***  
IEEE-488

## ORDERING INFORMATION

**DC 5010 Programmable Universal Counter/Timer** \$4,150

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.** \$3,995

**CONVERSION KIT (DC 510) IEEE Standard 488 Capability –** Order 040-1023-06 \$215

**OPTIONAL ACCESSORIES**  
See page 221.

\*The DC5010 complies with IEEE Standard 488.1-1987 and Tektronix Standard Codes and Formats.

# MEASUREMENT INSTRUMENTS

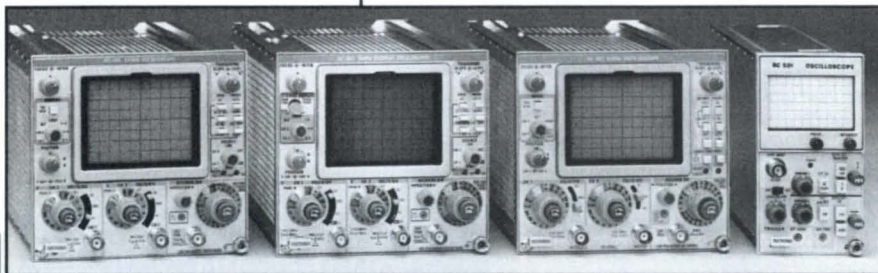


## SC 504 Dual-Trace Oscilloscope

- 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

## 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.

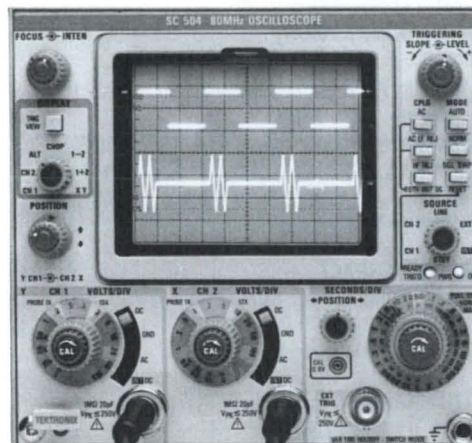


### OSCILLOSCOPE SELECTION GUIDE

	SC 504	SC 503	SC 502	SC 501
Bandwidth (MHz)	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 at 1 kHz)	500	700	700	
Sweep Rate (/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
Module Size	2 Wide	2 Wide	2 Wide	1 Wide
Recommended Probes	1X, P6106A; 10X, P6102A; 1X/10X, P6062B			
Price	\$5,295	\$4,995	\$3,295	\$2,995

### ORDERING INFORMATION

- SC 504 80 MHz Oscilloscope (070-2296-00) **\$5,295**  
 For Floating Measurements, order A6902B Isolator. **\$2,200**  
 See page 328 for complete description.



## SC 504

The SC 504 is a general-purpose, dual-trace, nondelayed-sweep oscilloscope. It has a high writing speed with a maximum sensitivity of 5 mV/div and a maximum sweep rate of 5 ns/div (with magnifier). This oscilloscope features Add (CH 1 plus CH 2), differential (CH 1 minus CH 2), and "true" X-Y modes, and also includes rear-interfacing capability (switchable CH 1, CH 2, and ext trig inputs). Enhanced autotriggering, trigger view, and variable trigger holdoff make this oscilloscope very versatile and easy to use.

## CHARACTERISTICS

### VERTICAL DEFLECTION

**Bandwidth At -3 dB Points** - dc to > 50 MHz to 35°C, > 70 MHz to 50°C.

**Rise Time** - 4.4 ns.

**Accuracy** - ±2%, +15°C to +35°C; ±3% 0 to 50°C.

**Step Response Aberrations** - ±4% to 35°C.

**AC Coupled Low-Frequency Response** ≤ -10 Hz, 1 Hz with X10 probe

**Deflection Factors** - 5 mV/div to 10V/div in a 1-2-5 sequence of 11 steps plus variable.

**Input R&C** - 1 MΩ ±1%, 20 pF.

**Maximum Input Voltage** - 250 V (dc + peak ac), 500 V p-p at 1 kHz.

**CMRR (CH 1 minus CH 2)** - > 50:1 at 1 MHz.

**Calibrator** - 0.6 V ±1%, ≈ 1 kHz.

### HORIZONTAL DEFLECTION

**Time Base** - 0.2 s to 50 ns/div, 21 steps in a 1-2-5 sequence, plus X10 magnifier to 5 ns/div.

**Sweep Accuracy** - 15 to 35°C

X1, ±3%; X10, ±4%; 0.2 s/div to 50 ms/div;

X1, ±2%; X10, ±3%; 20 ms/div to 0.2 μs/div;

X1, ±3%; X10, ±4%; 0.1 μs/div to 50 ns/div

**X-Y Mode Bandwidth** - DC to 2 MHz

### TRIGGERING

**Coupling** - DC, AC, AC LF REJ, HF REJ

**Trigger Sensitivity (min p-p signal) DC Coupling**

Source	≤ 30 MHz	30 M to 80 MHz
Ch 1 and Ch 2	0.4 div.	1.5 div., 150 mV
Ext. Rear Int.	60 mV	100 mV to 50 MHz

**Triggering Level Range** - Ext ≥ 1.4 V

### AVAILABLE REAR CONNECTIONS

Z Axis In, Ch 1 Trig Out, Ch 1 & Ch 2 In, 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

**Bandwidth at -3 dB** - 5 mV to 20 V/div, >10 MHz; 2 mV/div, >7 MHz; 1 mV/div, >5 MHz.

**Rise Time** - 35 ns, 5 mV to 20 V/div.

**Step Response Aberrations** -  $\pm 2\%$ ,  $\leq 3\%$  p-p.

**AC Coupled Low-Frequency Response** -  $\leq 10$  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.

**Accuracy** - 5 mV to 20 V/div,  $\pm 3\%$ ; 1 mV/div and 2 mV/div,  $\pm 5\%$ .

**Input R&C** - 1 M $\Omega$   $\pm 1\%$ , 47 pF.

**Maximum Input Voltage** - 350 V (dc + peak ac), 700 V p-p at 1 kHz.

**CMRR (CH 1 minus CH 2)** -  $\rightarrow 30:1$  at 1 MHz.

**Channel Isolation** -  $\leq 2\%$  to 10 MHz.

**Displayed Noise** -  $\leq 0.2$  mV p-p at 1 mV/div.

**Calibrator** - 0.6 V  $\pm 1\%$ ,  $\approx 1$  kHz.

**Delay Line** - Permits viewing leading edge of displayed waveform.

### HORIZONTAL DEFLECTION

**Time Base** - Calibrated range from 500 ns/div to 2 s/div, 21 steps in 1-2-5 sequence, X10 magnifier to 50 ns/div.

**Sweep Accuracy**<sup>\*1</sup> -  $\pm 4\%$ , 2 s/div to 0.5 s/div;  
 $\pm 3\%$ , 0.2 s/div to 5  $\mu$ s/div;  
 $\pm 4\%$ , 2  $\mu$ s/div to 500 ns/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	$\leq 5$ 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  $\geq 1.2$  V, Int  $\geq 6$  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.

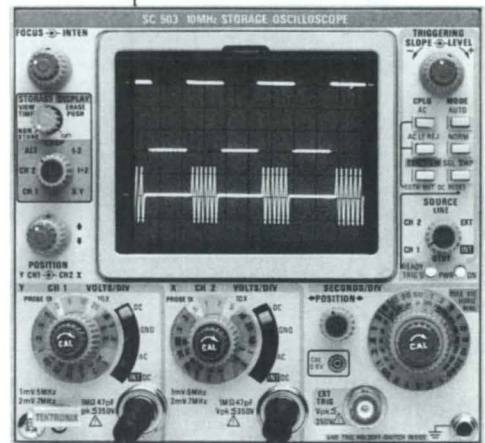
**Autoerase Viewing Time** - Continuously variable from 0.5 to 5 s.

**Maximum Recommended Storage Time** - 4 hrs.

<sup>\*1</sup> 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 503 Storage Oscilloscope

- 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



## ORDERING INFORMATION

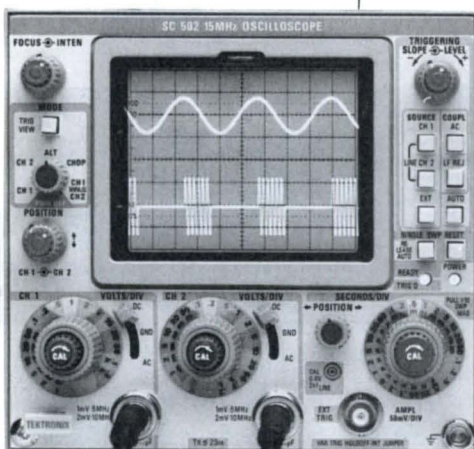
**SC 503 10-MHz Storage Oscilloscope** **\$4,995**  
Includes: Instruction manual (070-3438-00).

# MEASUREMENT INSTRUMENTS



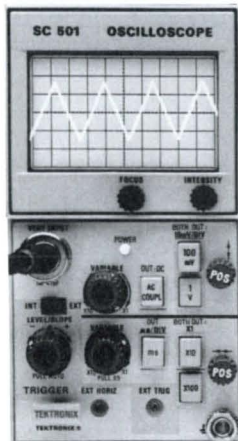
## SC 502 Dual-Trace Oscilloscope

- 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 Oscilloscope

- 5-MHz Bandwidth
- Single Compartment Sizing
- 6.4-cm (2.5 in.) CRT



### ORDERING INFORMATION

SC 502 15-MHz Oscilloscope Includes: Instruction manual (070-1878-01).	\$3,295
SC 501 5-MHz Oscilloscope Includes: Instruction manual (070-1700-01).	\$2,995

## 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.

## CHARACTERISTICS

### VERTICAL DEFLECTION

**Bandwidth at -3 dB** - 5 mV to 20 v/div, >15 MHz; 2 mV/div, >10 MHz; 1 mV/div, >5 MHz.

**Rise Time** - 23 ns.

**Step Response Aberrations** -  $\pm 2\%$ ,  $\leq 3$  p-p.

**AC Coupled Low-Frequency Response** -  $\leq 10$  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** -  $1 \text{ M}\Omega \pm 1\%$ , 47 pF.

**Accuracy** - 5 mV to 20 V/div,  $< 2\%$ ; 1 mV to 2 mV/div,  $< 5\%$ .

**Maximum Input Voltage** - 350 V (dc + peak ac), 700 V p-p at 1 kHz.

**CMRR (CH 1 minus CH 2)** -  $> 30:1$  at 1 MHz.

**Channel Isolation** -  $\leq 2\%$  to 15 MHz.

**Displayed Noise** -  $\leq 0.2$  mV p-p at 1 mV/div.

**Calibrator** -  $0.6 \text{ V} \pm 1\%$ ,  $\approx$  twice power-line frequency.

### HORIZONTAL DEFLECTION

**Time Base** - Calibrated range from 0.2  $\mu\text{s}/\text{div}$  to 0.5 s/div, 20 steps in 1-2-5 sequence, X10 magnifier to 20 ns/div.

**Sweep Accuracy**<sup>\*1</sup> -  $\pm 3\%$ , 0.5 s/div to 0.1 s/div;  
 $\pm 2\%$ , 50 ms/div to 1  $\mu\text{s}/\text{div}$ ;  
 $\pm 3\%$ , 0.5  $\mu\text{s}/\text{div}$  to 0.2  $\mu\text{s}/\text{div}$

**X-Y Mode Bandwidth** - DC to 2 MHz.

### TRIGGERING

**Coupling** - DC, AC, AC LF REJ.

**Trigger Sensitivity (min p-p signal) DC Coupling** -

Source	$\leq 5$ 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  $\geq 1.2$  V, Int  $\geq 8$  div.

### AVAILABLE REAR CONNECTIONS

Ext (Delayed) Gate In, Trig Gate Out, Gate Select In, Hold Off Out, Intensity In, Ramp Out, Ch 1 Trig Out.

### CRT

**Phosphor** - GH (P31)

**Accelerating Potential** - 12 kV

**Graticule** - 8X10 div (0.25 in/div) internal graticule lines.

\*1 Accuracy at 15° to 35°C, X1 magnifier. Derate additional 1% for X10 magnifier on, and an additional 1% for operation at 0° to 15°C and 35° to 50°C.

## SC 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:

**Bandwidth** - DC to  $> 5$  MHz.

**AC Coupled Low-Frequency Response** -  $\leq 2$  Hz.

**Deflection Factors** - 10 mV/div, 100 mV/div, and 1 V/div continuously variable.

**Accuracy** -  $< 3\%$ .

**Input R&C** -  $1 \text{ M}\Omega \pm 1\%$ , 47 pF.

**Maximum Input Voltage** - 350 V (dc + peak ac).

### HORIZONTAL DEFLECTION:

**Time Base** - 1  $\mu\text{s}/\text{div}$  to 100 ms/div, X5 multiplier provides 200 ns/div.

**Accuracy** -  $\leq 5\%$  for all sweep rates.

### AVAILABLE REAR CONNECTIONS

Ramp out, Vert in, Ext Trig, Ext Horiz.

### CRT

**Phosphor** - GH (P31).

**Accelerating Potential** - 1 kV.

**Graticule** - 6X10 div (0.2 in/div).



## SI 5010

The SI 5010 Programmable Scanner switches and routes up to 16 high-frequency input and/or output signals. It maintains a clean 50  $\Omega$  environment through the use of 50  $\Omega$  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.

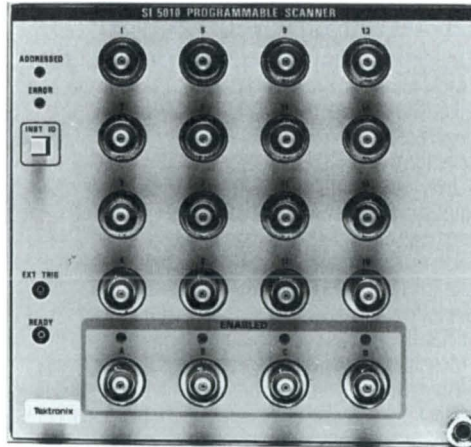
**Channel Configuration (Software Selectable)** – 1, 2, 3, or 4 groups of 4 channels. 2 groups of 8 channels. 1 group of 16 channels.

**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  $\Omega$ . See VSWR specification.

**Rise Time (Each Channel)** – 1 ns.



**Voltage Standing Wave Ratio (VSWR)** – Any 4 Channel Group: 1.25:1 at 100 MHz, increasing to 1.8:1 at 350 MHz. Any Other Combination: 1.5:1 at 100 MHz. 2:1 at 225 MHz.

**Insertion Loss** – 1 dB at 100 MHz.

**Channel Delay Matching** – Any Group of 4: 50 ps. Any Group of 8: 110 ps. Any Group of 16: 310 ps.

**Type of Relays** – 16 Form A, 4 Form "C". Pull-In Time: 3 ms. Release Time: 3 ms. Breakdown Voltage: 350 V (dc + peak ac). Series Path Resistance (End of Life): 0.5  $\Omega$

**Peak Carry Voltage** – Underterminated: 40 V maximum. 50  $\Omega$  Terminated: 12.5 V maximum.

**Peak Contact Current** – 0.25 A maximum.

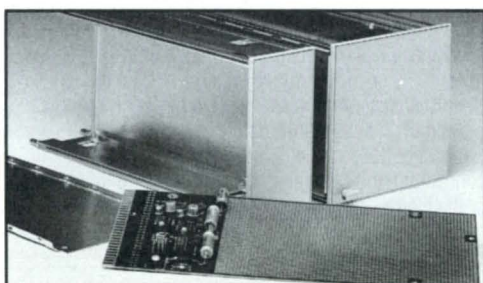
**Peak Switching Voltages** – Underterminated: 15 V maximum. 50  $\Omega$  Terminated: 3.73 V maximum.

**Peak Switching Current** – 0.01 A maximum.

## CUSTOM PLUG-IN KITS

### SINGLE COMPARTMENT WITH POWER SUPPLY BOARD (040-0803-02)

The kit includes parts and a pre-etched circuit board layout for (1) a ground-referenced positive and negative supply, capable of 7 to 20 V at up to 400 mA, and (2) a ground-reference supply, nominally 5 V, not adjustable, with up to 1 amp current capability. The circuit board includes the edge-connector interface and has about 30 square inches of 0.1" grid perforated board with plated holes for circuit development (see below).



### SINGLE COMPARTMENT WITH DEVELOPMENT BOARD (040-0652-05)

This kit comes without the power supply components or the pre-etched power supply circuit. The board includes the edge-connector interface and has about 35 square inches of board development area.

### SINGLE COMPARTMENT WITHOUT BOARD (040-0821-03)

This kit comes without a board for applications where custom circuit boards are fabricated.

### DUAL COMPARTMENT WITH DEVELOPMENT BOARDS (040-0754-07)

This kit has two development boards (30 and 35 square inches of development area) for applications requiring additional power, circuit area, or front panel space.

## 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

## ORDERING INFORMATION

SI 5010 Programmable Scanner	\$2,750
Includes: Instruction manual (070-3721-00); Instrument interface guide; Reference guide.	

### RECOMMENDED PROBES

P6156 – 10X Passive	\$255
P6156 Opt. 28 – 100X Passive	\$315
P6202A – FET	\$825
P6230 – Bias/Offset	\$525



## ORDERING INFORMATION

Single Compartment with Power Supply Board – Order 040-0803-03	\$160
Single Compartment with Uncommitted Board – Order 040-0652-06	\$135
Single Compartment Without Board – Order 040-0821-04	\$70
Double Compartment with Two Boards – Order 040-0754-07	\$260
Rear-Interface Data Book – Order 070-2088-04	\$27
Flexible Extender Cable – Order 067-0645-02	\$470

\*The SI 5010 complies with IEEE Standard 488.1-1987, and with Tektronix Standard Codes and Formats.



## AA 5001/AA 501A Distortion Analyzers

- **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  $\leq 3.0 \mu\text{V}$ .**
- **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).**

## 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 interpretation 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 Tektronix Application Note 75 AX-4485.

Level (amplitude) measurements are typically made with an ac voltmeter. A digital multimeter is built into the AA 5001/AA 501A, removing the need for a separate voltmeter.

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.

Whether the application is in the calibrating/verifying of low frequency oscillator products, base-band testing of satellite, microwave, and wire-line communications equipment, manufacturing of consumer audio products, or maintaining broadcast stations and recording studios, signal quality is of the utmost importance.

## AA 5001/AA 501A

The AA 5001/AA 501A Distortion Analyzers provide fully automated measurement of level, total harmonic distortion plus noise (THD+N), and intermodulation distortion (Option 01 for the AA 501A). The AA 5001 adds GPIB compatibility plus programmability.

### FULLY AUTOMATIC

Automatic measurement means that once the mode is selected and the test signal is applied, the operator simply reads the accurate result on the 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 user applied signal. The 0 dB reference memory stores the selected level, and all subsequent measurements are referenced to it. The user can choose true RMS or average response. While true RMS is generally more accurate, the averaging feature is convenient for comparison of new data with data taken on older instruments where averaging was the only mode available.

The fundamental frequency range is 10 Hz to 100 kHz, with harmonic measurements to 300 kHz. Any one of four built-in frequency-weighting filters can be switched into the signal paths for input signal preconditioning. External filters can be simply connected for special applications such as stereo pilot tone rejection, rejection of continuous tone squelch signals in mobile radio systems, or for selection of individual harmonics instead of total harmonic distortion measurements.

An Input-Monitor connector and a Function-Output connector permit oscilloscope display of the input signal or the filtered signal input used in THD+N measurement.





## 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  $\pm 10\%$  ( $\pm 1$  dB) for harmonics  $\leq 100$  kHz. 10 Hz to 100 kHz is within  $+10\%$  ( $+1$  dB),  $-20\%$  ( $-2$  dB for harmonics  $\leq 300$  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  $\Omega$ ), or dB ratio with push-to-set 0 dB reference.

**Level Ranges** – 200  $\mu$ V 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	$\pm 2\%$ (+2 counts)	$\pm 0.3$ dB $\dagger$ + 0.5% of reading
10 Hz to 100 kHz	$\pm 4\%$ (+2 counts)	$\pm 0.5$ dB $\dagger$ + 0.5% of reading

\* $\dagger$   $V_i \geq 100$   $\mu$ V, level ranging indicators extinguished.  $\pm 0.2$  dB at 1 kHz only. Flatness is 0.1 dB, 20 Hz to 20 kHz, and  $\pm 0.3$  dB, 10 Hz to 100 kHz.

**Bandwidth** –  $\geq 300$  kHz.

**Residual Noise** –  $\leq 3$   $\mu$ V ( $-108$  dBm) with 80 kHz and 400 Hz filters, RMS response; (AA 5001, AA 501A and AA 501A Option 01)  $\leq 1.5$   $\mu$ V ( $-114$  dBm) with "A" weighting filter, RMS response (standard instruments only);  $\leq 5$   $\mu$ V ( $-104$  dBm) with CCIR weighting filter, quasi-peak response (Option 02 instruments only).

### INTERMODULATION DISTORTION FUNCTION (AA 5001 and AA501A Option 01)

Fully automatic SMPTE, DIN, and CCIF difference tone measurements. Minimum input level 60 mV ( $-22$  dBm). Accuracy  $\pm 1$  dB. For IM Components  $\leq 1$  kHz.

**SMPTE and DIN Tests** – Lower Frequency Range: 50 to 250 Hz. Upper Frequency Range: Usable from 3 to 160 kHz. Level Ratio Range: 1:1 to 4:1 (lower:upper). Residual IMD: AA 5001  $\leq 0.0032\%$  ( $-90$  dB) with 60 Hz and 7 kHz or 250 Hz and 8 kHz test tones;  $\leq 0.0025\%$  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:  $\leq 0.0018\%$  ( $-95$  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  $\approx 3$  readings/s.

**Detection** – Average or true RMS for waveforms with crest factors  $\leq 3$ . 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  $\pm 5\%$ ; 18 dB/octave slope, at least 40 dB rejection at 60 Hz. 80 kHz Low Pass:  $-3$  dB at 80 kHz  $\pm 5\%$ ; 18 dB/octave slope.

30 kHz Low Pass: (AA 501A only)  $-3$  dB at 30 kHz  $\pm 5\%$ .

Audio Bandpass: (AA 5001 only)  $-3$  dB at 22.4 Hz and 22.4 kHz, both  $\pm 5\%$ . 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 k $\Omega$   $\pm 2\%$ , 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** –  $\geq 50$  dB at 50 or 60 Hz. Typically  $\geq 40$  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).

### FRONT-PANEL SIGNALS

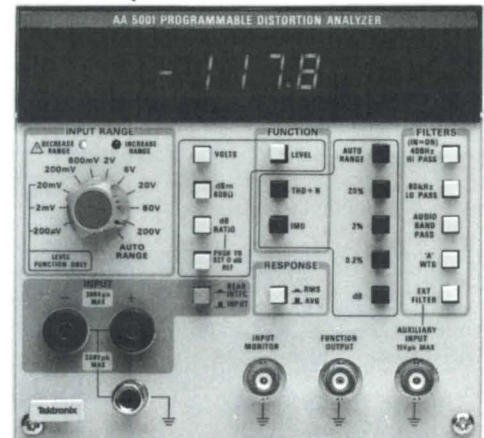
**Input Monitor** – Provides constant-amplitude version of signal applied to input. Output Voltage: 1 V RMS  $\pm 10\%$  for input signals  $> 50$  mV. Source Impedance: 1 k $\Omega$   $\pm 5\%$ .

**Function Output** – Provides a scaled sample of selected function signal. Output Voltage: 1 V RMS  $\pm 3\%$  for 1000 count display. Source Impedance: 1 k $\Omega$   $\pm 5\%$ .

**Auxiliary Input** – Provides input to detector circuit when Ext Filter button is depressed. Sensitivity: 1 V RMS  $\pm 3\%$  = 1000 count display. Impedance: 100 k $\Omega$   $\pm 5\%$ , ac coupled.

## ORDERING INFORMATION

AA 5001 Programmable Distortion Analyzer	\$3,995
Includes: Instruction manual (070-4598-01); Instrument Interface Guide (070-4788-00); Reference Guide (070-4597-00).	
Opt. 02 – CCIR/DIN (includes Intermodulation Distortion)	+\$410
AA 501A Distortion Analyzer	\$2,995
Includes: Instruction Manual (070-2958-00).	
Opt. 01 – Intermodulation Distortion.	+\$750
Opt. 02 – CCIR/DIN (includes Intermodulation Distortion)	+\$1,150



**GPB**  
IEEE-488

\* The AA 5001 complies with IEEE Standard 488.1-1987, and Tektronix Standard Codes and Formats



## SG 5010/SG 505 Low-Distortion Oscillators

- 10 Hz to 100 kHz Sine Wave Output
- Ultra-Low Distortion: 0.0008% THD (Typically 0.0003%)
- Floating or Grounded Output
- 600  $\Omega$  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)

### SG 5010/SG 505

The SG 5010 and SG 505 Oscillators generate an ultra-low distortion sine wave from 10 Hz to 163.8 kHz (SG 505 to 100 kHz) with less than 0.0008% and 0.0032% THD respectively. The THD is typically less than 0.0003% in the 20 Hz to 20 kHz range.

The SG 5010 offers the full benefits of TM 5000 configurability, GPIB compatibility, and compliance with Tektronix Standard Codes and Formats. It generates five waveforms: sine wave, square wave, SMPTE/DIN intermodulation test signal, CCIF intermodulation test signal, and sine wave burst. All of these signals may be swept in frequency or amplitude. The five-digit LED display indicates parameter values and units plus indicators for the remote and addressed states. Three source impedances are selectable and the output signal can be grounded or floating, balanced or unbalanced. Output amplitude is programmable from 0.2 mV to 21.2 V peak equivalent V RMS, supplying up to 28 dBm into a 600 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  $\pm 1\%$ ) 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 505)

#### MAIN OUTPUT

The following characteristics are common to the standard SG 505 and SG 505 with 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  $\pm 1\%$  of frequency setting.

**Calibrated Output** – Selectable from +10 to -60 dBm into 600  $\Omega$  in eight 10 dB steps. Accurate to within 0.2 dB at 0 dBm and 1 kHz. Step accuracy is 0.1 dB/10 dB step. An uncalibrated control provides continuous variation from at least +2.2 dB to <-10 dB from calibrated position.

**Amplitude Response** – Level flatness  $\pm 0.1$  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  $\Omega \pm 2\%$ ; floating or grounded through  $\approx 30 \Omega$ . Output impedance does not change with Output On/Off selection. Maximum floating voltage  $\pm 30$  V peak.

**Maximum Output Voltage** – At least 6 V RMS open circuit; 3.16 V RMS (+10 dBV or +12.2 dBm) into 600  $\Omega$ .

**SYNC OUTPUT Signal** – 200 mV RMS  $\pm 20\%$  sine wave to 20 kHz, at least 120 mV RMS at 100 kHz.

**Frequency** – Same as main output.

**Impedance** – Nominally 1 k $\Omega$ , ground referenced and isolated from main output.

#### REAR INTERFACE SIGNALS

**Buffered Main Output** – Buffered version of actual output signals from front-panel connector.  $\approx 600 \Omega$  output impedance.

**Sync Output** – Same as front-panel Sync Output except output impedance is  $\approx 50 \Omega$ .

#### SG 505 WITH OPTION 01 IM TEST SIGNAL

**LF Frequency** – Internally selectable 60 Hz ( $\pm 1$  Hz) or 250 Hz ( $\pm 3$  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  $\pm 20\%$ .

#### SG 505 WITH OPTION 02 BALANCED OUTPUT PLUS IM

**Calibrated Balanced Output** – Selectable from +22 to -68 dBm into 600  $\Omega$  in ten 10 dB steps. Accurate to within 0.2 dB at +22 dBm and 1 kHz. Step accuracy is  $\pm 0.1$  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  $\Omega \pm 2\%$ , 150  $\Omega \pm 2\%$ , or 50  $\Omega \pm 3\%$  floating or grounded through  $\approx 30 \Omega$ . Output impedance does not change with Output On/Off selection. Impedance to CT is 1/2 the selected impedance. Maximum floating voltage  $\pm 25$  V peak.

**Maximum Output Voltage** – At least 21 V RMS open circuit; 19.45 V RMS (+28 dBm) into 600  $\Omega$  from 50  $\Omega$ .

**Balance** –  $\leq 0.5\%$  mismatch of output open-circuit voltages referenced to CT for  $f \leq 20$  kHz with output grounded.



## CHARACTERISTICS (SG 5010)

### AVAILABLE FUNCTIONS

Sine wave, square wave, SMPTE/DIN 4:1, SMPTE DIN 1:1, CCIF, Sine-Wave Burst, IHF Burst ( $\pm 20$  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  $\pm 0.01\%$ . CCIF Center Frequency: 2.500 to 163.80 kHz  $\pm 0.01\%$ . Square Wave: 10 Hz to 163.80 kHz  $\pm 0.01\%$ .

**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  $\pm 2\%$ .

### Sine Distortion (Load 600 $\Omega$ 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  $\mu\text{s}$   $\pm 10\%$ .

**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  $\mu\text{V}$  to 21.2 V RMS. Into 600  $\Omega$ :  $-72.45$  to  $+28.05$  dBm.<sup>\*1</sup>

**Unbalanced**— Into Open Circuit: 200  $\mu\text{V}$  to 21.2 V RMS. Into 600  $\Omega$ :  $-72.45$  to  $+22.05$  dBm.<sup>\*1</sup>

**Resolution**— 0.05 dB in dBm mode, 0.25% or better in volts mode.

**Level Accuracy (Sine Wave)**— 20 Hz to 20 kHz  $\pm 2\%$  (0.2 dB). 10 Hz to 163.8 kHz  $\pm 3\%$  (0.3 dB).

<sup>\*1</sup>  $R_s = 50 \Omega$ . For  $R_s = 150 \Omega$ , subtract 1.25 dBm; for  $R_s = 600 \Omega$ , subtract 5.35 dBm.

### OUTPUT IMPEDANCE AND CONFIGURATION

50  $\Omega$   $\pm 3\%$ , 150  $\Omega$   $\pm 2\%$ , or 600  $\Omega$   $\pm 1\%$ , 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 k $\Omega$ ; a 2 V RMS input (2.83 V peak maximum) provides a calibrated output.



### SYNC OUTPUT

A ground referenced TTL-compatible signal is provided that allows stable oscilloscope display of all functions. In sine and square wave modes, the output is at the signal frequency. In the IM modes, the sync output is at the lower or offset frequency. In both burst modes, the sync signal follows the burst envelope.

### SWEEP MODE

Linear or logarithmic sweep of amplitude or frequency in any function. Sweep is composed of discrete steps. The following sweep functions are programmable via GPIB or from the front panel: swept parameter (frequency or amplitude), linear or log sweep, number of steps up to 99, time per step from 0.1 to 25 s, start frequency or voltage, and stop frequency or voltage. Start and stop frequencies or voltages can be anywhere within the range of the generator, and sweep direction can be upward or downward. Pen lift and ramp outputs are available for interface to an analog plotter.

### STORED SETUPS

Ten different complete front-panel setups can be stored in the nonvolatile internal memory and recalled from front-panel pushbuttons or via the GPIB. Additionally, the front-panel settings at power down are retained and used at power up.

### PROGRAMMABILITY

All functions, parameters, and modes can be controlled over the GPIB using simple English-like commands. All settings can be interrogated, with the resulting response usable as a command to return the instrument to that setting (Learn mode). The GPIB address can be displayed and changed from the front panel.



## ORDERING INFORMATION

<b>SG 5010</b> Programmable Oscillator.	<b>\$4,795</b>
Includes: Instruction manual (070-4331-00), Instrument Interface Guide (070-4790-00), Reference Guide (070-4330-00).	
<b>SG 505</b> Oscillator	<b>\$1,250</b>
Includes: Instruction manual (070-2823-00).	
<b>SG 505 OPTIONS</b>	
<b>Opt. 01</b> — IM Test Signal	<b>+\$225</b>
<b>Opt. 02</b> — Balanced Output plus IM. Includes: Cable assembly for sync output (175-1178-00).	<b>+\$730</b>

**SOFTWARE RECOMMENDATIONS**  
EZ-TEST PC — Order S45F030 **\$1,995**

IBM BASICA Program  
Available with GURU II  
Package: AUDIODEM BAS.

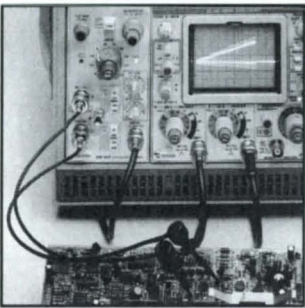
\* The SG 5010 complies with IEEE Standard 488.1-1987, and Tektronix Standard Codes and Formats

# SIGNAL CONDITIONERS



## 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.

### ORDERING INFORMATION

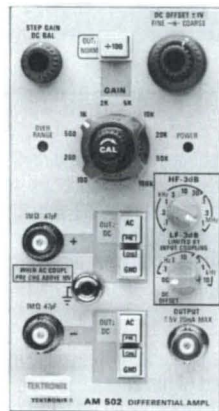
**AM 502 Differential Amplifier** \$1,795  
Includes: Instruction manual (070-1582-01).

## 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, level conversion (to 80 V peak-to-peak), current probe amplification and a unique time-interval to voltage converter.

## 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.

### 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  $\pm 20$  vertical divisions. The AM 502's true dc offset effectively provides thousands of vertical divisions of offset.

## CHARACTERISTICS

**Gain** - 100 to 100,000, 1 to 1000 in +100 Mode; 1-2-5 sequence; accurate within 2%. Continuously variable gain between steps in uncalibrated mode.

**HF -3 dB Point** - Selectable in 9 steps (1-3 sequence) from 100 Hz to 1 MHz; Upper -3 dB point reduces to 500 kHz at 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  $\pm 1V$ . Equivalent to  $\pm 100 V$  in +100 Mode.

**Common-Mode Rejection Ratio** - At least 100 dB, dc to 50 kHz. +100 Mode: At least 50 dB, dc to 50 kHz.

**Maximum Input Bias Current** -  $\pm 100$  pA each input for  $T \leq 30^\circ C$ .

**Maximum Voltage Drift** - 100  $\mu V/^\circ C$  referred to input.

**Maximum Noise** -  $\leq 25 \mu V$  (tangentially measured) referred to input.

**Common Mode Voltage Range** -  $\pm 5V$ , +100 Mode:  $\pm 50V$ .

**Maximum Safe Input Voltage** - dc coupled: 15 V (dc + peak ac). +100 Mode dc coupled: 350 V (dc + peak ac). AC coupled: 350 V (dc + peak ac) with coupling capacitor precharged.

**Input R and C** - 1 M $\Omega$  paralleled by  $\approx 47$  pF. Input impedance can be increased to a FET input via a simple internal jumper change.

**Maximum Output** -  $\pm 5 V$ ,  $\pm 20$  mA, output resistance is 5  $\Omega$  or less.

**Minimum Load Impedance** - 250  $\Omega$ .

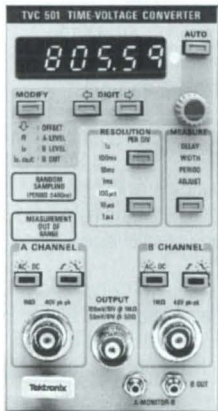
**Over-Range** - Front-panel lamp indicates most over-range conditions.



## TVC 501 TIME-INTERVAL TO VOLTAGE CONVERTER

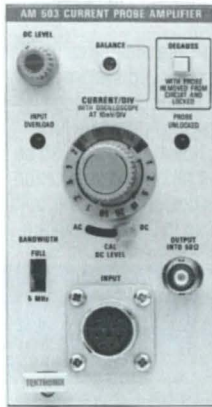
The TVC 501 adds three measurement functions to a scope's voltage vs. time capability: time-delay vs. time, pulse-width vs. time, and period vs. time. The TVC continuously measures the timing parameter and instantaneously generates a voltage proportional to the measurement. Conversions are performed pulse-to-pulse without averaging. The TVC 501 provides seven vertical scales from 1  $\mu$ sec to 1 sec per division. Up to 30,000 divisions of offset permits small timing variations to be viewed on events with large average values.

The continuous TVC output becomes another trace on a scope that can be correlated, measured, and analyzed with waveforms on other channels. Since the TVC generates voltages proportional to time-intervals, a scope can be set to trigger on timing violations such as a time-delay that exceeds a threshold or an incorrectly narrow pulse or glitch. See page 338 for detailed information.



## 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  $\Omega$  or 1 M $\Omega$  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 325 for detailed information. 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



AM503 Amplifier

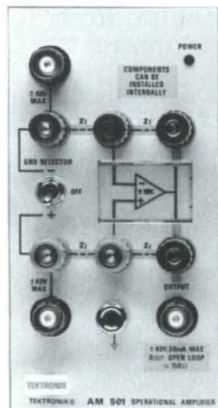
504, with the AM 503/A6303 Current Probe Amplifier in a TM 500/TM 5000 mainframe, you will have a convenient and compact high-current amplification/measurement system.

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.

## 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  $\Omega$  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  $\Omega$  load.

**Unity Gain Bandwidth** - At least 5 MHz into 800  $\Omega$  load.

**Common-Mode Rejection Ratio** - Typically >20,000:1 at 60 Hz for common-mode signals up to  $\pm 40$  V.

**Slew Rate** - At least 50 V/ $\mu$ s into an 800  $\Omega$  load.

**Input Bias Current** - Typically < 500 pA at 25°C, < 2 nA at 50°C.

**Drift** - <100  $\mu$ V/ $^{\circ}$ C.

**Noise** - <10  $\mu$ V rms.

**Maximum Differential Input Voltage** - 80 V.

**Voltage Range** - At least  $\pm 40$  V into 2 k $\Omega$ .

**Current Limit** - At least  $\pm 50$  mA.

**Open Loop Output R** -  $\approx 150 \Omega$ .

## 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.

## NEW TVC 501

### Time-Voltage Converter

- Real-Time Scope Display of Time-Interval Variations vs. Time
- Time Delay, Pulse Width, and Period Measurements
- >2 Million Uninterrupted Event-by-Event Measurements/Second

## AM 503/AM 503S Current Probe Amplifier

- Displays Current Signals on an Oscilloscope
- DC to 50 MHz bandwidth

## ORDERING INFORMATION

<b>TVC 501</b> Time-Voltage Converter. See page 338 for further information	<b>\$2,500</b>
<b>AM 503</b> Current-Probe Amplifier. See page 325 for further information.	<b>\$1,450</b>
<b>AM 503S</b> Current Probe System Includes: AM 503, A6302 (calibrated to AM 503), Tool Box, TM 502A. See page 325 for further information.	<b>\$2,400</b>

## AM 501 Operational Amplifier

- $\pm 40$  V, 50 mA Output
- Open-Loop Gain 10,000
- 50 V/ $\mu$ s Slew Rate
- Symmetrical Differential Design
- Optional Circuit Board to Customize Function

## ORDERING INFORMATION

<b>AM 501</b> Operational Amplifier Includes: Instruction manual (070-1616-01).	<b>\$995</b>
<b>AM 501</b> Auxiliary Circuit Board Kit Order 013-0146-00	<b>\$33</b>

# OSCILLOSCOPE CALIBRATION INSTRUMENTS



## CG 5010 CG 5011 Calibration Generators

- 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 the new SG 5030 Programmable Leveled Sinewave Generator for oscilloscope bandwidth calibration.

In addition to the programmable instruments, 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.

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.

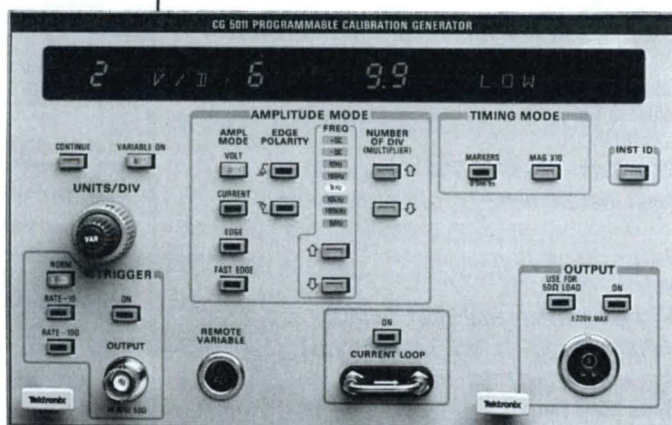
The PG 506A Calibration Generator provides clean, fast-rise square waves and calibrated-amplitude square waves for checking oscilloscope transient response and for setting the vertical-amplifier gain of the oscilloscope respectively. Like the TG 501A, the PG 506A has a variable mode of operation which allows you to read the oscilloscope's calibration error directly in percent from its digital display.

The SG 503 and SG 504 generators provide leveled sine waves for bandwidth checks and triggering performance checks. The range of the SG 503 is 250 kHz to 250 MHz, while the range for the SG 504 is from 245 to 1050 MHz.

The SG 502 Oscillator is perfect for calibration applications where verification of low-frequency rolloff in ac modes and performance measurement of low-frequency-reject triggering modes is required.

### OSCILLOSCOPE CALIBRATION INSTRUMENT SELECTION GUIDE

Instrument	Primary Functions	Secondary Functions	Module Width
CG 5010 / CG 5011 Programmable Calibration Generator	Amplitude Calibration and Time Base Calibration	Testing risetime and transient response, attenuator compensation, oscilloscope non-linearity	3 Wide
SG 5030 Programmable Leveled Sinewave Generator	Bandwidth Calibration	Broadband sinewave generation	3 Wide
PG 506A Calibration Generator	Amplitude Calibration	Testing risetime and transient response, attenuator compensation	1 Wide
TG 501A Time Mark Generator	Time Base Calibration	Testing oscilloscope nonlinearity	1 Wide
SG 502 Oscillator	LF Response & Triggering	Low distortion leveled signal source	1 Wide
SG 503 Leveled Sinewave Generator	Bandwidth Calibration	General leveled RF signal source	1 Wide
SG 504 Leveled Sinewave Generator	Bandwidth Calibration	General leveled RF signal source with frequency modulation capability	1 Wide



### 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.

**GPIB\***  
IEEE-488

\*The CG 5010/5011 Calibration Generators comply with IEEE Standard 488.1-1987 and Tek Standard Codes and Formats.



## CHARACTERISTICS

### VOLTAGE (AMPLITUDE MODE)

The standard voltage is used to calibrate vertical display accuracy.

**Range** – 40  $\mu$ V to 200 V, 1 M $\Omega$  load; 40  $\mu$ V to 5 V, 50  $\Omega$  load (1-2-5 steps with multiplier).

**Multipliers** – 1, 2, 3, 4, 5, 6, 8, or 10.

**Polarity** – Positive from ground.

**Aberrations** – Less than  $\pm 15\%$  of Amplitude ( $\pm 10$  mV).

**Accuracy** –  $\pm (0.25\% + 1 \mu\text{V})$ .

**Frequency** – 40  $\mu$ V 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** –  $\pm 9.9\%$

### 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  $\pm 15\%$  of Amplitude ( $\pm 100 \mu\text{A}$ ).

**Accuracy** –  $\pm (0.25\% + 2 \mu\text{A})$ .

**Frequency** – Dc or 10 Hz to 1 MHz (decade steps).

**Droop** –  $\leq 1\%$  p-p.

**Variable Range** –  $\pm 9.9\%$

### LOW EDGE AND HIGH EDGE (AMPLITUDE MODE)

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  $\Omega$ , Low Edge

1.2 V to 100 V p-p 1 M $\Omega$  load, High Edge (1-2-5 steps with multipliers).

**Multipliers** – 1, 2, 3, 4, 5, 6, 8, or 10.

**Aberrations** –  $\pm 2\%$  of square wave Amplitude

**Accuracy** –  $\pm 3\%$ .

**Polarity** – Positive or negative transitions to ground (Low Edge). Positive transitions only (High Edge).

**Risetime/Falltime** –  $\leq 1.3$  ns (Low Edge).  $\leq 100$  ns (High Edge).

**Long Term Flatness** –  $\pm 0.5\%$  after first 500 ns (Low Edge).  $\pm 0.5\%$  after first 10 ns (High Edge).

**Frequency** – 10 Hz to 1 MHz in decade steps. (Low Edge). 10 Hz to 100 kHz in decade steps. (High Edge).

**Variable Amplitude Range** –  $\geq \pm 9.9\%$  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  $\mu$ s to 5 s range only).

**Accuracy** – 0.01%. With Opt. 01,  $\pm 0.0003\%$  ( $+15^\circ\text{C}$  to  $+50^\circ\text{C}$ ).

**Amplitude (CG 5010)** – 1 V minimum into 50  $\Omega$ .

**(CG 5011)** – 1 V minimum 5 s to 2 ns, 350 mV minimum: 1 ns, 100 mV minimum: 0.5 ns.

**Variable Range** –  $\pm 9.9\%$

### 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** – 0.01%. With Opt. 01  $\pm 0.0003\%$  ( $+15^\circ\text{C}$  to  $+50^\circ\text{C}$ ).

**Edge Position Uncertainty** –  $\pm 40$  ps.

**Amplitude** – 1 V into 50  $\Omega$

**Variable Range** –  $\pm 9.9\%$

### TRIGGER OUTPUT

The oscilloscope under test is normally triggered externally from this source.

**Output Amplitude** – 1 V minimum into 50  $\Omega$ .

**Trigger Rate (Marker Mode)** – Normal: Slaved to marker rate from 100 ns to 5 s; remains at 100 ns for faster markers. Divided by 10: Reduces normal trigger rate by a factor of ten. Divided by 100: Reduces normal trigger rate by a factor of one hundred.

**Slewed Edge Mode** – One trigger per slewed edge.

**All Other Modes** – Normal: Slaved to output frequency. Divided by 10: One-tenth output frequency. Divided by 100: One-hundredth output frequency.

### REFERENCE FREQUENCY

**Output Frequency** – 1 MHz with internal time base accuracy.

**Output Amplitude** – TTL compatible.

**Input Frequency** – 1, 2, 3, 4 or 5 MHz.

**Input Amplitude** – 1 V to 10 V RMS

**Required Accuracy** –  $\pm 0.001\%$ .

### 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** –  $\leq 150$  ps.

**Aberrations** –  $\pm 3\%$  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  $\pm 5\%$  into 50  $\Omega$ .

**Variable Range** –  $\pm 10\%$

### GENERAL

**Environmental** – Operating  $0^\circ\text{C}$  to  $+50^\circ\text{C}$ .

**Non-Operating** –  $-20^\circ\text{C}$  to  $+65^\circ\text{C}$ .

**Power Consumption** – 65 VA.

## ORDERING INFORMATION

<b>CG 5010 Programmable Calibration Generator</b>	<b>\$17,500</b>
Includes: Output cable assembly (012-0884-00); Pulse head (015-0611-00); Instrument interface guide (070-7747-00); Instruction manual (070-7745-00); Programmer's Reference Manual (070-7748-00); Service Manual (070-7746-00).	
<b>CG5011 Programmable Calibration Generator.</b>	<b>\$18,995</b>
Includes: Same as above	
<b>Opt. 01</b> – Adds High Stability Time Base	<b>+\$650</b>
<b>Opt. 02</b> – Deletes Pulse Head	<b>-\$1,100</b>
<b>OPTIONAL ACCESSORIES</b>	
<b>Comparator Head</b> – Order 015-0310-01.	<b>\$885</b>
<b>Remote Variable</b> – Order 015-0309-01.	<b>\$590</b>
<b>Pulse Head</b> – (When purchased separately.) Order 015-0311-01.	<b>\$1,935</b>
<b>Rigid Circuit Board Extender</b> – Order 067-0975-00.	<b>\$170</b>
<b>Flexible Circuit Board Extender – Trouble Shooting Aid</b> – Order 067-0974-00.	<b>\$585</b>



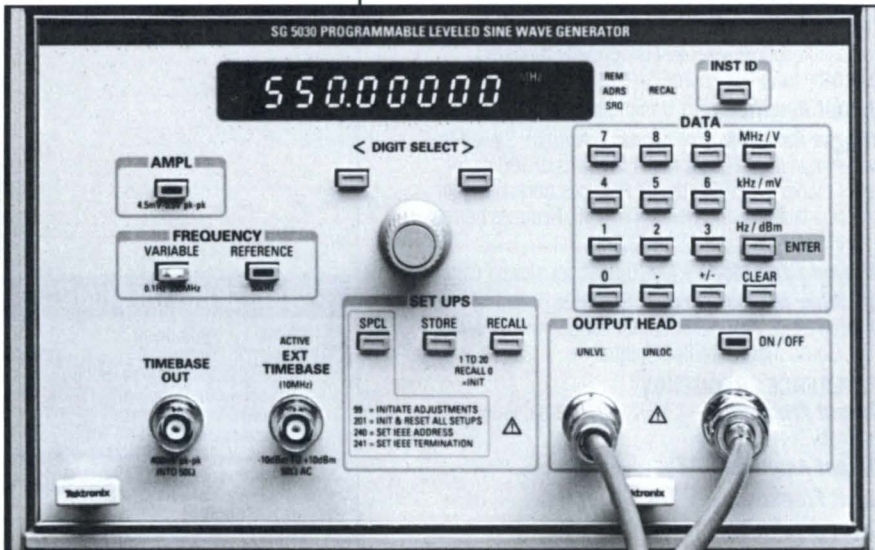
## SG 5030 Leveled Sinewave Generator

- **Oscilloscope Bandwidth Calibration**
- **0.1 Hz to 550 MHz**
- **4.5 mV to 5.5 V Amplitude Range**
- **Amplitude Flatness From  $\pm 1.5\%$  to  $\pm 4\%$  of 50 kHz Reference Frequency**
- **20 Stored Front Panel Settings**

### SG 5030

The SG 5030 is the only choice for anyone who needs leveled output amplitude to calibrate analog or digital scopes with bandwidth to 550 MHz – under either local or programmable control. That's because no other programmable leveled sine wave generator is built specifically to fill scope calibration requirements. The SG 5030's leveled output is variable from 0.1 Hz to 550 MHz with a reference frequency of 50 kHz. Crystal-controlled frequency accuracy eliminates drift so there's no second-guessing results.

Accurately calibrated output voltage is provided from 4.5 mV to 5.5 V peak-to-peak into 50  $\Omega$ . Absolute amplitude accuracy is  $\pm 1.5\%$  from 0.1 Hz to 50 kHz, with flatness from  $\pm 1.5$  to  $\pm 4\%$  over the remainder of the frequency range to 550 MHz.



**GPIB \***  
IEEE-488

### ORDERING INFORMATION

**SG 5030** – Programmable Leveled Sine Wave Generator **\$9,650**  
Includes: Operators Manual (070-7705-00), Instrument Interfacing Guide (070-7704-00), Reference Guide (070-7706-00), Leveling Head (015-2350-00).

#### OPTIONAL ACCESSORIES

Instruction Manual – **\$55**  
Order 070-7703-00.

\*The SG 5030 complies with IEEE Standard 488.1-1987 and with Tektronix Standard Codes and Formats.

### CHARACTERISTICS

#### FREQUENCY

##### Range/Resolution –

0.1 Hz – 4.9999 kHz: 0.1 Hz steps  
5 kHz – 49.999 kHz: 1 Hz steps  
50 kHz – 550 MHz: 10 Hz steps

##### Accuracy With Internal Timebase (within 1 year of adjustment) –

Range ppm of Setting + Hz  
0.1 Hz – 4.9999 kHz:  $\pm(3 + 0.06)$   
5 kHz – 49.999 kHz:  $\pm(3 + 0.3)$   
50 kHz – 550 MHz:  $\pm(3 + 3)$

##### Accuracy With External Timebase (10 MHz) –

0.1 Hz – 4.9999 kHz:  $\pm(\text{ext. t.b. error} + 0.06 \text{ Hz})$   
5 kHz – 49.999 kHz:  $\pm(\text{ext. t.b. error} + 0.3 \text{ Hz})$   
50 kHz – 550 MHz:  $\pm(\text{ext. t.b. error} + 3 \text{ Hz})$

#### AMPLITUDE

##### Range/Resolution –

4.5 mV – 55 mV: 0.02 mV/step  
55.2 mV – 550 mV: 0.2 mV/step  
552 mV – 5.5 V: 2 mV/step  
–42.95 dBm – +18.75 dBm: 0.05 dBm/step

##### Accuracy (within 1 year of adjustment) –

0.1 Hz – 50 kHz:  $\pm 1.5\%$  of setting

##### Flatness (within 1 year of adjustment) –

50 kHz – 100 MHz:  $\pm 1.5\%$  of 50 kHz Ref. Frequency  
100 MHz – 250 MHz:  $\pm 3\%$  of 50 kHz Ref. Frequency  
250 MHz – 550 MHz:  $\pm 4\%$  of 50 kHz Ref. Frequency

#### OUTPUT

**Leveling Settling Time** – Less than 20 ms

**Source Resistance** – 50  $\Omega$ ,  $\pm 1\%$

**DC Offset** –  $\pm 20$  mV

**VSWR** – Less than 1.2:1 up to 550 MHz

#### HARMONIC DISTORTION

**0.1 Hz – 49.999 kHz** – All Harmonics and Spurs  $< -50$  dBc

**50 kHz – 550 MHz** – 2nd Harmonic  $< -30$  dBc. All others  $< -35$  dBc. Nonharmonics  $< -40$  dBc. Phase Noise  $< -85$  dBc/Hz at 10 kHz offset.

#### INTERNAL TIMEBASE OUTPUT

**Frequency** – 10 MHz

**Accuracy** –  $\pm 3$  ppm

**Amplitude** – 400 mV p-p into 50  $\Omega$

**Impedance** – 50  $\Omega$

#### EXTERNAL TIMEBASE INPUT

**Frequency** – 10 MHz,  $\pm 1.5$  ppm

**Amplitude** –  $-10$  dBm to  $+10$  dBm, (70 to 700 mV rms)

**Impedance** – 50  $\Omega$  ac, 500  $\Omega$  dc

#### GENERAL

**Environmental** – Operating 0°C to 40°C

**Non-operating** – 40°C to +71°C

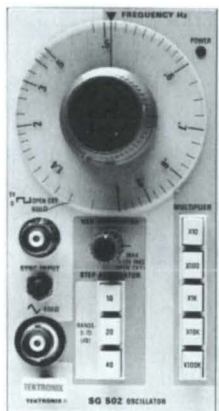
**Power Consumption** – 65 VA

A remote leveling head is standard and plugs directly into the oscilloscope to ensure that the output signal is level at all times. All other signal generators are specified at the front-panel BNC connector, not at the end of the cable going to the instrument under test.

Frequency and amplitude along with 20 front-panel store/recall settings are all fully programmable. Automating test procedures makes scope calibration some four times faster than manual test methods allow – and virtually eliminates the risk of operator error.

Configure the SG 5030 with a CG 5010 or CG 5011 Programmable Calibration Generator. As three-wide TM 5000 Series modules, they conveniently fill a six-slot TM 5006A mainframe to form a complete, cost-effective benchtop or rackmount calibration system.





## SG 502

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. Frequency accuracy within

5% of dial setting from 5 Hz to 50 kHz; within 10% of dial setting from 50 to 500 kHz.

**Amplitude Response (1 kHz Reference)** – Flatness: 0.3 dB over entire range.

**Attenuation** – Selectable from 0 to 70 dB in 10-dB

steps with pushbuttons. Accurate within 0.2 dB for each step selected, additive. An uncalibrated control provides continuous variation from 0 to 40 dB.

**Harmonic Distortion** – < 0.035% (70 dB) from 20 Hz to 50 kHz. < 0.15% from 50 to 500 kHz RL  $\geq$  600  $\Omega$ .

**Maximum Output Voltage** – 5 V RMS open circuit; 2.5 V RMS into 600  $\Omega$ .

**Output Impedance** – 600  $\Omega$ , 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.

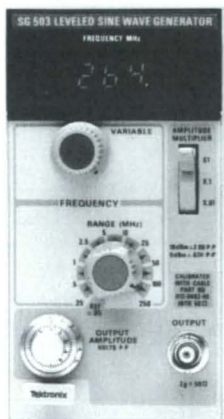
**Amplitude** – + 5 V, fixed, open circuit.

**Output Impedance** – 600  $\Omega$ , 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 k $\Omega$ .



## 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  $\Omega$ .

## CHARACTERISTICS

**Frequency Range** –

250 kHz to 250 MHz, plus 50 kHz reference frequency.

**Frequency Accuracy** – Within  $\pm 0.7$  of one count of the least significant digit of indicated frequency.

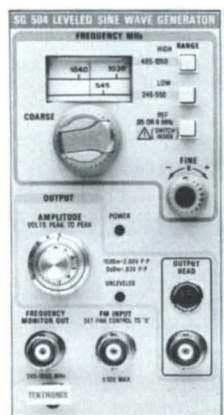
**Amplitude Range** – 5 mV to 5.5 V p-p into 50  $\Omega$  termination in three decade ranges.

**Amplitude Accuracy (50 kHz Reference)** – Within 3% of indicated amplitude on (X1) range, 4% on (X.1) range, and 5% on (X.01) range.

**Flatness (P-P)** – From 250 kHz to 100 MHz, output amplitude will not vary more than 1% of the value at 50 kHz except that up to +1.5%, -1% variation may occur between 50 and 100 MHz on amplitude multiplier X.1 and X.01 ranges only. From 100 to 250 MHz, amplitude variation is within 3% of the value at 50 kHz.

**Harmonic Content** – Second Harmonic: At least 35 dB down. Third Harmonic and All Higher Harmonics: At least 40 dB down.

**Rear Interface** – Addresses the leveling circuit.



## SG 504

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  $\Omega$ .

## 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** –  $\pm 2\%$  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** –  $\pm 4\%$  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:  $\pm 9$  V produces from 0.05% to 0.5% deviation of carrier, depending on output frequency.

**Frequency Monitor Output** –  $\geq 0.3$  V p-p into a 50  $\Omega$  load from 245 to 1050 MHz.

**Rear Interface** – Address FM input, frequency-monitor output, and amplitude control.

## SG 502 Oscillator

- 5 Hz to 500-kHz Sine Waves and Square Waves
- Low-Distortion Sine Wave
- 5 V RMS Open Circuit – 600  $\Omega$  Source
- 0 to 40 dB Output Variable Plus 0 to 70 dB in 10 dB Steps

## ORDERING INFORMATION

SG 502 Oscillator \$1,650  
Includes: Instruction manual (070-1430-01).

## SG 503 Levelled Sinewave Generator

- 250 kHz to 250 MHz
- Leveled, Variable Output
- Digital Readout of Frequency

## ORDERING INFORMATION

SG 503 Signal Generator \$3,595  
Includes: Three-foot precision 50  $\Omega$  cable (012-0482-00); Instruction manual (070-6770-00).

## SG 504 Levelled Sinewave Generator

- 245 to 1050 MHz
- Leveled, Variable Output
- Frequency-Modulation Capability
- Internal Peak Detection

## ORDERING INFORMATION

SG 504 Signal Generator \$4,950  
Includes: Instruction manual (070-1632-01); Leveling head (012-0282-01).

# 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 **\$3,795**  
Includes: Instruction manual (070-6687-00).

#### OPTIONAL ACCESSORIES

**Precision Voltage Divider** – Order 015-0265-00. **\$295**  
**Tunnel-Diode Pulser** – Order 067-0681-01. **\$340**



## 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  $\mu\text{V}/\text{div}$  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  $\approx 1$  ms or dc.

**Amplitude** – From 200  $\mu\text{V}$  p-p to 100 V p-p in 1-2-5 sequence, accurate within 0.25% into 1 M $\Omega$ . 100  $\mu\text{V}$  p-p to 5 V p-p into 50  $\Omega$ .

**Error Readout** – Range:  $\pm 7.5\%$ . Resolution: 0.1%.

### PULSE MODES

**Period** – 1  $\mu\text{s}$  to 10 ms (within 5%) in decade steps with the variable control in Cal position. Variable extends period to at least 100 ms.

**Symmetry** –  $\approx 50\%$  duty cycle.

### HIGH AMPLITUDE OUTPUT

**Rise Time** – Underterminated: 100 ns or less. Terminated into 50  $\Omega$ : 10 ns or less.

**Amplitude Range** – Underterminated: 6 V or less to at least 60 V. Terminated into 50  $\Omega$ : 0.5 V or less to at least 5 V.

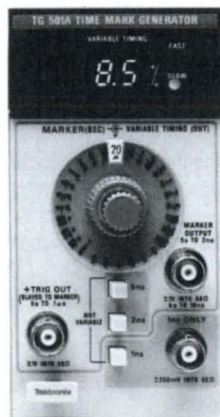
**Leading-Edge Aberrations** – Within 2% or 50 mV p-p, whichever is greater, when terminated into 50  $\Omega$ .

## 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 **\$3,295**  
Includes: Instruction manual (070-1576-02).



## TG 501A

The TG 501A Time Mark Generator provides marker outputs from one nano-second to five seconds. A unique feature of the TG 501A is a variable timing output with a front panel two-digit LED display. The display indicates percentage of timing error between the normal time interval and a variable interval that lines up the marker pulse with graticule or division marks on the display. This feature not only provides direct

readout in terms of percent error, but also helps eliminate errors associated with visually estimating error from a display.

**Markers** – 1 ns through 5 s in a 1-2-5 sequence.

**Marker Amplitude** –  $\geq 1$  V peak into 50  $\Omega$  on 5 s through 10 ns markers.  $\geq 750$  mV p-p into 50  $\Omega$  on 5 ns and 2 ns markers.  $\geq 200$  mV p-p into 50  $\Omega$  on 1 ns markers.

**Trigger Output Signal** – Slaved to marker output from 5 s through 100 ns. Remains at 100 ns for all faster markers.

**Internal Time Base** – Crystal Frequency 5 MHz; Stability (0 to 50°C within 5 parts in 10<sup>7</sup> after 1/2 hour; Long-Term Drift 1 part or less in 10<sup>7</sup> per month; Setability adjustable to within 5 parts in 10<sup>8</sup>).

**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).



## 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.

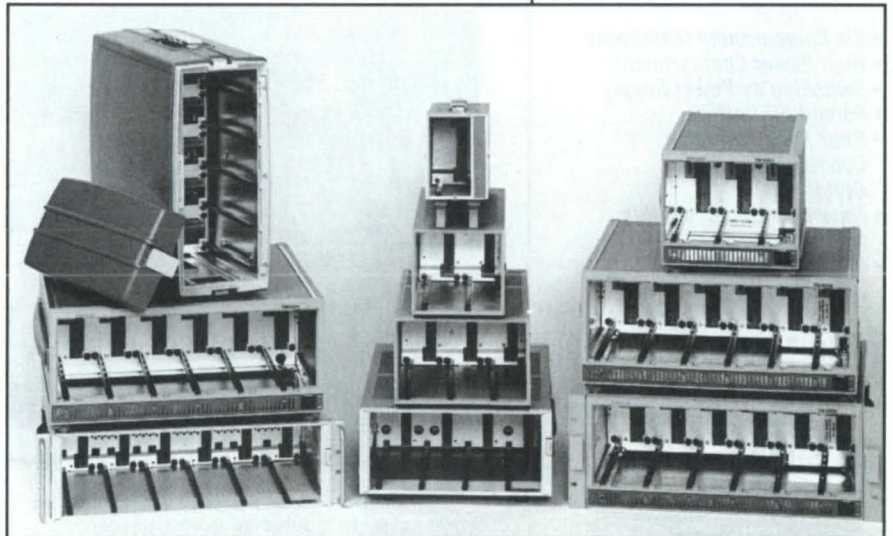
### TM 5000 Power Module Mainframes

The TM 5000 mainframes extend the convenience of the TM 500 concept into the programmable instrument IEEE Standard 488 arena. The TM 5003 accepts up to three instruments at one time; the TM 5006A accepts up to six instruments at one time. These two TM 5000 mainframes were designed 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 503B, TM 504, TM 506A, TM 5003 and TM 5006A. The TM 502A and TM 5003 are the most compact of the multiple instrument units. The TM 504, TM 506A, and TM 5006A each include a high-power compartment at the right-hand side to supply higher current levels to instruments that provide higher performance or higher output levels, such as the PS 503A, and PS 5010 Power Supplies. The TM 506A, TM 5003, and TM 5006A incorporate a quiet fan for optimum cooling. All operate from 110 or 220 V ac.



TM 5000/TM 500 Mainframes

### 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 5006A Option 10 rackmount mainframes each features slide assemblies and handles, plus a higher-power fan to accommodate the higher ambient temperatures often found in enclosed racks and consoles.

### Rear Interface Capability

Most TM 500 plug-in modules contain a duplication of the front-panel input and output connections in the back. These interface lines are built into the rear-edge circuit card connector of each plug-in. Some plug-in modules also have additional signal or control lines that are present only at the back of the instrument. In either case, different modules may be interconnected by the user to reduce front-panel clutter or to perform functions not otherwise available. 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 TM 5003/TM 5006 comply with IEEE Standard 488.1-1987

# MAINFRAMES



## TM 5006A 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

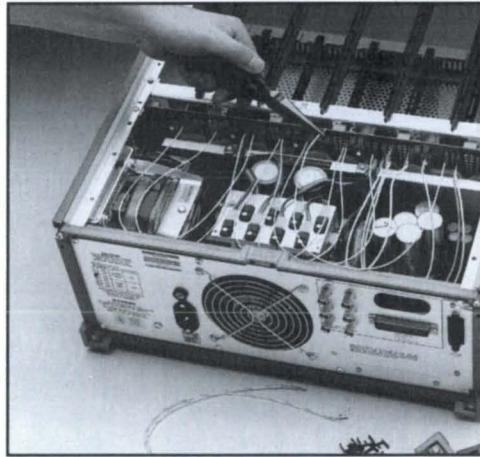


## TM 5003 Power Module

- Three Compartment Mainframe
- Switching dc Power Supply
- Forced-Air Cooling
- Interface Connections on Rear Panel Via Option 02
- IEEE Standard 488 Compatibility



\*The TM 5006A and TM5003 comply with IEEE Standard 488.1-1987



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 monolithic 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 multifunction 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 jumper 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.

### TM 5006A

The TM 5006A mainframe can accept and provide power for up to six single-width TM 500 and/or TM 5000 plug-ins. The right hand compartment is a high-power compartment. The mainframe features a switching dc power supply. All dc voltages are electronically regulated. Forced-air cooling is standard.

**Available options:** Option 02 Rear Interface, Option 10 Rackmount, Option 12 Combination of Options 02 and 10 and Option 15 which improves EMI compatibility.

Cabinet-to-rackmount conversion kit, equipped with slide out assembly, required to convert a TM 5006A to rackmount capability. Order 040-0982-00.

Rackmount-to-cabinet conversion kit, equipped to convert a TM 5006A with rackmount configuration to cabinet style. Order 040-0983-00.

### TM 5003

The TM 5003 can accept and provide power for up to three single-wide TM 500 and/or TM 5000 plug-ins. It features a switching dc power supply. All dc voltages are electronically regulated. Forced-air cooling is standard.

**Available options:** Option 02 Rear Interface.

### CHARACTERISTICS

	TM 5006A		TM 5003		TM 515		TM 506A		RTM 506		TM 504		TM 503B		TM 502A		TM 501A	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
Width	445	17.5	230	9	381	15	445	17.5	483	19	305	12	214	8.4	145	5.7	96.7	3.87
Height	194	7.6	194	7.6	173	6.8	194	7.6	152	6	152	6	140	5.5	140	5.5	156	6.25
Depth	488	19.2	488	19.2	508	20	488	19.2	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	14.5	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	20.9	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 66		48 to 66		48 to 400		48 to 400		48 to 440	
Power Consumption VA maximum	=650VA		=300VA		=500VA		=650VA		=650VA		=460VA		=250VA		=120VA		=120VA	

(Actual power consumption depends on plug-in selection and operating modes)



## TM 506A

The TM 506A mainframe accepts up to six different TM 500 plug-ins, providing a complete test station with one power cord. The right hand compartment is a high-power compartment. Forced air cooling is standard. Like most TM 500 mainframes, the TM 506A is available with the Option 02 which allows rear interfacing of different modules, reducing front panel clutter.

*Available options:* Option 02 Rear Interface.

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 506A with rackmount configuration to cabinet style. Order 040-0983-00.

## 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

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 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. The right hand compartment is a high-power compartment.

*Available options:* Option 02 Rear Interface.

## TM 503B

The TM 503B accepts up to three, single width TM 500 plug-ins. This light weight, portable, benchtop mainframe includes a tilt bail handle and rear panel power entry, switch, and line selector assembly.

*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.

*Available options:* Option 13 Includes Toolbox plug-in (016-0362-02).

## 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.

## ORDERING INFORMATION

<b>TM 5006A</b> Power Module Mainframe Includes: Instruction manual (070-7614-00)	\$1,195	<b>TM 5003</b> Power Module Mainframe Includes: Instruction manual (070-2955-00).	\$995
<b>Opt. 02</b> – Rear Interface.	+\$190	<b>Opt. 02</b> – Rear Interface.	+\$100
<b>Opt. 10</b> – Rackmount.	+\$100	<b>A1-A5</b> Power Cord Options	NC
Includes high-power fan.		<b>TM 503B</b> Power Module Mainframe Includes: Instruction manual (070-7808-00).	\$495
<b>Opt. 12</b> – Combination Opt. 02 and Opt. 10	+\$290	<b>Opt. 02</b> – Rear Interface.	+\$75
<b>Opt. 15</b> – Electro Magnetic Compatibility	+\$300	<b>A1-A5</b> Power Cord Options	NC
<b>A1-A5</b> Power Cord Options	NC	<b>TM 504</b> Power Module Mainframe Includes: Instruction manual (070-1716-01).	\$695
<b>TM 506A</b> Power Module Mainframe Includes: Instruction manual (070-6929-00).	\$795	<b>Opt. 02</b> – Rear Interface.	+\$120
<b>Opt. 02</b> – Rear Interface.	+\$150	<b>TM 502A</b> Power Module Mainframe Includes: Instruction manual (070-6502-00).	\$395
<b>Opt. 10</b> – Rackmount. Includes high-power fan.	+\$100	<b>Opt. 13</b> – Includes Plug-in Toolbox.	+\$75
<b>Opt. 12</b> – Combination Opt. 02 and Opt. 10.	+\$250	<b>A1-A5</b> Power Cord Options	NC
<b>A1-A5</b> Power Cord Options	NC	<b>TM 501A</b> Power Module Mainframe Includes: Instruction manual (070-7613-00).	\$625
<b>RTM 506</b> Rackmount Power Module Mainframe Includes: Instruction manual (070-1786-02).	\$1,495	<b>A1-A5</b> Power Cord Options	NC
<b>Opt. 02</b> – Rear Interface.	+\$180		
<b>TM 515</b> Power Module Mainframe Includes: Instruction manual (070-2020-02).	\$1,295		
<b>Opt. 05</b> – Rear Interface.	+\$90		
<b>Opt. 06</b> – 48 to 440 Hz Fan.	+\$170		

## TM 506A Power Module

- Six Compartments Mainframe
- High Power Compartment
- Forced Air Cooling
- Interface Connection on Rear Panel Via Option 02

## RTM 506 Power Module

- Six Compartment Mainframe
- Standard 19 inch Rackmounting
- High Power Compartment
- Forced Air Cooling
- Interface Connections on Rear Panel Via Option 02

## 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 504 Power Module

- Four Compartment Mainframe
- High Power Compartment
- Interface Connections on Rear Panel with Option 02

## NEW TM 503B Power Module

- Three Compartment Mainframe
- Interface Connections on Rear Panel Via Option 02

## TM 502A Power Module

- Two Compartment Mainframe

## TM 501A Power Module

- Single Compartment Mainframe

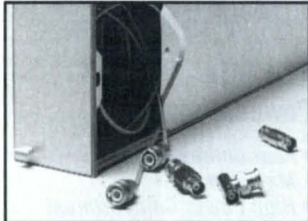
# AUXILIARY INSTRUMENTS



## ORDERING INFORMATION

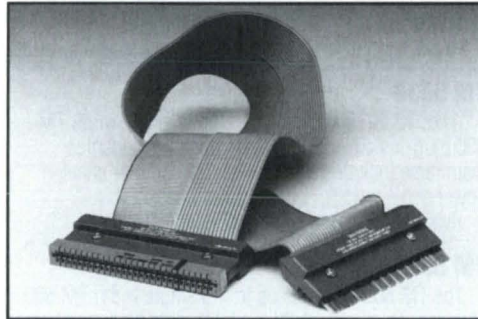
<b>Extender Cable</b> – for TM 500 / TM 5000 mainframes. Order 067-0645-02	<b>\$470</b>
<b> GPIB Extender Cable</b> – Order 067-0996-00	<b>\$235</b>
<b>Front - Panel Cover</b> – (TM 503A) Order 200-3554-00	<b>\$26</b>
(TM 504) Order 200-1727-00	<b>\$20</b>
(TM 506) Order 200-1728-00	<b>\$21</b>
(TM 5003) Order 200-3252-00	<b>\$11.25</b>
<b>Mainframe Retainer Bar Kit</b> – (TM 504) Order 020-0548-00	<b>\$65</b>
(RTM 506) Order 020-0549-00	<b>\$115</b>
(TM 506A/TM 5003/TM 5006A)	<b>*1</b>
<b>Retainer Clips</b> – Order 343-1085-01	<b>\$2.00</b>
<b>Accessory Pouch</b> – Order 016-0351-00	<b>\$33</b>
<b>Blank Plug-in Panel</b> – Order 016-0195-05.	<b>\$42</b>
<b>Plug-in Toolbox</b> – Order 016-0362-02.	<b>\$90</b>
<b>GPIB Interconnecting Cables</b> – (0.5) Order 012-1015-00	<b>\$85</b>
(2m) Order 012-0630-01	<b>\$105</b>
(2m) Double Shielded – Order 012-0630-03	<b>\$110</b>
<b>Rear Interface Data Book</b> – 070-2088-04.	<b>\$27</b>

\*1 Contact your local sales representative.



Plug-In Toolbox

## AUXILIARY INSTRUMENTS ACCESSORIES AND FLEXIBLE PLUG-IN EXTENDER CABLES

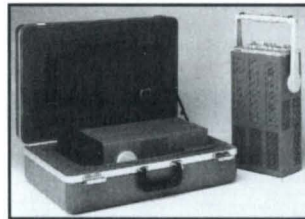


Designed to couple a TM 500 or TM 5000 Plug-in with the mainframe rear interface or GPIB board connections outside the mainframe for calibration and/or Customer Plug-in design.

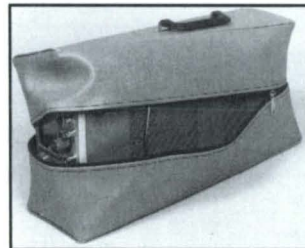
Standard Extender Cable (shown).  
Order 067-0645-02.  
GPIB Extender Cable. Order 067-0996-00.

### TM 500 CARRYING CASE

These luggage-type carrying cases 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 503B and TM 504. Order 016-0565-01  
TM 515. Order 016-0643-00.



### RAIN COVERS 016-0621-00



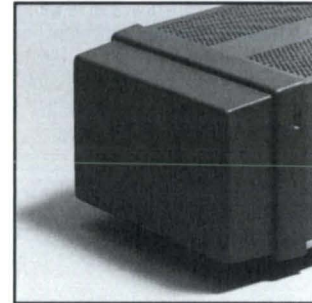
These soft, weather-proof vinyl-coated Rain Covers come in sizes for TM 503B, TM 504, and the TM 5000 monolithic packages.  
Order 016-0621-00

### PLUG-IN TOOLBOX 016-0362-02

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).  
Order 016-0362-02

### PROTECTIVE FRONT COVER

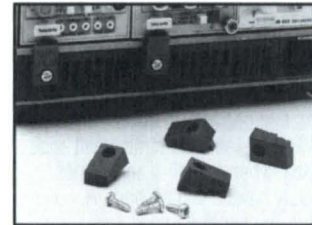
A snap-on front cover, molded of high-impact plastic, is available for the TM 503B and TM 504 mainframes.  
TM503A. Order 200-3554-00  
TM5003. Order 200-3252-00



Protective Front Cover

### 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.

TM 506A/TM 5003, and TM 5006A use Retainer Clips.  
Order (354-1085-00).  
TM502A, TM503B. Order (407-3658-00).

### ACCESSORY POUCH 016-0351-00

Made for carrying probes, cables, or other accessories, this soft vinyl pouch snaps on to the carrying handle of any TM 5000/TM 500 mainframe or HagenTektronix 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.

Order 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 306 for additional information.

### BLANK PLUG-IN PANEL 016-0193-05

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.

Order 016-0193-05

### REAR INTERFACE DATA BOOK 070-2088-04

The Rear Interface Data Book provides diagrams and related interface information for most of the TM 5000/TM 500 plug-ins. Order 070-2088-04.



DM250

The DM250 auto-ranging DMM delivers fast, accurate readings on a 3 1/2 digit LCD and an analog bar graph. The DM250 also offers color-coded input terminals which prevent erroneous settings and terminal selection.

### AC VOLTAGE

AC Voltage Range	Resolution	Accuracy (40 to 500 Hz)
0 to 2 V	1 mV	±1.25%, ±5 counts
0 to 20 V	10 mV	±1.25%, ±5 counts
0 to 200 V	100 mV	±1.25%, ±5 counts
0 to 750 V	1 V	±1.25%, ±5 counts

10 MΩ, paralleled by less than 100 pF of Input Impedance

1100 V DC or 1100 V Peak-To-Peak Overload Protection

### DC VOLTAGE

DC Voltage Range	Resolution	Accuracy (% of reading)
0 to 200 mV	100 μV	±0.5%, ±1 count
0 to 2 V	1 mV	±0.5%, ±1 count
0 to 20 V	10 mV	±0.5%, ±1 count
0 to 200 V	100 mV	±0.5%, ±1 count
0 to 1000 V	1 V	±0.5%, ±1 count

10 MΩ Input Impedance

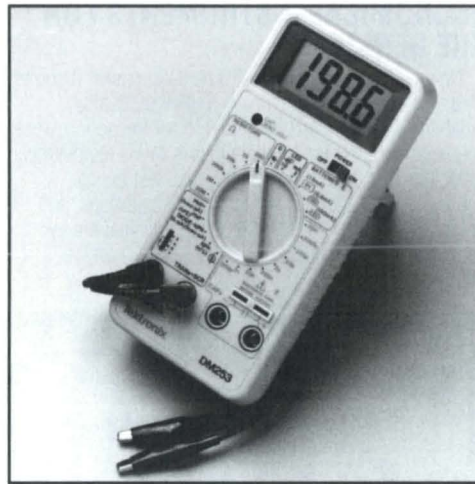
1100 V DC or 1100 V Peak-To-Peak Overload Protection

### AC/DC CURRENT

AC/DC Current Range	Res.	Accuracy (% of reading)	
		AC (40 to 500 Hz)	DC
0 to 200 μA	0.1 μA	±1.5%	±0.75%
0 to 20 mA	10 μA	±3 counts	±1 count
0 to 200 mA	100 μA	Same as above	
0 to 2 A	1 mA	±2.5%	±1.5%
0 to 10 A	10 mA	±5 counts	±3 counts

### RESISTANCE

Resistance Range	Res.	Maximum Test Current	Accuracy (% of reading)
0 to 200 Ω	0.1 Ω	2.5 mA	±0.75%, ±1 count
0 to 2 kΩ	1 Ω	250 μA	±0.75%, ±1 count
0 to 20 kΩ	10 Ω	50 μA	±0.75%, ±1 count
0 to 200 kΩ	100 Ω	5 μA	±0.75%, ±1 count
0 to 2 MΩ	1 kΩ	500 nA	±1.0%, ±3 counts
2 to 20 MΩ	10 kΩ	50 nA	±1.5%, ±5 counts



DM253

The DM253 offers 3 1/2-digit testing of capacitance, resistance, transistors, diodes, LEDs and batteries. Twenty-six user ranges ensure versatility.

### CAPACITANCE

Capacitance Range	Resolution	Accuracy (% of reading)	Test Frequency
0 to 200 pF	0.1 pF	±0.5%, ±5 counts*	820 Hz
0 to 2 nF	1 pF	±0.5%, ±5 counts	820 Hz
0 to 20 nF	10 pF	±0.5%, ±5 counts	820 Hz
0 to 200 nF	100 pF	±0.5%, ±5 counts	820 Hz
0 to 2 μF	1 nF	±0.5%, ±5 counts	820 Hz
0 to 20 μF	10 nF	±0.5%, ±5 counts	82 Hz
0 to 200 μF	100 nF	±0.5%, ±5 counts	8.2 Hz
0 to 2000 μF	1 μF	±1.0%, ±1 count	8.2 Hz
0 to 20 mF	10 μF	±1.5%, ±1 count	8.2 Hz

\*+0.5 pF for this range only.

### RESISTANCE

Resistance Range	Res.	Accuracy (% of reading)	Maximum Open Circuit Voltage
0 to 200 Ω	0.1 Ω	±0.5%, ±4 counts	3.2 V
0 to 2 kΩ	1 Ω	±0.5%, ±1 count	0.5 V
0 to 20 kΩ	10 Ω	±0.5%, ±1 count	0.5 V
0 to 200 kΩ	100 Ω	±0.5%, ±1 count	0.5 V
0 to 2 MΩ	1 kΩ	±0.5%, ±1 count	0.5 V
0 to 20 MΩ	10 kΩ	±2.0%, ±1 count	0.5 V

## Two Rugged Handheld Instruments

### DM250 Digital Multimeter

- FEATURES/BENEFITS
- 3 1/2 Digit LCD with Analog Bar Graph
- Auto Power Off After 30 Minutes from Last Function or Mode Change
- Autoranging, Data Hold, Memory Offset
- Rugged, Water-Resistant, Yellow Case with Built-in Stand and Probe Holders
- Designed to UL 1244 Specifications
- One Year Warranty

### DM253 Component Checker

- FEATURES/BENEFITS
- 3 1/2 Digit LCD
- Over-range Indication
- Low Battery Indication
- Rugged Yellow Case with Built-in Stand
- Designed to UL 1244 Specifications
- One Year Warranty

- APPLICATIONS
- Field Service/Plant Maintenance
- Electronic Troubleshooting
- Classroom Labs/Laboratory Bench
- Component Checking

## ORDERING INFORMATION

### DM250 Digital Multimeter \$135

Includes: Right angle test leads (012-1381-00); spare fuse (159-5001-00); 9 V battery; operator's manual (070-8216-00)

### DM253 Component Checker \$100

Includes: Right angle test leads (012-1382-00); spare fuse (159-0183-00); 9 V battery; operator's manual (070-8217-00)

### OPTIONAL ACCESSORIES

Soft Carrying Case - Order 118-8338-00 \$6.50



**S**ix tough yet affordable test bench instruments 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 (1 Hz Res.)
- 8 Digit Display
- Switchable Input Sensitivity
- Overrange Indicator
- 100 kHz Lowpass Filter
- UL Listed, CSA Certified

The TM250 Series is available directly from your local Tektronix Authorized Stocking Distributor or Education Representative. See page 388 for information.

## ECONOMICAL INSTRUMENTS FOR THE BENCH

Now you can have TEK instrumentation, even if you're on a budget. But you don't have to give up quality, reliability or safety considerations to get the performance you need. The six instruments in this series are designed especially to handle basic to advanced test bench applications for industry, educational institutions, and hobbyists. New to the TM250 Series this year are two counters; see the CMC250 and the CDC250 on the following pages.



## CPS250

The CPS250 Triple Output Power Supply is a versatile instrument with two variable and one fixed output. Its attractive, compact design with tilt-bail handle takes up less bench space than most other power supplies. It's designed to meet most basic test and lab bench requirements. Test leads are included.

## CHARACTERISTICS

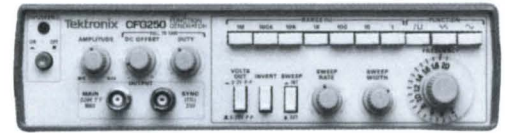
**Outputs** – Two 0 V to 20 V, 0.5 A max; One 5 V fixed, 2.0 A max.

**Load/Line Regulation** – 0 to 20 V: 0.01% + 3 mV; 5 V fixed: 0.1% + 5 mV.

**Ripple/Noise** – 2 mV rms (5 Hz to 1 MHz).

**Tracking Error** –  $\pm 0.2 \pm 20$  mV.

**Indicators** – Analog-type meters  
Voltage Range: 0 – 25 VDC  $\pm 2.5\%$  of full scale.  
Current Range: 0 – 600 mA  $\pm 2.5\%$  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.

**Duty Cycle** – 5 to 1 min. (square and triangle).

**Frequency Range** – 1.0 Hz to 1.0 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  $\Omega$  load: 50 mV p-p to 10 V p-p; 5 mV p-p to 1 V p-p.

**Accuracy** –  $\pm 5\%$  of full scale.

**DC Offset** – + 10 V to -10 VDC continuously variable.

**Output Impedance** – 50  $\Omega \pm 10\%$ .

**Sine Wave Distortion** – 10 Hz to 100 kHz: < 1%.

**Square Wave Response** –  $\leq 100$  ns rise/fall time, with maximum output to 50  $\Omega$ .

**Triangle Linearity** – 20 Hz to 200 kHz:  $\geq 99\%$ , 200 kHz to 2 MHz:  $\geq 97\%$ .

**Pulse Output Amplitude** – 3 V p-p (open); Rise Time: 25 ns.

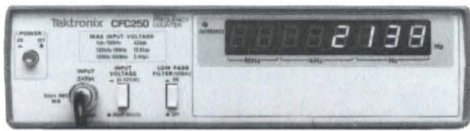
**Sweep Rate** – 0.5 Hz to 50 Hz continuously variable.

**Sweep Width** – Variable from 1:1 to 100:1.

## TM250 CHARACTERISTICS

	CPS250		CFG250		CFC250		CDM250		CMC250		CDC250	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
Dimensions												
Height	100	3.94	64	2.5	64	2.5	64	2.5	64	2.5	64	2.5
Width	240	9.46	240	9.46	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	190	7.49	190	7.49
Weight	kg	lb	kg	lb	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	1.9	4.2	1.8	4.2
<b>Power Requirements</b>												
Max. Power Usage (all units)	165 VA, 131 W; 20 VA, 17 W; 16 VA, 13 W; 8 VA, 7 W; 15 VA, 12 W; 21 VA, 18 W											
Line Volt Ranges (at 50 Hz to 60 Hz)	90 to 110 VAC; 108 to 132 VAC; 180 to 220 VAC; and 216 to 250 VAC											
<b>Environmental</b>												
Operating Temp.	0°C to +50°C at 75% relative humidity.								0° to 40°C at 70% RH		10° to 40°C at 75% RH	
Nonoperating Temp.	-20°C to +60°C at 80% relative humidity.										-10° to 60°C at 80% RH	





### CFC250

The CFC250 Frequency Counter counts the frequency of sine, square and triangle waves from 5 Hz to 100 MHz at input levels from 30 mV to 42 V peak. Applications include the adjustment, testing and repair of items including audio instruments, AM/FM radios, televisions, CB radios, computer clocks, amateur radios and musical instruments.

### CHARACTERISTICS

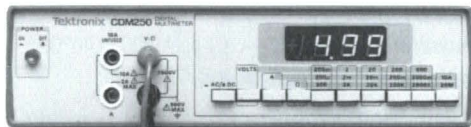
- Frequency Range** – Ac coupled: 5 Hz to 100 MHz.
- Sensitivity** – 5 Hz to 30 MHz: 30 mVrms; 30 MHz to 70 MHz: 50 mV rms; 70 MHz to 100 MHz: 80 mVrms.
- Attenuation** – Selectable Range: 3 V to 42 V range or 80 mV to 5 V range.
- Impedance** – 1.0 MΩ paralleled by 40 pF.
- Maximum Input Voltage** – 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

- 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* <sup>1</sup>
2 V	1 mV	2 mA	1 μA* <sup>1</sup>
20 V	10 mV	20 mA	10 μA* <sup>1</sup>
200 V	100 mV	200 mA	100 μA* <sup>1</sup>
500 V	1 V	2 A	1 mA* <sup>2</sup>
		10 A	10 mA* <sup>1</sup>

\*<sup>1</sup> DC Accuracy: ±1.0% of reading ±1 count (18 to 28°C).

\*<sup>2</sup> DC Accuracy: ±1.0% of reading ±3 counts (18 to 28°C), AC Accuracy: ±1.5% of reading ±4 counts (18 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 VDC or 350 VAC rms
- CMRR** – Dc: >100 dB (50/60 Hz); ac: > 60 dB (50/60 Hz)
- NMRR** – > 50 dB (50/60 Hz).

#### RESISTANCE

Ohm Range	Resolution	Maximum Test Current
200 Ω	0.1 Ω	2.5 mA* <sup>1</sup>
2 kΩ	1 Ω	250 μA* <sup>2</sup>
20 kΩ	10 Ω	50 μA* <sup>2</sup>
200 kΩ	100 Ω	5 μA* <sup>2</sup>
1 MΩ	1 kΩ	500 nA* <sup>2</sup>
20 MΩ	10 kΩ	50 nA* <sup>3</sup>

\*<sup>1</sup> Accuracy: ±0.75% of reading ±4 counts (18 to 28°C).

\*<sup>2</sup> Accuracy: ±0.75% of reading ±1 count (18 to 28°C).

\*<sup>3</sup> Accuracy: ±1.5% of reading ±5 counts (18 to 28°C).

- Response Time** – 5 seconds (200 Ω to 2 MΩ); 15 seconds (20 MΩ).
- 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.

### CDM250

#### Digital Multimeter

- AC/DC Volts (500 V Range)
- Ohms (20 MΩ Range)
- Current (10 A Range)
- Overload Protection
- UL Listed, CSA Certified

### NEW CMC250

#### Multifunction Counter

- 5 Hz to 100 MHz (CH 1)
- 80 MHz to 1.3 GHz (CH 2)
- Measurements: Frequency, Period Avg., Period, Totalize, Self Check
- 8 digit LED display
- Overrange Indication
- Display hold
- Remote start-stop
- UL Listed, CSA Certified

### NEW CDC250

#### Universal Counter

- 5 Hz to 175 MHz
- 8 digit LED display: autodecimal measurement unit
- Frequency Ratio
- Time Interval
- Totalize
- UL Listed, CSA Certified

The TM250 Series is available directly from your local Tektronix Authorized Stocking Distributor or Education Representative. See page 388 for information.



## ORDERING INFORMATION

<b>CPS250</b> Triple Output Power Supply 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.	<b>\$445</b>
<b>CFG250</b> 2 MHz Function Generator Includes: Operator's Manual (070-6738-00), 1 Year Warranty, U.S. Power Cord.	<b>\$365</b>
<b>CFC250</b> 100 MHz Frequency Counter Includes: Operator's Manual (070-6741-00), 1 Year Warranty, U.S. Power Cord.	<b>\$345</b>
<b>CDM250</b> Digital Multimeter Includes: DMM Test Leads (1 pair Black/Red) (196-3200-00), Operator's Manual (070-6736-00), 1 Year Warranty, U.S. Power Cord.	<b>\$345</b>
<b>CMC250</b> 1.3 GHz Frequency Counter Includes: Operator's Manual (070-7942-00), 1 Year Warranty, U.S. Power Cord	<b>\$445</b>
<b>CDC250</b> 175 MHz Universal Counter Includes: Operator's Manual (070-7999-00), 1 Year Warranty, U.S. Power Cord	<b>\$595</b>
<b>WARRANTY-PLUS SERVICE OPTIONS</b>	
<b>Opt. M7</b> - 2 annual calibrations.	
CPS250	+\$43
CFG250	+\$58
CMC250	+\$43
CFC250	+\$43
CDC250	+\$43
CDM250	+\$43
<b>Opt. M9</b> - +2 yrs warranty repair	
CPS250	+\$85
CFG250	+\$116
CMC250	+\$40
CFC250	+\$85
CDC250	+\$85
CDM250	+\$85

## OPTIONAL ACCESSORIES

<b>Service Manuals -</b>	
CPS250 (070-6739-00)	\$40
CFG250 (070-6737-00)	\$40
CMC250 (070-7941-00)	\$35
CFC250 (070-6741-00)	\$40
CDC250 (070-7998-00)	\$40
CDM250 (070-6735-00)	\$40

## INTERNATIONAL POWER PLUG OPTIONS

<b>Standard</b> - U.S. Power Cord	NC
<b>Opt. A1</b> - Universal Euro	NC
220 V, 50 Hz (020-0859-00)	
<b>Opt. A2</b> - United Kingdom	NC
240 V, 50 Hz (020-0861-00)	
<b>Opt. A3</b> - Australian	NC
240 V, 50 Hz (020-0861-00)	
<b>Opt. A4</b> - North American	NC
240 V, 60 Hz (020-0862-00)	
<b>Opt. A5</b> - Switzerland	NC
220 V, 50 Hz (020-0863-00)	

\*1 Contact your local sales office.



## NEW CMC250

The CMC250 1.3 GHz Multifunction Counter measures the frequency of sine, square and triangle waves from 5 Hz to 1.3 GHz. The CMC250 also provides period and totalize measurements. The counter has two input channels: Channel 2 is a special 50  $\Omega$  terminated input for use in high frequency systems, and Channel 1 is a standard 1 M $\Omega$  input for frequency measurements up to 100 MHz. This counter will be of special interest to radio amateurs because of its ability to measure high frequency systems.

## CHARACTERISTICS

**Range** - Frequency, Ac Coupled: CH 1-5 Hz to 100 MHz, CH 2-80 MHz to 1.3 GHz, sine wave; Period, frequency range, 0.4  $\mu$ s to 0.2s. Totalize; 0 to 99,999,999 counts plus overrange; repetition rate, 5 Hz to 10 MHz.

**Sensitivity** - CH 1-5 Hz to 30 MHz: 20 mV rms; 30 MHz to 100 MHz: 50 mV rms. CH 2-80 MHz to 600 MHz: 10 mV rms; 600 MHz to 900 MHz: 25 mV rms; 900 MHz to 1.3 GHz: 50 mV rms.

**Attenuation** - Selectable Range: 3 V to 42 V range (Hi) or 50 mV to 5 V range (Lo).

**Impedance** - CH 1: 1.0 M $\Omega$  paralleled by 40 pF, CH 2: 50  $\Omega$

**Maximum Input Voltage** - CH 1: 42 V peak, CH 2: 1 Vrms.

**Resolution** - Frequency, CH1 (selectable) kHz Mode: 0.1 Hz to 100 kHz, MHz Mode: 1 Hz to 1000 Hz; CH 2: 10 Hz to 10 kHz. Period: 100 ps to 100 ns switchable in 4 decade steps.

**Accuracy** - Frequency, Time base accuracy  $\pm 1$  count; Period, time base accuracy  $\pm 1$  count  $\pm$  trigger instability.

**Gate Time Indicators** - CH 1: 0.01 s, 0.1 s, 1.0 s & 10 s; CH 2: 0.027 s, 0.27 s, 2.7 s, & 27 s. CH 1 Period: 1, 10, 100, or 1000 cycles.

## TIME BASE ACCURACY

**Crystal Frequency** - CH 1: 10 MHz; CH 2: 3.90625 MHz.

**Temperature Stability** -  $\pm 10$  ppm, 0°C to 40°C.

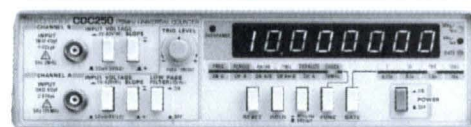
**Aging Rate** -  $\pm 10$  ppm per year.

## OTHER CHARACTERISTICS

**Low Pass Filter** - -3 dB point at 100 kHz.

**Display** - 8 digit LED.

**Overrange Indicator** - Lighted LED.



## NEW CDC250

The CDC250 175 MHz Universal Counter counts frequency of sine, square and triangle waves from 5 Hz to 175 MHz at input levels from 20 mV to 42 V peak. The CDC250 also provides period measurements, frequency ratio, time interval and totalize measurement functions. The CDC250 has a temperature compensated time base to ensure performance in changing ambient temperature. Service technicians will find the CDC250 useful as a standard to calibrate other equipment.

## CHARACTERISTICS

**Range** - Frequency, Ac Coupled: kHz Mode-5 Hz to 10 MHz; MHz Mode-5 MHz to 175 MHz. Period: 0.5  $\mu$ s to 0.2 s; frequency range, 5 Hz to 2 MHz. Ratio, frequency range CH A: 5 Hz to 10 MHz; CH B: 5 Hz to 2 MHz. Time Interval, frequency range: 5 Hz to 2 MHz, square wave. Totalize: 5 Hz to 10 MHz, Count: 0 to 99,999,999 before overrange.

**Sensitivity** - CH A, kHz mode, 5 Hz to 10 MHz: 20 mV rms, MHz mode, 5 MHz to 125 MHz: 50 mV rms, 125 MHz to 150 MHz: 100 mV rms, 150 MHz to 175 MHz: 150 mV rms; CH B, 5 Hz to 2 MHz: 30 mV rms.

**Attenuation** - Selectable Range: Times 1 or Times 10.

**Impedance** - CH A & B, 1.0 M $\Omega$  paralleled by  $\leq 40$  pF.

**Maximum Input Voltage** - 42 V peak.

**Resolution** - Frequency, 0.1 Hz to 1 kHz, in decade steps; Period 100 ps to 100 ns, in decade steps; Ratio, CH B frequency divided by CH A. Time Interval, 100 ps to 100 ns, in decade steps.

**Accuracy** - Frequency, time base accuracy  $\pm 1$  count; Period, time base accuracy  $\pm 1$  count  $\pm$  trigger instability; Ratio, resolution  $\pm$  ratio x trigger instability; Time Interval, time base accuracy  $\pm 1$  count  $\pm$  trigger instability  $\pm$  number of cycles averaged.

## TIME BASE ACCURACY

**Crystal Frequency** - 10 MHz.

**Temperature Stability** -  $< \pm 1$  ppm, 0°C to 40°C.

**Aging Rate** -  $< \pm 1$  ppm per year.

## OTHER CHARACTERISTICS

**Slope** - Selectable, positive, or negative-going.

**Low Pass Filter** - -3 dB at 10 kHz.

**Display** - 8 digit LED.

**Overrange Indicator** - Lighted LED.

## CURVE TRACER SELECTION GUIDE

371A	370A	577	571
High Power	Medium Power	Medium Power	Low Cost
3000 Watts	220 Watts	100 Watts	100 Watts
3000V or 400A	2000V or 10A	1600V or 20A	100V or 2A
GPIB Programmable	GPIB Programmable		
Front Panel Control	Front Panel Control	Front Panel Control	Front Panel Control
Third Bias Supply	Third Bias Supply		
Store 64 Setups & 64 Displays on 3 1/2" Disk		Display Storage	Memory Storage of
Store 16 Setups & 16 Displays in Memory		Option	12 Setups and 1 Display

## THE 370A AND 371A CURVE TRACERS

The new industry standard 370A and 371A Curve Tracers provide dc parameter characterization of transistors, thyristors, diodes, SCRs, MOSFETs, optoelectronic components, solar cells, solid state displays and other semiconductor devices. With the 370A and 371A you can perform measurements to compare a device to the manufacturer's specifications, identify components with the same characteristics, and analyze component failures.

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

The 370A/371A's non-volatile memory provides automatic test sequencing. In addition, the GPIB interface and an IBM compatible PC allow external controller test sequencing. With either method, the 370A or 371A front panel settings can be recalled and measurements made, storing the results for later review or comparison.

## INTERACTIVE CONTROL

The 370A and 371A use the same familiar interactive manual controls that are available on Tektronix 576, 577D1 and 577D2 Curve Tracers. With interactive control, you can refine characterizations for unique devices during research or design. After completing the characterization definition, the interactive setting can be automated by storing the settings in the curve tracer's memory, disk or an external controller.

## DIGITAL STORAGE DISPLAY

The digital storage display, which has a bright, flicker-free trace, 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.

24 characters of displayed information can be annotated on-screen from either the front panel of 370A and 371A or remotely from an IBM PC compatible controller.

## HARDCOPY

Plotter output data is sent directly from the 370A and 371A without the need for a controller. While plotting, the 370A and 371A can continue performing the next tasks.

## INTERFACE

The 370A and 371A have a GPIB interface conforming to IEEE Standard 488.1-1987 with Tektronix codes and formats.

## TEST FIXTURING

The test fixture is a standard accessory that provides a safety enclosure to assure operator protection when device measurements are performed. The test fixture accommodates standard A1001 through A1005 adapters with Kelvin sensing, 3-pin adapters without Kelvin sensing (013-0128-00, 013-0073-00, 013-0070-01, 013-0072-00) and the A1023 surface mount adapter. Also, the 371A test fixture accommodates devices as large as 8" x 5" x 4.75" with special attachment leads.

If you wish to construct a unique test fixture unit, order the optional 371A Field Wiring Cable (cable/plug assembly without test fixture enclosure).

## SOFTWARE

For automated custom device characterization, the 370A Utility Software or 371A Utility Software with an IBM PC provide customized tests, consistent measurements and logging of results. With the 370A Device Test Software, you can automatically characterize most semiconductor components.

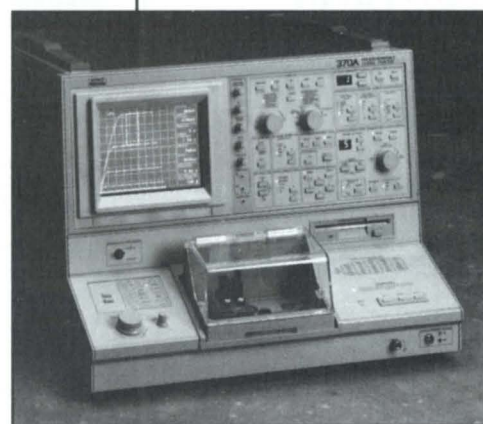
## ACQUISITION

In storage mode, information is displayed in one of three ways: normal, envelope or average.

## AUXILIARY SUPPLY

The auxiliary supply is a third voltage source for biasing devices from -40 V to +40 V with 20 mV resolution.

See next page for characteristics and ordering information.



370A Curve Tracer

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## 370A/371A Programmable Curve Tracers

## AUTOMATED DEVICE CHARACTERIZATION FOR:

- Manufacturing Processes
- Incoming Inspection
- Semiconductor R & D
- Quality Control
- Component Engineering
- Component Matching
- Failure Analysis

## FEATURES

- Automatic Test Sequences
- GPIB Programmable Storage
- 3 1/2" MS-DOS Compatible Disk Storage
- 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

**370A****Device Test Software**

- Automatic Measurements from IBM Compatible PC with GPIB
- Select from Common Device Types
- Select Common DC Measurements
- Software Automatically Handles GPIB and 370A Controls
- Pass/Fail Result Comparison
- Log Files for Storing Results

**370A or 371A Utility Software**

- Automatic Measurements from IBM Compatible PC
- Develop Custom Device Tests
- Archive Curves and Front Panel Settings
- Example Test Programs
- Source Code Included
- Log Files for Storing Results

**370A CHARACTERISTICS**

Range	16 V	80 V	400 V	2000 V
Max Peak Current	10A	2A	.4A	.05A
Peak Current Pulsed	20A	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

**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  $\mu$ V resolution) to 500 V/div for the collector and 5 mV/div (50  $\mu$ V 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  $\mu$ s or 300  $\mu$ s wide pulses.

**370A 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

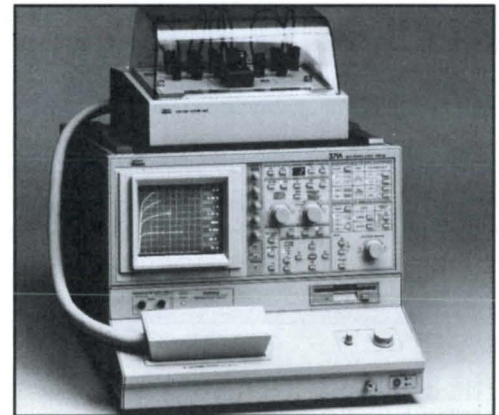
These common dc measurements are typically performed at least four times faster than manual methods.

**370A OR 371A 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 370A and 371A 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.



371A Curve Tracer

**371A CHARACTERISTICS****Peak Power**

3 kW\*<sup>1</sup> 300 W\*<sup>1</sup> 30 W\*<sup>2</sup> 3 W\*<sup>2</sup> 300 mW\*<sup>2</sup> 30 mW\*<sup>2</sup>

**Collector Current Available**

400 A 40 A 40 mA 4 mA 4 mA 0.4 mA

**Maximum Peak Collector Voltage**

30 V 30 V 3 kV 3 kV 300 V 300 V

\*<sup>1</sup> 250  $\mu$ sec pulsed collector supply

\*<sup>2</sup> Sinewave collector supply

**COLLECTOR CURRENT**

Maximum Power	Current/Division (in 1-2-5 increments)
3 kW	1 A/div to 50 A/div
300 W	500 mA/div to 5 A/div
30 W	100 $\mu$ A/div to 5 mA/div
3 W, 300 mW	10 $\mu$ A/div to 500 $\mu$ A/div
30 mW	1 $\mu$ A/div to 50 $\mu$ A/div

**STEP GENERATOR**

The step generator provides 0 to 10 normal steps for 30 W and below or pulse mode steps for 3 kW and 300 W. The pulsed current steps are 500, 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  $\mu$ s or 300  $\mu$ s wide pulses.

**ORDERING INFORMATION****370A Curve Tracer**

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 fuse (159-0160-00); power cord (161-0066-00); operator's manual (070-6064-00);

Opt. 1P - HC100 Plotter  
 Opt. 1R - Rack Mounting  
 Opt. 26 - 370A Utility SW  
 Opt. 27 - 370A Device Test SW

**\$20,900**

+\$895  
 +\$450  
 +\$495  
 +\$1,960

**370A OPTIONAL ACCESSORIES**

Service Manual - (070-7780-00) **\$120**  
 Calibration Fixture - (067-1286-00) **\$440**  
 Rackmount Kit - Order 016-0930-00 **\$950**  
 Socket Adapters - See adapters section  
 Cart - K217 Rack Instrument Cart **\$625**  
 Cameras - See Test & Measurement accessories

**371A High Power Curve Tracer** **\$24,900**

Includes: In-line transistor adapter A1002; TO3/T066 adapter A1003; non-volatile memory (020-1310-00); power cord (161-0066-00); operator's manual (070-6839-00); and pocket reference guide (070-6841-00).

Opt. 1P - HC100 Plotter **+\$895**  
 Opt. 1R - Rack Mounting **\*1**  
 Opt. 26 - 371A Utility SW **+\$495**

**371A OPTIONAL ACCESSORIES**

Field Wiring Cable - (198-5628-00) **\$295**  
 Service Manual - (070-6840-00) **\$85**  
 Calibration Fixture - (067-1345-00) **\$3,200**  
 Rackmount Kit - (016-0930-00) **\$950**  
 Socket Adapters - See adapters section  
 Cart - K217 Rack Instrument Cart **\$625**  
 Cameras - See Test & Measurement accessories

**370A/371A SOFTWARE**

S48P104 370A Utility Software **\$495**  
 S48P105 371A Utility Software **\$495**  
 S48P401 370A Device Test Software **\$1,960**

3 1/2" disks, order Opt. 01 with all software products to specify 5 1/4" disks

\*<sup>1</sup> Contact your local sales office.

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.

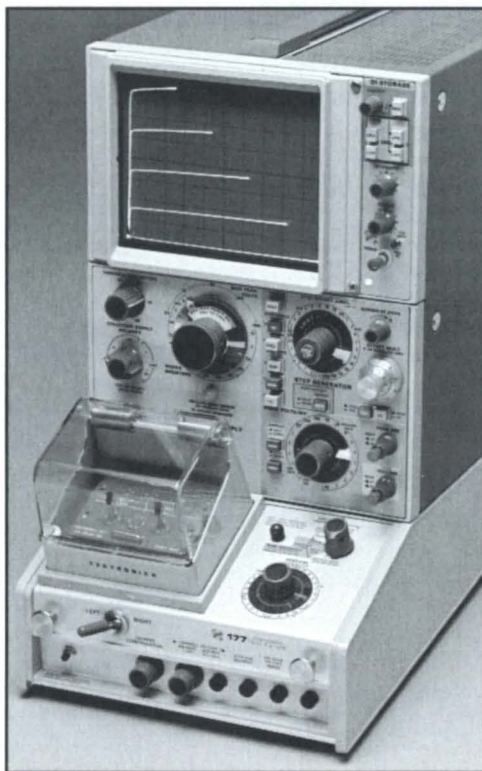
Typical measurements include leakage, breakdown voltages up to 1600 volts, MOSFET  $V_{gs(th)}$ , SCR  $V_{gt/igt}$ , Diode  $V_f$ , ZENER  $V_z/V_f$ , resistance as well as other dc parameters.

### INTERACTIVE CONTROL

The 577D1 and 577D2 provide the same industry standard and familiar interactive manual controls available on Tektronix 370A, 371A and 576 Curve Tracers. 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 8 x 10-cm display with parallax-free, internal graticule. The 577D1 has a split screen storage display useful for comparing two devices. The 577D2 has a non-storage display.



577D1 with 177 plug-in adapter

### 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  $\mu$ s 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.

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 complete the system.

Either standard, hardwire, or multiple op-amp test cards with a 178 and a 577D1/D2 provides common op-amp measurements:  $\pm$  input current, offset voltage, CMRR, gain,  $\pm$  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.

## 577D1/577D2 Curve Tracer System

### FEATURES

- Measures DC Parameters of 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	<b>\$9,125</b>
577D2 Nonstorage Curve Tracer Requires 177 or 178	<b>\$8,000</b>
<b>TEST FIXTURES</b>	
177 Standard Test Fixture Includes: A1005 Axial diode lead adapter; A1007 transistor adapter; safety cover (337-1194-02); instruction manual (070-1436-00).	<b>\$1,885</b>
178 Linear-IC Test Fixture 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).	<b>\$4,775</b>
<b>577D1/D2 OPTIONAL ACCESSORIES</b>	
Test Set Up Cards - Package of 250 (070-1639-01)	<b>**1</b>
CRT Implosion Shield - Clear For 577D1 Order 337-1440-00	<b>\$4.25</b>
Camera - See Camera section.	
Cart - K213	<b>\$700</b>
Socket Adapters - See Adapters section	
<b>178 OPTIONAL ACCESSORIES</b>	
2 Inch Patch Cord - Package of 1 Order 012-0200-00	<b>\$8.50</b>
<b>TEST CARDS</b>	
Standard Op Amp - (included with 178) Order 013-0149-02	<b>\$320</b>
Hardwire Op Amp - Order 013-0150-02	<b>\$160</b>
Multiple Op Amp - Order 013-0155-01	<b>\$935</b>
Positive Regulator - Order 013-0147-00	<b>\$2,165</b>
Negative Regulator - Order 013-0148-00	<b>\$1,925</b>
576/577 Data Sheet - 48W-3346-3	<b>NC</b>
<b>APPLICATION NOTES</b>	
Testing 2N3904 - 48W-4021-1	<b>NC</b>
Testing 2N4441 - 48W-4020-1	<b>NC</b>

<sup>\*\*1</sup> Contact your local sales office.

## 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
- Built-in Test Sockets

### ORDERING INFORMATION

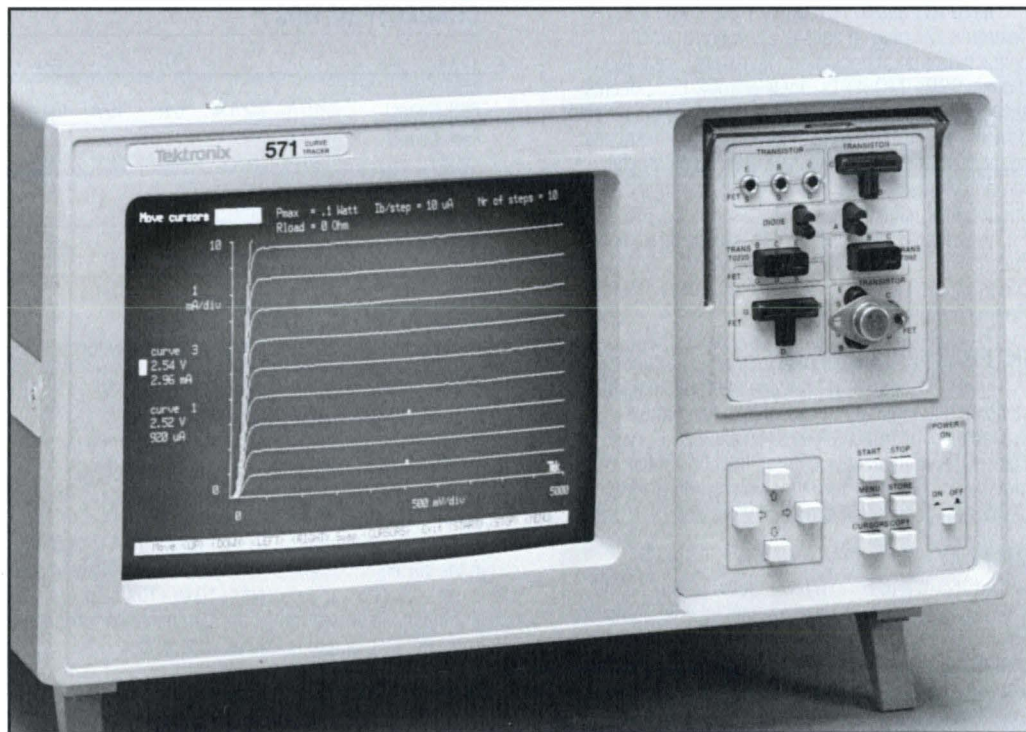
**571 Curve Tracer** **\$2,950**  
Includes: Operators Manual, Power Cord

#### 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) **\$33**  
**Printer Cable** – Shielded (012-0555-00) **\$125**



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 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 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  $\Omega$  and 1, 10 k $\Omega$ .

**Base Drive** – max 10 steps, 0.5  $\mu$ A/step to 20 mA/step both source and sink in 15 ranges.

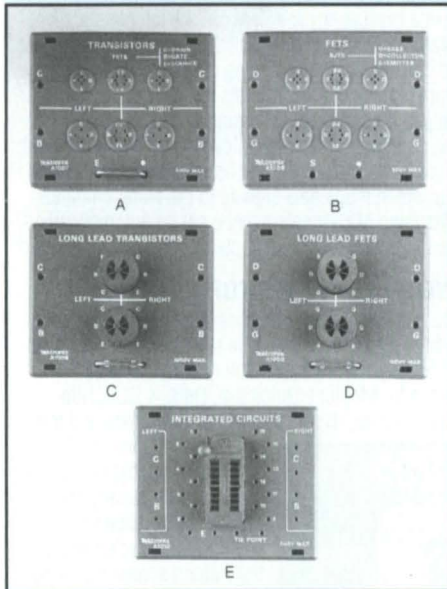
**Gate Drive** – 0.1 V/step to 1 V/step positive and negative in 4 ranges.

**$I_c$  Measurement** – 5  $\mu$ A to 200 mA/div. in 15 ranges.

**Cursors** – Two cursors can be moved along the displayed curves. The X and Y position of the cursor will be displayed on the screen. Basic accuracy is 2% of full scale, all mentioned ranges are in 1-2-5 sequence.

**Printer Out** – Centronics® parallel interface. Output format for Epson® or IBM® compatible.

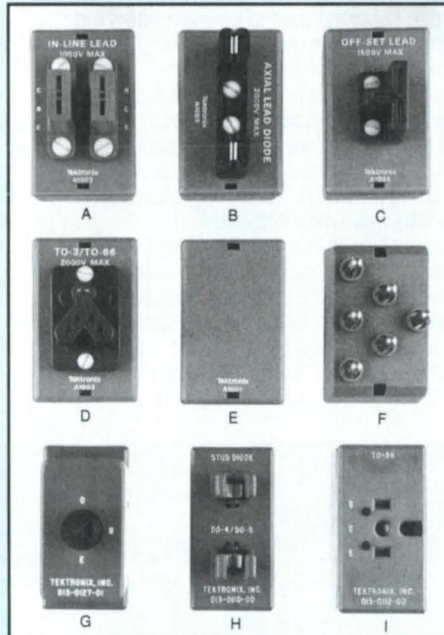
## DEVICE ADAPTERS



### 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 **\$305**
- B. FET Adapter for most FETs** - Order A1009 **\$305**
- C. Long Lead Transistor Adapter For Transistors with Untrimmed Leads** - Order A1006 **\$285**
- D. Long Lead FET Adapter for FETs with Untrimmed Leads** - Order A1008 **\$285**
- 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 **\$420**



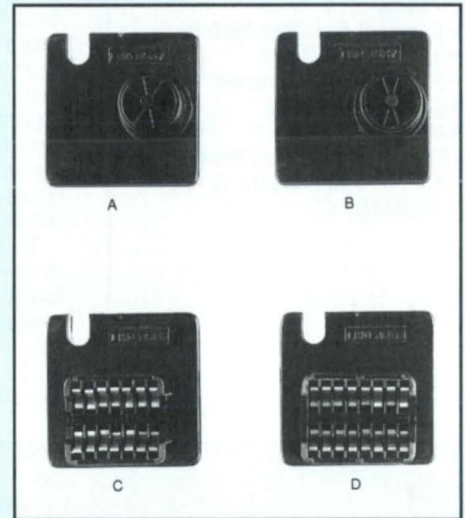
### KELVIN SENSING ADAPTERS

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 **\$150**
- B. Axial Lead Diode Adapter** - Order A1005 **\$150**
- C. Offset Lead Adapter for Power Transistor** - Order A1004 **\$150**
- D. TO-3/TO-66 Adapter for Power Transistors** - Order A1003 **\$150**
- E. Blank Adapter for Mounting Custom Sockets** - Order A1001 **\$90**
- F. Example showing 6th pin for Base/Gate Kelvin Sensing.**
- G. Transistor Adapter Accepts Long or Short Lead Transistors** - Can be rewired to fit non-standard configurations. Order 013-0127-01 **\$110**
- H. Stud Diode Adapter** - Order 013-0110-00 **\$130**
- I. TO-36 Adapter** - Order 013-0112-00 **\$130**

NOTE: The three adapters below should only be used with 576, 177 and 178 curve tracers.

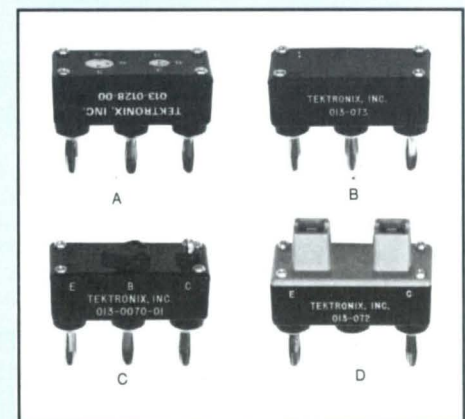


### MULTILEAD SOCKETS

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 **\$85**
- C. 14 lead dual-in-line package** - Order 136-0443-00 **\$85**
- D. 16 lead dual-in-line package** - Order 136-0442-00 **\$70**

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 **\$55**
- B. Blank adapter for mounting special sockets** - Order 013-0073-00 **\$32**
- C. TO-3 and TO-66 transistor adapter** - Order 013-0070-01 **\$120**
- D. Axial lead diode adapter** - Order 013-0072-00 **\$120**

## 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)
- 1, 2, or 3 year Warranty Available

### 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.

### 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 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

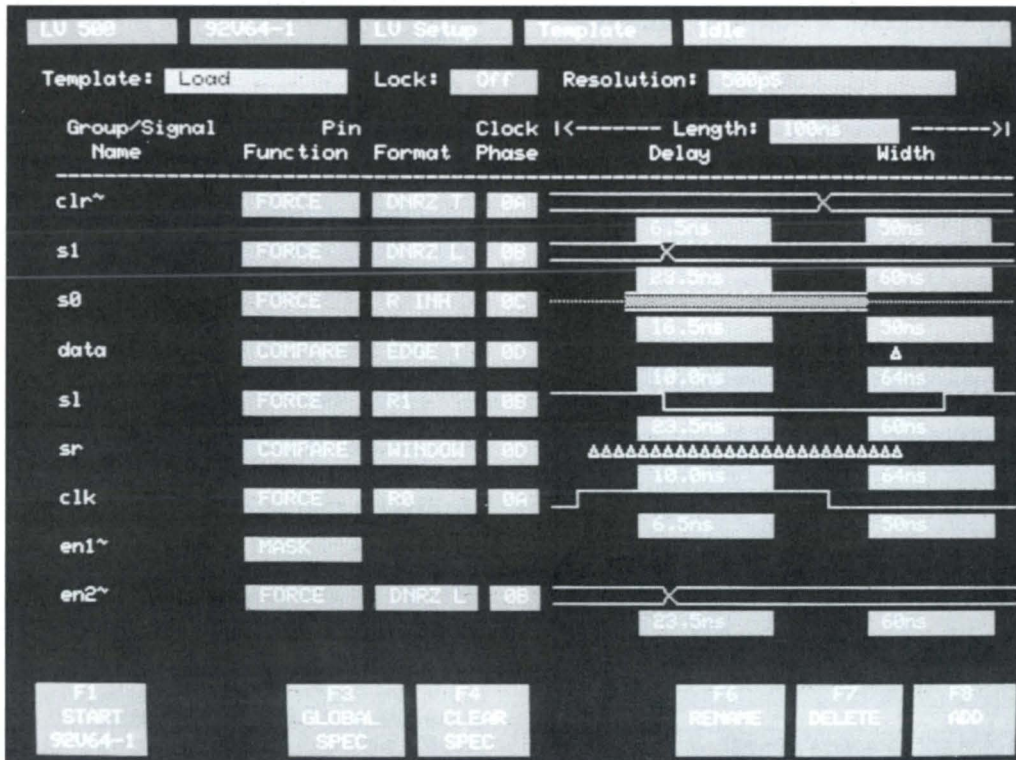
The LV500 system tests digital devices with up to 256 bi-directional channels at data rates up to 50 MHz. With a deep (64K) pattern memory, tests are performed realistically and efficiently.

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. Each LV 500 system is configured with the following standard equipment: Mainframe, color display, expansion mainframe (LV 514 only), testhead (with specified number of channels), continuity test, PGA, and DIP DUT cards, two programmable power supplies, Schmo Plot software, User's Manual, backup software, and Tutorial Package.

### THE TekWAVES CONNECTION

A companion product to the LV500 is the TekWAVES ASIC Verification 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 256.





LV500 template setup screen for timing definition.

## ORDERING INFORMATION

**LV511 64 Channel ASIC Verification System** **\$55,000**  
 Opt. Q0 - On-site Installation **+\$600**  
 Opt. W2 - +1 Yr. Warranty **+\$4,433**  
 Opt. W3 - +2 Yrs. Warranty **+\$8,867**

**LV512 128 Channel ASIC Verification System** **\$94,000**  
 Opt. Q0 - On-site Installation **+\$700**  
 Opt. W2 - +1 Yr. Warranty **+\$6,340**  
 Opt. W3 - +2 Yrs. Warranty **+\$12,680**

**LV513 192 Channel ASIC Verification System** **\$133,000**  
 Opt. Q0 - On-site Installation **+\$800**  
 Opt. W2 - +1 Yr. Warranty **+\$8,680**  
 Opt. W3 - +2 Yrs. Warranty **+\$17,360**

**LV514 256 Channel ASIC Verification System** **\$172,000**  
 Opt. Q0 - On-site Installation **+\$900**  
 Opt. W2 - +1 Yr. Warranty **+\$11,020**  
 Opt. W3 - +2 Yrs. Warranty **+\$22,040**

The following options are available for all LV500 systems:  
 Opt. 2C - GPIB/Expansion Intf. **+\$1,950**  
 (standard on the LV 514)  
 Opt. 4C - EtherNet LAN Interface **+\$3,600**  
 Opt. 3M - Simulator Translator S/W **+\$1,000**  
 Opt. 14 - 20 MB Removable Hard Disk **+\$1,200**

### INTERNATIONAL POWER PLUG OPTIONS

Options A1 - A5 - Available **NC**  
 See page 374 for description.

## LV500 DUT CARDS

**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.  
 Pkg of five. Order 020-1740-00  
 Pkg of ten. Order 020-1741-00

**\$1,060**  
**\$1,895**

**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.

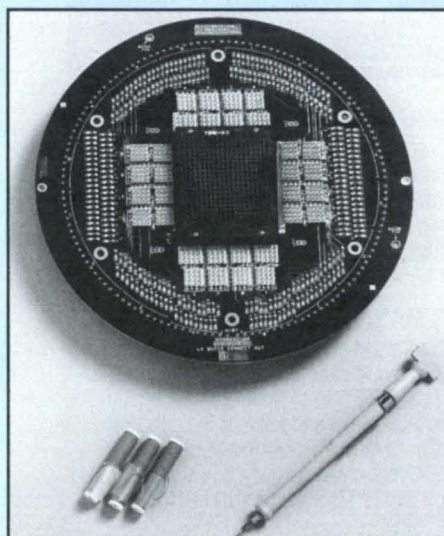
Pkg of five. Order 020-1738-00  
 Pkg of ten. Order 020-1739-00

**\$1,015**  
**\$1,895**

**Scratch Pad DUT Card** - 0.1 grid (center-to-center) for developments of custom device interfaces. Grid area is 5.5 inches in diameter.

Pkg of five. Order 020-1809-00  
 Pkg of ten. Order 020-1810-00

**\$1,060**  
**\$1,895**



The LV500 Quick Connect DUT Card Kit.

**Quick Connect PGA DUT Card Kit** - 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

**\$1,025**

**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

**\$2,900**

**DUT card and 128 coax cables.**

Order 020-1802-00

**\$4,025**

**DUT card and 192 coax cables.**

Order 020-1898-00

**\$4,900**

**DUT Card and 256 coax cables.**

Order 020-1803-00

**\$6,490**

**DUT Card only.** Order 020-1804-00

**\$1,900**

**Static Grounding Wrist Strap** -

Order 006-7248-00

**\$19.25**

- 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

**THE INTELLIGENT LINK OF DESIGN AND TEST**

The Waveform Analysis and Verification Environment (WAVES) provides a software environment that links hardware design with hardware testing. TekWAVES consists of a core Test and Measurement framework, along with an ASIC Verification module that provides tools for the ASIC design engineer. It runs on either Apollo or SUN workstations and allows you to easily create and edit stimulus data, TekWAVES can automatically generate a test program for the LV500 ASIC Verification System.

algorithmically generate clock patterns. Changes made with the State Editor are immediately reflected in the Timing Editor, and vice-versa.

The TIMING EDITOR lets you edit waveforms graphically. Using the mouse, you can drag 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 sub-routines 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 timing to control the frequency of a transition.

**AUTOMATIC TEST PROGRAM GENERATION**

TekWAVES eliminates the need for you to learn a specialized programming language specific to your 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 graphically wiring between icons that represent individual tasks, then running all the tasks with a click of the mouse.

**LV500 COMMUNICATIONS**

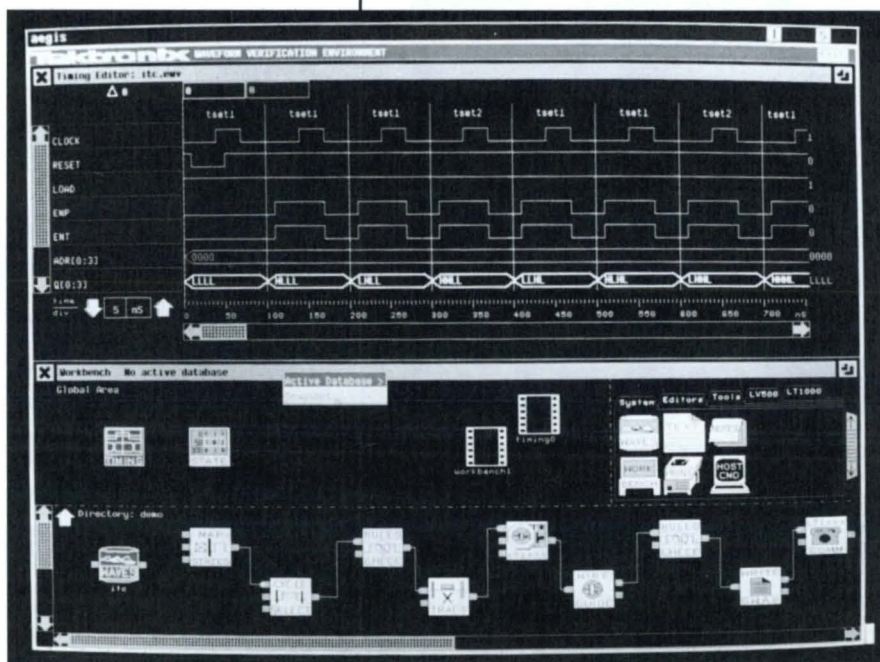
TekWAVES can generate a test program that uses all the advanced features of the LV500, and it provides easy transfer of files back and forth to the tester via RS-232, GPIB, or Ethernet LAN communications.

**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**

<b>WAV20V</b> TekWAVES/LV for Apollo Computers	<b>\$5,000</b>
<b>WAV30V</b> TekWAVES/LV for SUN Computers	<b>\$5,000</b>
<b>OPTIONS COMMON TO WAV20V and WAV30V</b>	
<b>Opt. W9</b> - 12 months Software Subscription Service (US)	<b>+\$900</b>
<b>Opt. 1S</b> - 12 months Software Subscription Service (Int.) (WAV20V) (WAV30V)	<b>+\$900</b>
<b>WAV20V</b> Update kit WAV20V, Inc. SW and documentation	<b>\$1,800</b>
<b>WAV2RV</b> 12 months Software Subscription Service (excludes media and documentation)	<b>\$750</b>

\*1 Contact your local sales office.

**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 a tool from a Card File using the mouse, 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

## TEKWARE PROGRAMS COMPLEMENT TEKTRONIX INSTRUMENTS

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.

### 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 260.

## SOFTWARE SELECTION GUIDE

The software product chart on the following pages provides an easy way to match software 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.

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# TEST AND MEASUREMENT SOFTWARE

			INSTRUMENTS SUPPORTED																										
PRODUCT NAME	PRODUCT NUMBER	Page Reference	DSA 601A/602A	11801A/CSA 803	11402A/11403A/CSA 404	7104 1 GHz, Analog Scope	7D20 Programmable Digitizer	2467B/65A/B/45A/B Scope	2430A/31L/32A/39/40 DSO	2402A TekMate Controller	2221A/24/30/32 DSO-GPIB	2221A/24/30A/32 DSO-RS-232	222 Handheld DSO	RTD 710/A Digitizer	RTD 720 Digitizer	DCS01/MUX16 Digital Camera	1230 Logic Analyzer	2782 Program, Spectrum Analyzer	490P-2750P-Series Pgm. Spectrum	TM 5000 Mod. Inst.	AFG5101 (Arb. Wfm. Gen.)	VXI Instruments	TSI 8150 Test System Interface	370A Pgm. Curve Tracer	371A Hi-Power Pgm. Curve Tracer	Instruments from other vendor	2510 TestLab Waveform Analyzer	2710/2712 Spectrum Analyzer	3052 Digital Sig. Proc. System
Test Management System (TekTMS)	S3FT100/200/300	261	●	●	●				●	●										●	●	●				●			
EZ-TEST	S45F030	263	●	●	●			●	●	●				●										●					
Signal Processing & Display (SPD)	S3FG130	264	●	●	●	●			●	●	●			●	●												*7		
ASYST & Drivers	S47P305/S42P301/302	266	●	●	●	●			●	●	●			●												●	*2		
ASYSTANT GPIB	S42P311	266	●	●	●	●			●	●	●															●	*2		
LabWindows	S3FG910/912	265	●	●	●	●			●	●	●			●							●	●	●			●	*2		
222 Virtual Front Panel	CAT200	112											●																
i-Pattern™	S47P107	267	●	●	●	●	●	●	●	●	●	●		●		●													
Template/Waveform Processing Program	S47P110	267	●	●	●				●	●																			
11000 Series DSO Utility	S47P108	268	●	●	●					●																			
DITS ANSI/CCITT	S37J101/102/103	355							●	●																			
2402A TekMate DSO Utilities	S37UT01	269							●	●																			
Program Development Pkg.	S37UD01	269							●	●																			
Integrated TeleServicing	S41TSS1	270								●																			
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 DCS MUX16		*3			●		●									●										●			
1230/PC RS-232 Applications	S43R101	153								●							●												
2782/PC Utility	S26UT00	174								●								●											
2710/PC Utility	S26UT10	174								●																			●
EMI Prequalification	S26EM00	174								●									●										
General RF Applications (GRASP)	S26RF00	174								●									●										
Remote Site Monitoring (RSM)	S26RM00/01	174								●									●										
WaveWriter Waveform Generation	S75WVWR	262		●				●	●	●									●		●	●							
370 Device Test	S48P401	*3							●	●															●				
370 Utility	S48P104	*3							●	●															●				
371 Utility	S48P105	*3							●	●																●			
Unix Based																													
Frequency Enhancement S/W Util.	S2M6100	184																											●

The 2510 TestLab Analyzer writes waveform data to an integral MS-DOS formatted 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.



## Technical Assistance Services (TAS)

- Installation Assistance
- Familiarization Training
- Custom Training
- Problem Definition and Debugging Assistance
- Interface Assistance
- Applications Assistance

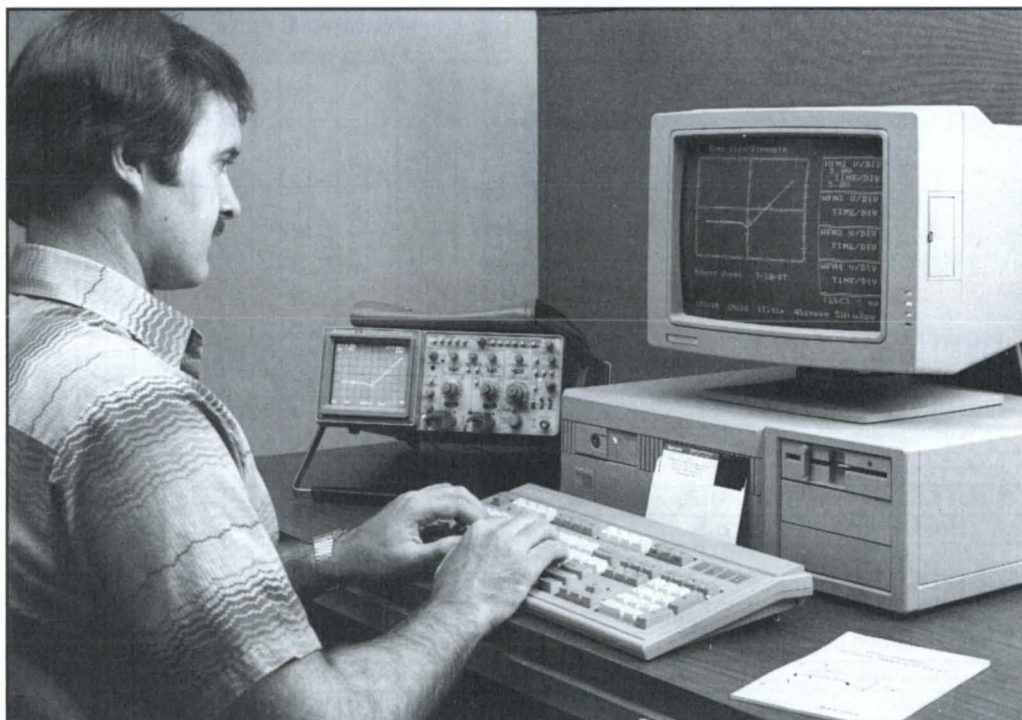
### ORDERING INFORMATION

#### T&M Products \$125/hr.

Order 068-9080-00. Availability is limited. Please contact your local Tektronix Sales Engineer for more information and availability in your area.

#### Microwave & RF Instruments

Order 068-9220-00 \$125/hr.



### 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.

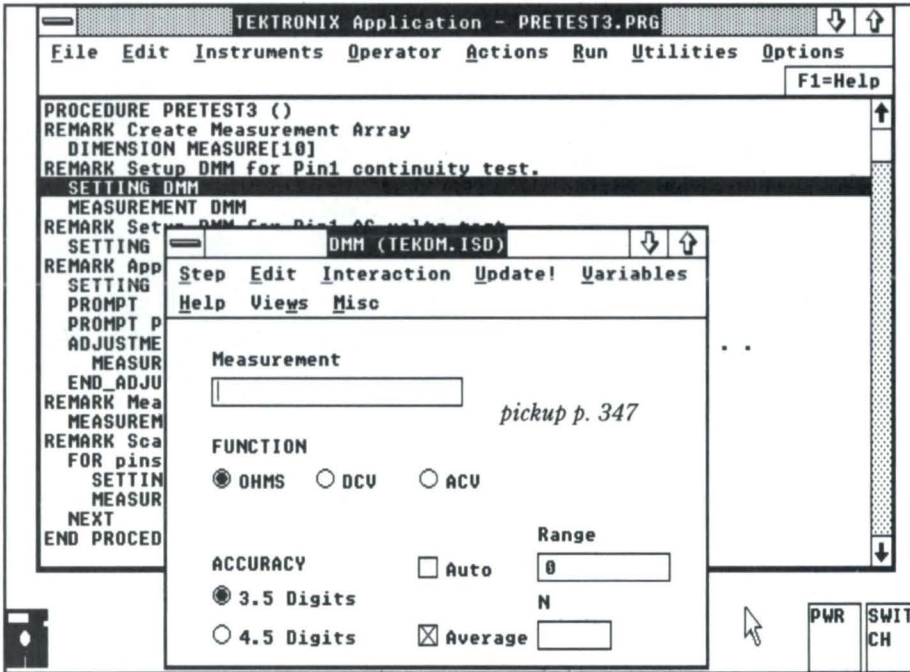
### Tektronix Application Engineer consultation is designed specifically to optimize the operation of Tek instruments and software

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



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.

### Runtime Code Generator

The new runtime code generator in conjunction with the Microsoft C 6.0 compiler provides dramatically improved speed and performance.

### 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.

More than 40 VXI instruments and 95 GPIB & CDS-Bus instruments are supported in the instrument libraries.

### Develop Your Own Front Panels Quickly

Develop instrument front panels in less than an hour 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 Test Management System (TekTMS)

- New Runtime Code Generator
- Easy-to-Use Outline View of Test Program
- Instrument Front Panel Libraries for more than 40 VXI and 95 GPIB and CDSbus instruments
- 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, 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 version 3.0 or later version with Microsoft Mouse or equivalent.

### ORDERING INFORMATION

TektMS is provided on both 5 1/4 in. and 3 1/2 in. diskettes.

**S3FT100** TektMS Interactive Procedure Generator **\$2,695**

**S3FT110** Runtime Code Generator **\*\***

**S3FT200** TektMS VXI Instrument Front Panel Library **\$495**

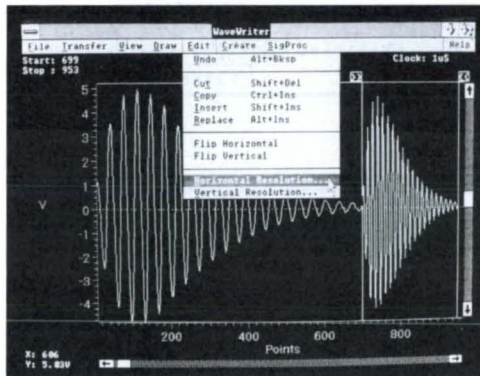
**S3FT300** TektMS GPIB Instrument Front Panel Library **\$495**

\*\* Contact your local sales office.

## WaveWriter™

Arbitrary Waveform Generation Software  
WaveWriter simplifies the creation and editing of waveforms for arbitrary waveform generators and digital 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.



WaveWriter allows easy creation and modification of custom waveforms.

WaveWriter WAVEFORM CREATION  
AND EDITING SOFTWARE

## Waveform Generation

WaveWriter™ is the new software support package for creating and modifying arbitrary waveforms for the Tektronix Arbitrary Waveform Generators and digital oscilloscopes. WaveWriter represents a major step forward in allowing easy creation of the real world signals which are increasingly being used to test circuit tolerances, drive vibration/shake tables, and simulate other non-ideal or corrupted signals.

WaveWriter offers an easy to use alternative to general-purpose programming languages for waveform definition. Its user interface is based on Microsoft Windows™, with pull-down menus and mouse-selected icons. (Alternatively, you can use a command-driven interface.) It can work on its own, or as an integral part of TekTMS test program generation software.

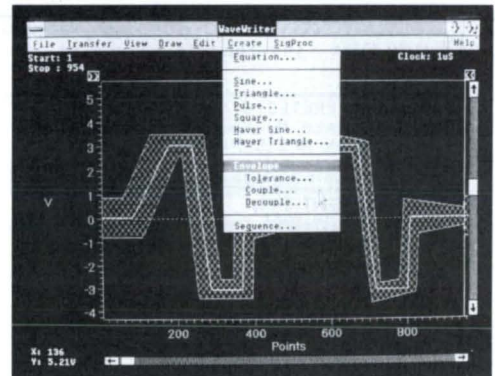
## Acquire Signals Oscilloscopes

Signals may be acquired from the Tektronix 11000 Series, 2200 Series, 2400 Series oscilloscopes as well as the VXI digitizer VX5260. The signals may then be modified and recreated on the arbitrary waveform generators.

## 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.



Create the reference memory template waveform for pass/fail testing on 2400 series oscilloscopes.

## Edit Waveforms Graphically

By defining sections of a waveform with WaveWriter's markers (which work like the cursors on an oscilloscope display), you can perform mathematical functions, including inversion; scale vertically and horizontally; and cut and paste. For example, you can add harmonically related sinusoids to construct a signal from its Fourier components. Or, starting with a signal captured by an oscilloscope, you can add glitches and distortion to test a circuit's response to specific kinds of signal aberrations.

## Automatic 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.

## 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, 2402A TekMate, or a suitably configured IBM PC AT or clone.

WaveWriter requires MS DOS or PC DOS 3.0 or later, and Microsoft Windows Version 3.0 or later, with a Microsoft Mouse or equivalent.



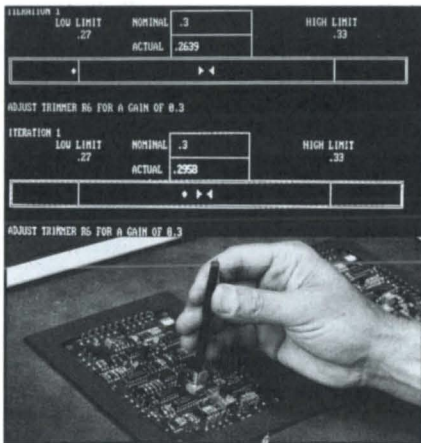


Figure 1. The adjustment step acquires measurements and displays them on screen relative to nominal and upper and lower test limits, simplifying UUT adjustment procedures.

## 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.

Let the instruments create your software. EZ-Test learns the settings of GPIB instruments and generates program code automatically.

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 2402A

EZ-TEST comes complete with runtime libraries to produce compiled test programs which run on the TekMATE 2402A with a 2400 Series Digital Sampling Oscilloscope.

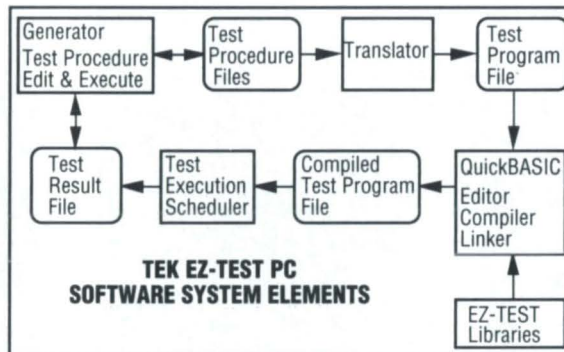


Figure 2. TEK EZ-TEST PC Software System

### 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 TekMate 2402A Instrument Controller 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 2402A system controller 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	\$1,995
Opt. 06 - Delete Microsoft QuickBASIC (required for international orders)	-\$100

## 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

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.

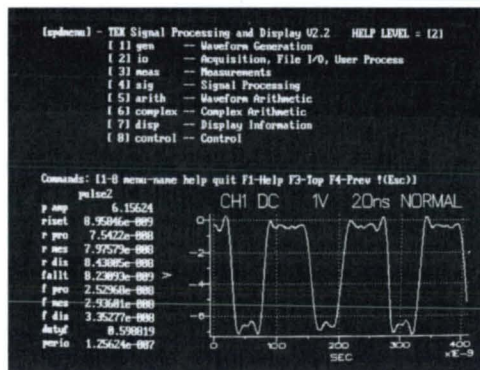
SPD supports the Tektronix HC100 plotter and the 4693D or 4696 printers.

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.

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.



## 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

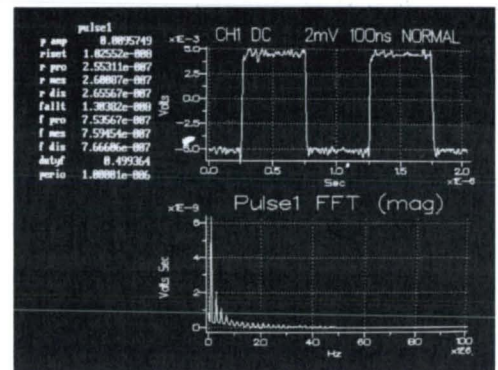
The Acquisition Library acquires waveforms from Tektronix digitizers and formats them for use by other SPD functions. Waveform acquisitions from digitizers can be achieved with a single menu selection or function call. The library supports these Tektronix digitizer products:

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.

# PROGRAMMING ENVIRONMENT LABWINDOWS®



## LABWINDOWS® VERSION 2.0

LabWindows is a software development system for building test and measurement applications. LabWindows gives QuickBASIC and C programmers a complete set of development tools to create PC-based instrumentation systems with GPIB, VXI, and RS-232 programmable instruments. The development system includes an interactive development environment and function libraries for data acquisition, instrument control, data analysis, and data presentation.

The LabWindows Standard Package gives users an interactive environment for developing QuickBASIC and C programs. In the environment, users can call any of the functions in the LabWindows Libraries. The libraries include the GPIB Library, RS-232 Library, Data Acquisition Library, Formatting and I/O Library, Analysis Library, Graphics Library, User Interface Library, and the Instrument Library. The development environment has pull-down menus and optional mouse support for simple and direct access to all editing and debugging tools. Debugging tools include break points, single-stepping, and the ability to view and edit program variables and data when running a program.

Users access each of the functions in the LabWindows Libraries with function panels. A functional panel is an intuitive full-screen interface that lets you create and execute library functions without typing or editing code. The function panel is used to interactively test functions and copy the working function directly into your program.

The LabWindows Instrument Library has drivers for controlling over 120 GPIB, VXI, and RS-232 instruments. Instrument drivers eliminate the low-level programming details of instruments with intuitive, high-level QuickBASIC and C function calls. For example, the function read.waveform (CH1, wave) will query a GPIB or

VXI Digitizer for a waveform from channel 1, read the raw data, convert the data into actual values, and place them in array, wave. By using instrument driver, developers can concentrate on developing their application rather than programming their instruments.

The LabWindows User Interface Library gives users the ability to create a graphical user interface for their system. The interface is created with a graphical editor and controlled with functions in the User Interface Library. The interface can include graphical panels and pull-down menus. Panels can be created with several types of input and output controls, graphs, and strip charts. PCX images can also be displayed on panels to show diagrams, schematics, and connections to a unit under test. The User Interface Library and the Graphics Library can output data to graphics printers as well as HPGL files and compatible plotters.

## OPTIONAL LABWINDOWS LIBRARIES

VXI Library: Complete set functions for controlling VXI instruments from GPIB, MXI, or embedded PC-controllers. Functions are available for communication with both message based and register based devices.

Advanced Analysis Library: High performance analysis library with over 125 functions that include: signal generation, real and complex FFTs, inverse FFTs, FHT and inverse FHT; power spectrum; integration; differentiation; convolution; correlation; pulse parameters, FIR and IIR digital filters; windowing functions; curve fitting; variance, RMS, linear equations; one- and two-dimensional polynomial evaluation.

## LabWindows® Version 2.0

- *Interactive Program Development*
- *Automatic Code Generation*
- *Libraries for Programming GPIB, VXI, and RS-232 Instruments*
- *User Interface Library for Creating Graphical User Interfaces*
- *Uses Standard Programming Languages – Microsoft QuickBASIC and C*

### SYSTEM REQUIREMENTS

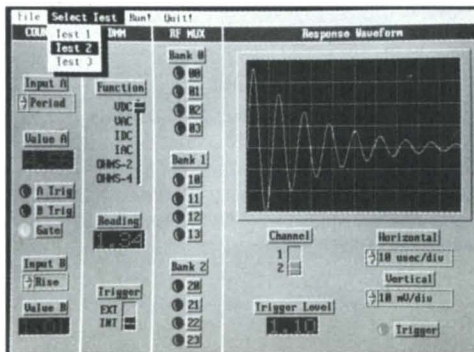
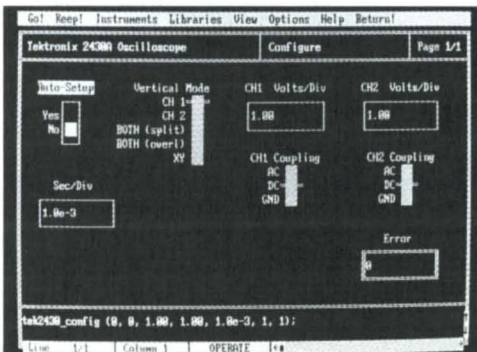
IBM PC AT or compatible, or PS/2; minimum 80286 processor; 2M or memory (up to 16M); 1 hard disk; EGA, VGA, or Hercules graphics adapter; MS-DOS 3.0 and above; Tek GPIB interface board.

### ORDERING INFORMATION

<b>S3FG910</b> LabWindows Version 2.0 Standard Package	*1
<b>S3FG912</b> LabWindows Version 2.0 Advanced Analysis Library LabWindows VXI Library for:	*1
VXIpc-386	*1
AT-MXI	*1
MC-MXI	*1

*LabWindows is a registered trademark of National Instruments.*

\*1 *Contact your local sales office.*



**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

**ASYSTANT GPIB**

- Menu Driven
- Statistical and Numerical Analysis
- Waveform Processing

**ORDERING INFORMATION**

**S42P301** – ASYST Scientific Software. ☎ **\$2,095**

Includes: Software Modules 1, 2, and 4 on 5 1/4" DS/DD disk and manuals.

**S42P302** – Driver Software for ASYST Requires S42P301 or equivalent software. ☎ **\$435**

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).

**S47P305** – 11000 Series DSO Driver for ASYST. Requires S42P301 or equivalent. ☎ **\$450**

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).

**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 and ASYSTANT are trademarks of Asyst Technologies, Inc.*

**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 Digitizer 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, DSA 600 Series Digitizing Signal Analyzers, and CSA 803.

**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.

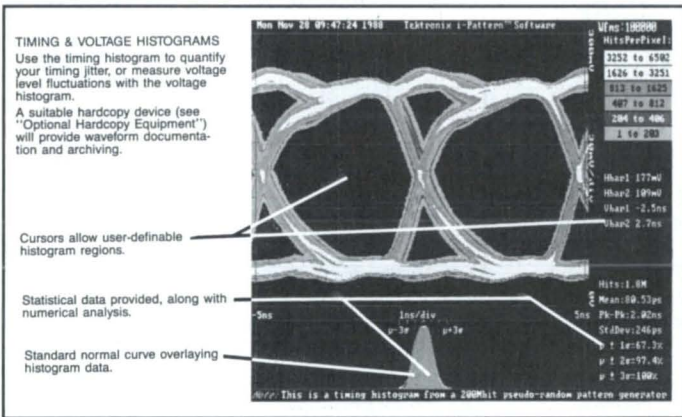
Now you can use your instrument more effectively. And, you can integrate basic graphics and analysis with instrument control so you can observe events as they occur.

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.

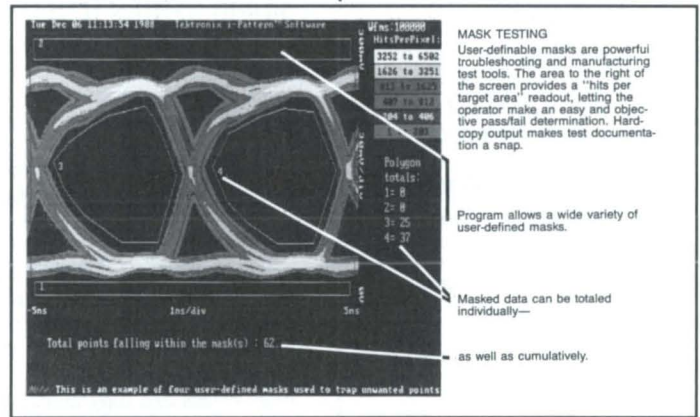
When you combine all of ASYSTANT GPIB's IEEE Standard 488 interface capabilities with its analysis and graphics functions, you have a powerful and flexible tool. A tool available at any time. A tool that provides easy setup, a natural user interface, effortless graphics, and simple-to-use math functions.

# SIGNAL CHARACTERIZATION AND MASK TESTING SOFTWARE

**i-PATTERN™ TWPP**



*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 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 parameters are automatically calculated, with user-definable tolerances selectable for Pass/Fail testing.

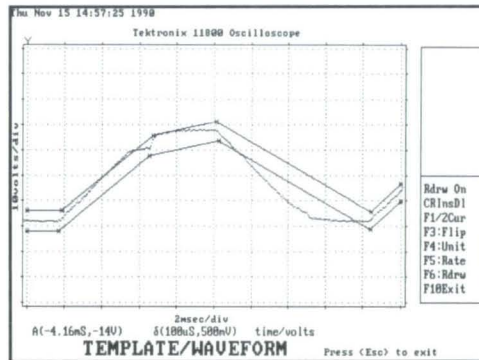
The software supports all Tektronix 11000 Series and 2400 Series Oscilloscopes, the Tektronix DSA 600 Series Digitizing Signal Analyzers, the Tektronix 2230A Portable DSO, the SCD 1000 and SCD 5000 Waveform Recorders, the Tektronix 7D20 and Sony/Tektronix RTD 710A programmable waveform digitizers.

## TEMPLATE/WAVEFORM PROCESSING PROGRAM

The Template/Waveform Processing Program works with all 11000 Series oscilloscopes, and runs on the 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."



*Creating a Template 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

<b>\$47P107</b> – i-Pattern Software	<b>\$935</b>
Includes: Software Operator Manual (070-7340-00).	
<b>Opt. 01</b> – 5 1/4" flexible disk	<b>NC</b>
<b>Opt. 02</b> – 3 1/2" micro disk	<b>NC</b>
<b>Demo Disk</b> – 42W-7389	<b>NC</b>
<b>\$47P110</b> – Template/Waveform Processing Program	<b>\$435</b>
Includes: Software Operator Manual (070-7423-00).	
<b>Opt. 01</b> – 5 1/4" flexible disk	<b>NC</b>
<b>Opt. 02</b> – 3 1/2" micro disk	<b>NC</b>

**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**

<b>S47P108</b> – 11000 Series DSO Utility Software. Includes: Software Operator Manual (070-7394-00).	<b>\$495</b>
<b>S47H211</b> – 11400 Series/HP Series 200/300 Time and Amplitude Measurement Software. Includes: Software Operator Manual (070-6897-00).	<b>\$1,050</b>

**11000 SERIES UTILITY SOFTWARE**

The 11000 Series Utility Software packages provide complete GPIB or RS-232-C control of the Tektronix 11000 Series oscilloscopes, CSA 803, CSA 404 or the DSA 600A 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.

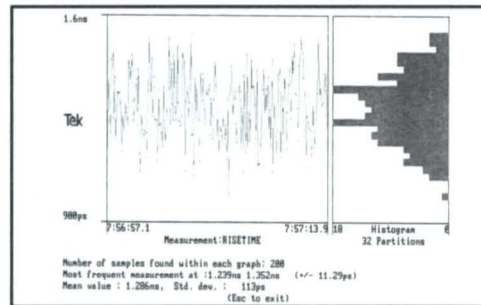
**BASIC HARDWARE CONFIGURATION**

IBM PC, XT, or AT; and DOS 2.0 or above – compatible with 640 K 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.

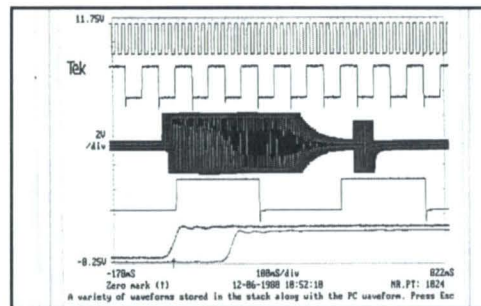
**TEKTRONIX MEASUREMENT APPLICATION PROGRAMS**

The TekMAP (Tektronix Measurement Application Programs) library of software products supports the Tektronix 11400 Series oscilloscopes in automated engineering or research environments.

TekMAP software extends the versatility of Tektronix digitizers by integrating them with IBM PCs or HP Series 200/300 technical computers.



*Measurement features of the 11000 Series DSOs are available through the menus and are supported by measurement logging, statistics, and screen graphics.*



*Multiple waveforms can be acquired and displayed on the PC screen and output to a plotter or dot-matrix printer.*

Extended measurement capabilities, such as 14 automated pulse-parameter measurements, Fast Fourier transformation, and propagation-delay measurements, are provided by the Time and Amplitude Measurement Software (TAMS) products.

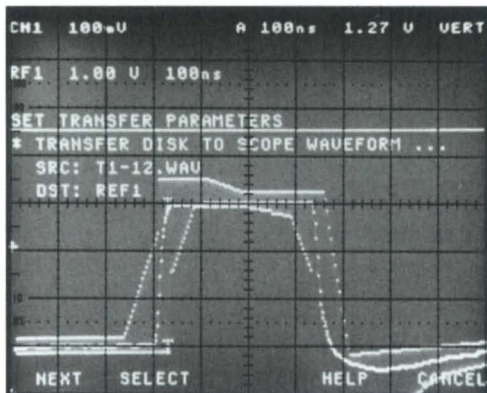
Please contact your local Tektronix Sales Engineer or representative regarding hardware configuration requirements and current software offerings.

## DSO UTILITY SOFTWARE

### A 2402A TEKIMATE, A 2400 SERIES DIGITIZING OSCILLOSCOPE AND SOFTWARE: A COMPLETE STAND-ALONE TEST STATION

The 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

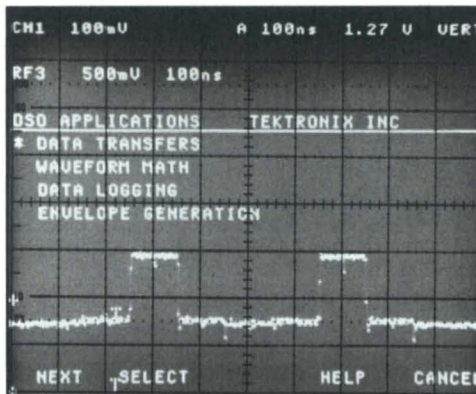
The Program Development System (PDS) software saves time and cuts programming costs. Use an IBM-compatible computer to develop your test routines with PDS. Then transfer these programs to the 2402A TekMate Instrument Extension for execution with a 2400 Series Digitizing Oscilloscopes. Other GPIB-programmable 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.

Software packages save test development time and money.

## DSO Utility Software

- 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

<b>\$37UT01</b> – DSO Utility Software (Also available as part of 2402A Option 01.)	<b>\$775</b>
<b>Opt 1S</b> – Software Subscription (International only)	<b>+\$155</b>
Extends software upgrades and product support to one full year.	
<b>Opt 3S</b> – Software Subscription Renewal (International only)	<b>+\$155</b>
<b>\$37UD01</b> – Program Development System	<b>\$1,295</b>
<b>Opt 1S</b> – Software Subscription (International only)	<b>+\$260</b>
Extends software upgrades and product support to one full year.	
<b>Opt 3S</b> – Software Subscription Renewal (International only)	<b>+\$260</b>

### Easy-to-use software for digital storage oscilloscopes

- *Data Communications, Data Management, and Waveform Graphics in One Package*
- *Easy-to-Use Windows and Pop-up Menus*
- *Easy Creation of Reference Libraries*

#### TeleServicing Software includes:

- *Standard Phone Line and RS-232-C Link-up*
- *Built-in Phone Directory with 20 User-Definable Automatic Dialing Entries*

### ORDERING INFORMATION

#### \$41SAVE – WaveSaver Software ☎\$199

Includes:  
Software (on 5-1/4" and 3-1/2" diskettes),  
User manual (070-7875-00).

#### \$41TSS1 – Integrated TeleServicing 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 updated.

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

### NEW WAVESAVER DOCUMENTATION PACKAGE

WaveSaver is a new applications software package designed for use with Tek's 2221(A), 2224, 2230 and 2232 digital storage oscilloscopes and the IBM PC. In one easy-to-use package, WaveSaver enables you to quickly and easily transfer waveforms to and from your digital storage oscilloscope. With WaveSaver's pop-up menus you can:

- Transfer waveforms to and from the oscilloscope
- Display waveforms on the PC screen in EGA color graphics
- Store and retrieve waveform data to disk
- Add notes to the displayed waveforms
- Document waveform display via printer and HPGL-plotter (four-color) output
- Send numeric waveform data to a printer
- Read oscilloscope front-panel settings
- Change menu settings, re-arm single-shot trigger

### 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)
- IBM MDA, CGA, or EGA graphics adaptor and compatible monitor
- Tek DSO with option 12 (RS-232-C interface)
- RS-232-C Cables (e.g. part number 012-0911-00 DB25-DB25 straight-through)

### INSTRUMENT COMPATIBILITY

Tek WaveSaver Software is compatible with the Tektronix 2221, 2221A, 2224, 2230, and 2232 Digital Storage Oscilloscopes.

### LICENSING AND WARRANTY

- License: Break-the-Seal, single installation
- Warranty: 90 days distribution media and encoding (only)



*Tek's TeleServicing Software combines data communications, data management, and waveform graphics in one affordable, integrated package.*

### THE FIELD TELESERVICING SOLUTION

For even more functionality, Tek's integrated TeleServicing Software combines the data management and waveform graphics of WaveSaver with modem communications.

With Tek TeleServicing Software, you can connect a compatible Tek 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.

### 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 26 K 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.

### REQUIRED EQUIPMENT

- Same as WaveSaver Software, plus
- Hayes-compatible 300/1200-baud modems

### INSTRUMENT COMPATIBILITY

Same as Tek WaveSaver Software.

### 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 instruments—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 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 software generation, instrument control and results processing software. Tek offers a variety of 286/386 controllers, Test System Interfaces, and software such as Tek TMS to make 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 instruments, the CDSbus/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 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 custom system.

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 quilworks of components from different vendors.

Tektronix provides 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.

## CDSbus

With the acquisition of Colorado Data Systems (CDS) in 1990, Tektronix also acquired a complete line of over 60 low-cost card-modular instruments. These CDSbus instruments include data acquisition and signal conditioning, switching systems, MIL-STD-1553, ARINC-429, Synchros/Resolvers, and RF/Microwave measurement.

## 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 provide 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 and CDS, two of the five founding members of the consortium which developed the VXIbus standard, are at the leading edge of VXI technology and innovation, offering their first VXI products in 1988 and continuing to broaden their portfolio this year. And, as with our GPIB instrumentation, Tek sells not just VXIbus products, but total systems solutions using combinations of VXIbus, CDSbus, and GPIB products.

## SOFTWARE PACKAGES

- **Tek TMS**
  - Provides test program generation and execution for GPIB, VXIbus, and CDSbus only environments.
  - Interactive front panels for GPIB, VXIbus and CDSbus instrumentation, and a facility for user developed front panels.
- **WaveWriter**
  - Creates custom waveforms for Tek Arbitrary Waveform Generators and DSOs.
- **SPD**
  - Provides 196 processing, analysis, and data-to-display functions using Tek digitizers.
- **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.
- **i-Pattern**
  - Timing-jitter and noise analysis for Telecom and other time domain signals.
  - Runs on 2200, 2400, 7000, 11000, and RTD digitizing scopes.
- **DCS01GPH**
  - Automates setting communications and certain functions via GPIB for 2467B Opt. 10 and 11302A.
  - Provides digitization of real time analog scope waveforms.

## 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. 488-1978 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* 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.

## 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
- VXIbus Card Instrumentation Systems
- CDSbus Card Modular Systems
- Custom Systems

## 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 because they are:

- Easy to learn and use
- Meet stringent testing standards
- Are rugged, student-proof and safe
- Same high-quality instruments used in industry
- Provide smooth transition from school to career

**THE LONG TERM CHOICE**

Tektronix commitment to education does not end with the purchase of equipment. Our long-term commitment to education is demonstrated by the availability of:

- Courseware & instructional materials
- Rugged and safe equipment
- Operator & technician training
- Extended warranties

**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 products include:

- Analog and Digital Oscilloscopes
- Logic Analyzers, Spectrum Analyzers
- Function Generators, Power Supplies, Counters
- Automatic stimulus and measurements tools
- Modular instruments for custom systems
- A full line of accessories

From basic to advanced laboratory and bench instrumentation, our products will meet your needs in:

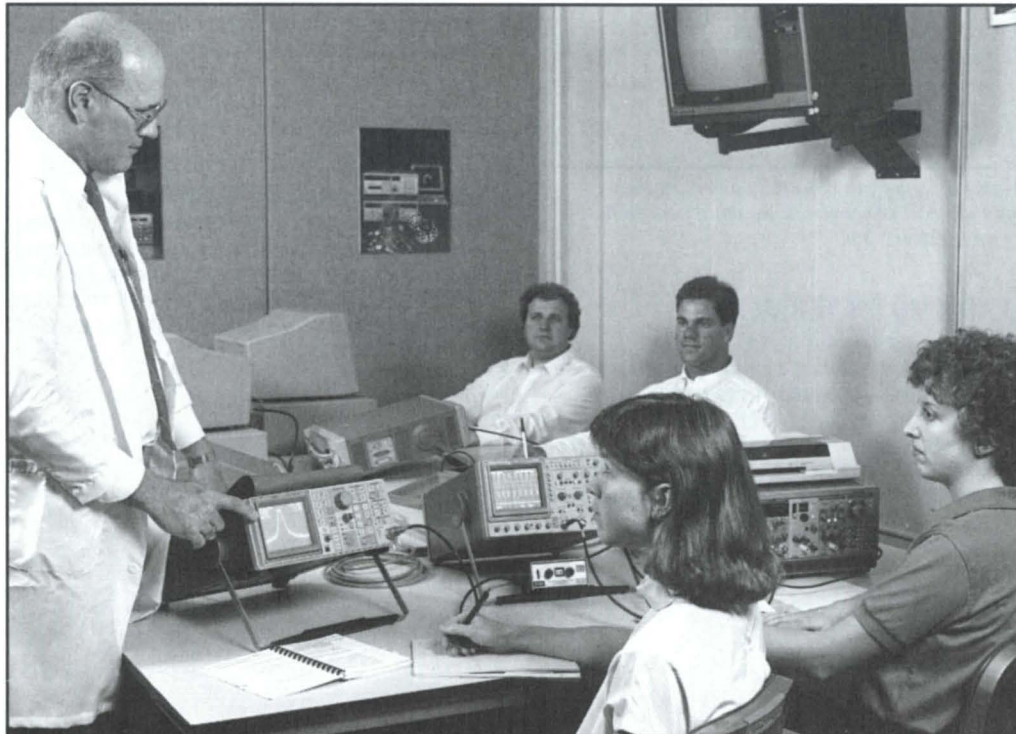
- Electronics
- Physics
- Mechanical Engineering
- Semi and fully automated test

And in every 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.

**T**ektronix 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.*

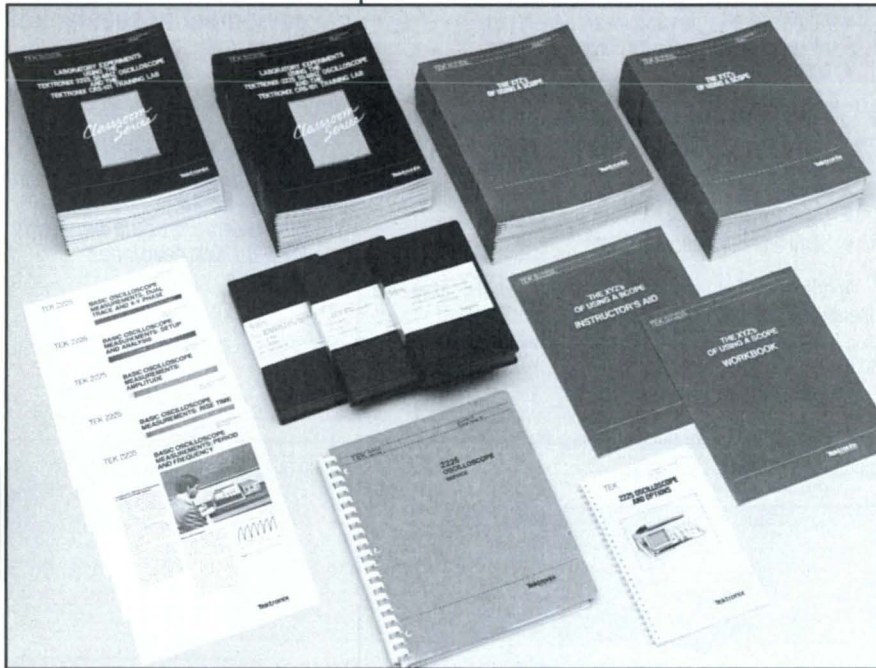


*Tektronix offers the total solution for your classroom with a broad range of test and measurement instrumentation. From spectrum analyzers and oscilloscopes to modular instruments and printers.*

**'A diverse environment demands an extensive selection'**

### COURSEWARE AND TRAINING

For many instructors, the time spent preparing to teach far outweighs the time spent teaching. That's why we offer comprehensive and self-contained courseware. This courseware is designed to complement and supplement the broad range of Tektronix test and measurement products and your classroom curriculum.



*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

Tektronix learning materials are:

- written by educators and instructional designers
- professionally produced
- comprehensive, covering both operations and concepts
- designed for beginning through advanced students
- available in videotapes, workbooks, instructors guides, quickstart, and self-study packages

*For ordering information on self-study and QuickStart packages as well as the videotape and literature offerings, see page 276.*

### 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 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, electrostatic 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.



Tek cameras and printers make lab documentation easy. Tek SCOPE-MOBILE® carts free up valuable bench space and make sharing of equipment between students convenient.



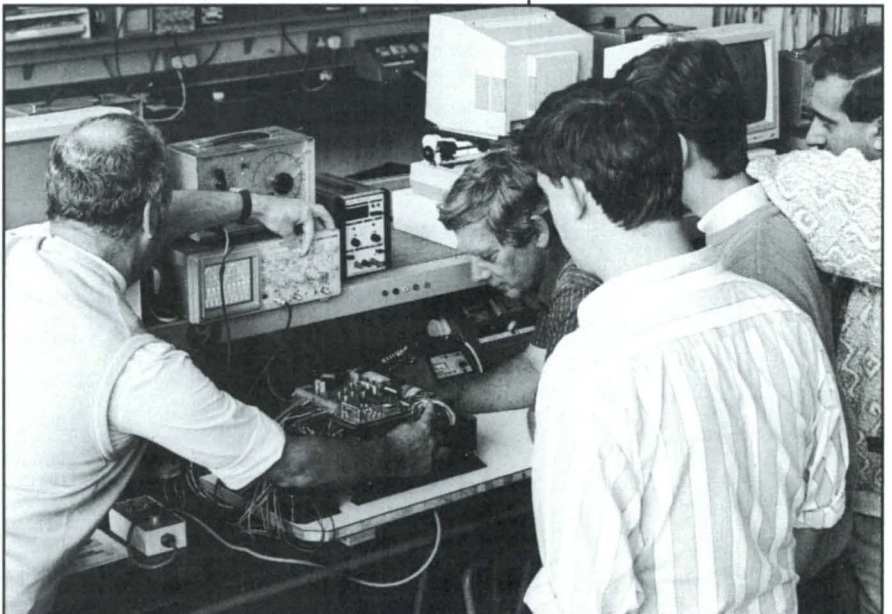
Lab bench stations can be configured to your needs. Our stackable triple-output power supply, digital multimeter, 100 MHz frequency counter and 2 MHz function generator (see pages 246 and 248) join a 50 MHz dual-trace oscilloscope (page 106) as a popular setup for basic lab stations.

## 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.'***



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:*

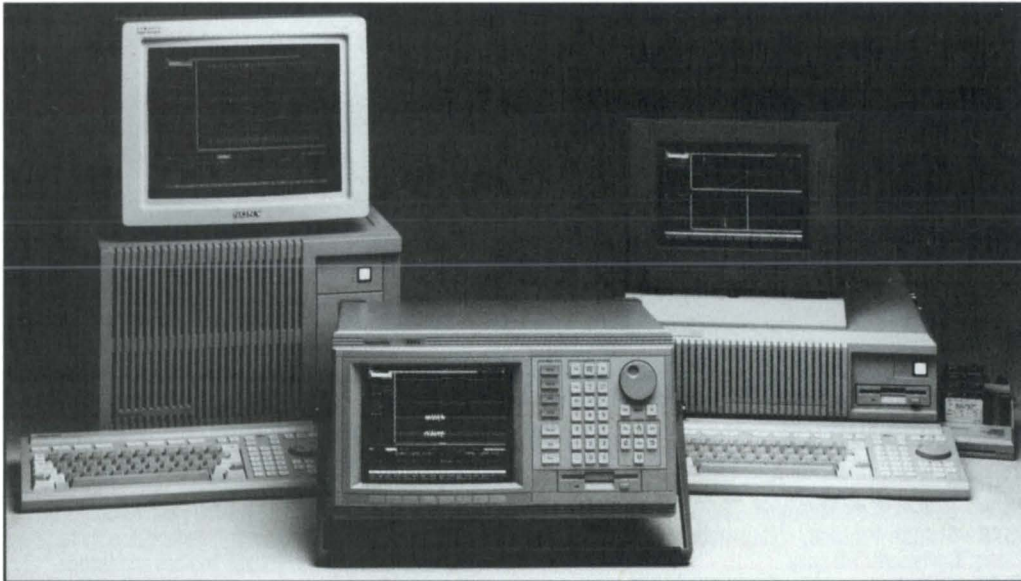
**NTSC format (used in USA)**

- 00 = 3/4"      01 = BETA I
- 02 = BETA II    03 = BETA III
- 04 = VHS/NTSC

- PAL format**      **SECAM format**
- 06 = VHS/PAL    07 = VHS/SECAM
- 08 = Workbooks

**ORDERING INFORMATION**

SELF-STUDY PACKAGES		VIDEO TAPES	
Each self-study course includes a detailed video instruction tape and a workbook. Additional workbooks are 4/\$100.		<b>Operating the 2247A</b> 068-0327-XX	<b>Oscillo-what? What is an Oscilloscope?</b> \$60 Discusses the display, vertical, horizontal and trigger sections and introduces digitizing oscilloscopes. 068-0218-XX
<b>Fundamentals of Analog Scopes</b> \$115 068-0270-XX	<b>Operating the 2430A</b> \$145 068-0267-XX	<b>Operating the 2432</b> \$145 068-0266-XX	<b>Oscilloscope Primer Practical Scope</b> \$60 How to use a scope, acquire a trace, select suitable vertical and horizontal scale factors, and how to use the special features on the Tektronix 2225 oscilloscope. 068-0227-XX
<b>Fundamentals of Probes</b> \$115 068-0269-XX	<b>Operating the 2432A</b> \$145 068-0305-XX	<b>Operating the 2440</b> \$145 068-0265-XX	<b>Advanced 2200 Series Operation</b> \$60 068-0151-XX
<b>Fundamentals of Digital Scopes</b> \$115 068-0268-XX	<b>Operating the 2445A/2465A</b> \$145 068-0262-XX	<b>Operating the 2445B/2465B/2467B</b> \$145 068-0261-XX	<b>CDM250 Video Tape</b> \$60 Digital multimeter training 068-0254-XX
<b>Fundamentals of GPIB</b> \$115 068-0260-XX	<b>Operating the 11301A/11302A</b> \$145 068-0264-XX	<b>11301/11302 Waveform Measurement</b> \$145 068-0304-XX	<b>CFC250 Video Tape</b> \$60 Frequency counter training 068-0253-XX
<b>Fundamentals of RS232</b> \$115 068-0259-XX	<b>Using the PC as a Controller</b> \$145 068-0301-XX	<b>11401/11402 Waveform Measurement</b> \$145 068-0302-XX	<b>CFG250 Video Tape</b> \$60 Function generator training 068-0252-XX
<b>Fundamentals of Logic Analyzers</b> \$115 068-0291-XX	<b>Fundamentals of Logic Analyzers</b> \$115 068-0291-XX	<b>11401/11402 Advanced Waveform Measurement</b> \$145 068-0303-XX	<b>CPS250 Video Tape</b> \$60 Power supply training 068-0251-XX
<b>Operating the 2201</b> \$60 068-0290-XX	<b>Operating the 2205</b> \$60 068-0289-XX	<b>Operating the 1230</b> \$115 068-0288-XX	<b>The Vital Link - Probe and Signal Concepts</b> \$75 068-0229-XX
<b>Operating the 2210</b> \$125 068-0274-XX	<b>Operating the 2211</b> \$125 068-0311-XX	<b>QUICKSTART PACKAGES</b> Each package is designed to give step-by-step instruction using workbooks and specially designed signal generation boards.	<b>LITERATURE</b> <b>Lab Bench Equipment Orientation</b> \$50 Instructor guide and workbooks for CFC250, CFG250, CDM250 and CPS250. (50 workbooks, 1 guide) 062-9511-00
<b>Operating the 2213A/2215A</b> \$115 068-0278-XX	<b>Operating the 2220</b> \$125 068-0273-XX	<b>2400 Series Digital Oscilloscopes QuickStart Package</b> *1 \$220 020-1679-00 U.S. power (VHS/NTSC) 020-1681-00 European power (VHS/PAL)	<b>2225 Oscilloscope XYZs Primer</b> \$135 Covers horizontal, vertical and trigger functions, controls, use of probes, terminology, and theory of waveforms and measurement techniques. (50 primers, 1 guide, 1 workbook) 062-9322-00
<b>Operating the 2221</b> \$115 068-0272-XX	<b>Operating the 2224</b> \$125 068-0310-XX	<b>2402 TekMate QuickStart Pkg.</b> \$270 020-1747-00 (U.S.) 020-1748-00 (European)	<b>An Introduction to Digital Storage</b> \$120 062-9465-00 (50 Primers)
<b>Operating the 2225</b> \$115 068-0279-XX	<b>Operating the 2230</b> \$125 068-0271-XX	<b>11403 QuickStart Package</b> ** 020-1767-00 (U.S.) 020-1768-00 (European)	<b>ABCs of Probes</b> \$120 062-9471-00 (50 primers)
<b>Operating the 2232</b> \$125 068-0312-XX	<b>Operating the 2235</b> \$115 068-0277-XX	<b>DSA 600 QuickStart Package</b> \$220 020-1769-00 (U.S.) 020-1770-00 (European)	<b>*1 Video-tape included where noted.</b>
<b>Operating the 2236</b> \$115 068-0276-XX	<b>Operating the 2245/2246A</b> \$115 068-0275-XX	<b>2252/2247A/2245A QuickStart Package</b> *1 \$199 020-1864-04 (VHS/NTSC) 020-1864-06 (VHS/PAL)	<b>** Contact your local sales office.</b>
<b>Operating the 2245A</b> \$125 068-0325-XX	<b>Operating the 2246A</b> \$125 068-0326-XX	<b>2232/2224/2221A QuickStart Package</b> *1 \$199 020-1812-04 (VHS/NTSC) 020-1812-06 (VHS/PAL)	
		<b>2211 QuickStart Package</b> *1 \$199 020-1811-04 (VHS/NTSC) 020-1811-06 (VHS/PAL)	



*TestLab™, a new test strategy for physical measurements. Up to 8 channels with the 2505, 32 channels with the 2510, and 96 channels with the 2520.*

## TestLab™ MULTI-CHANNEL ANALYZERS

The 2505, 2510 and 2520 TestLab Multi-Channel Analyzers present a new test strategy to engineers and technicians who make measurements on physical phenomena. 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.

Service, 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, telephone signals and power quality testing all need the efficient, cost-effective performance of TestLab.

### MULTI-CHANNEL ACQUISITION

Acquire up to 8 channels with the 2505, 32 channels with the 2510, and 96 channels with the 2520. Data can be acquired with varying sample rates, record lengths, and high resolutions for viewing and measuring test parameters. Quick setup of multiple channels is possible with the Autoset feature which automatically sets input controls on all active channels. TestLab mainframes are card modular. The 2505 mainframe accepts 1 acquisition card. The 2510 mainframe accepts up to 2 acquisition cards. The 2520 mainframe accepts up to 6 acquisition cards. The three types of acquisition cards can be used together in any combination in the 2510 or 2520 mainframes. System software is identical and allows sharing of files between all mainframes.

### GENEROUS RECORD LENGTH, HIGH RESOLUTION

Records up to 1 M points 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, the "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 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.

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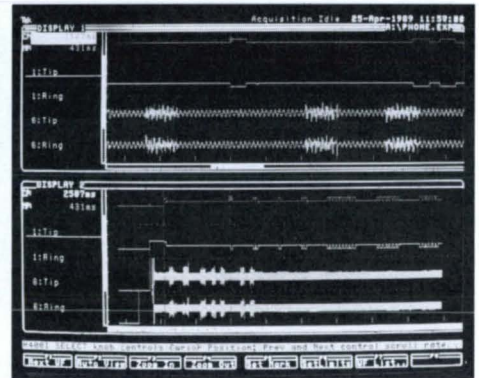
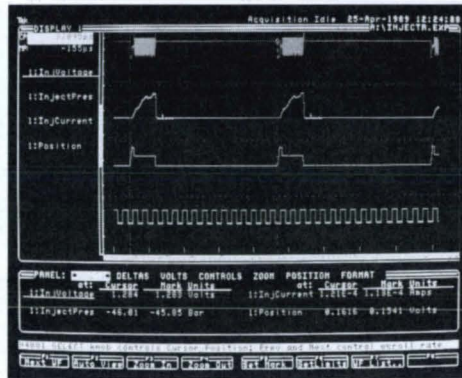
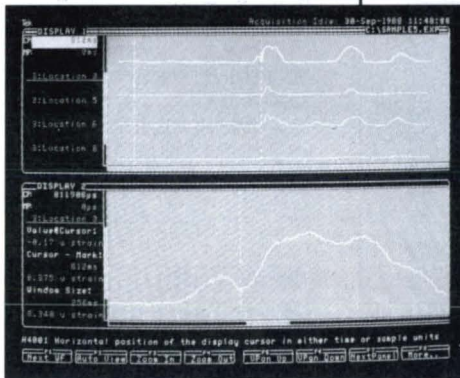
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## NEW 2505/2510/ 2520 TestLab

- *Simultaneous Multi-Channel Acquisition: 2 to 96 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: The 2505, with built-in Monitor, makes 8 channel Acquisition truly portable – under 34 pounds!*



*Optional Signal Conditioning Accessory 25BP4*



Powerful display system allows user configured formats for different applications – without writing software.

## CHARACTERISTICS

### DISPLAY

**2505** – Built-in 9" monochrome.

**2510** – Multiple-frequency color monitor or folding electro-luminescent flat panel.

**2520** – Multiple-frequency color monitor.

**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 combinations 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 kilobytes.

**Standard Hard Disk** – Internal 20 megabytes.

**Optional Hard Disks** – 40 and 80 megabytes.

### INTERFACING

**Types** – IEEE-488 (GPIB), RS-232-C, and parallel printer are available using COMM Pack plug-in modules. HPGL plotter output using RS-232 connections.

**Files** – ASCII, Lotus 1-2-3 (.WKS), and DADiSP. Format translations can be performed on a PC with PC utility translation program provided.

### TestLab SIGNAL CONDITIONING

**25BP4 Measurement Interface Unit** provides a simple signal conditioning solution for the 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.

### POWER REQUIREMENTS

**2505 Mainframe** – 110 to 220 VAC, 50/60 Hz.

**2510 Mainframe (Include Flat-Panel Display)** – 110 or 220 VAC, 50/60 Hz, 500 VA max.

**2520 Mainframe** – 110 V or 220 VAC 50/60 Hz, 975 VA typical.

**Color Monitor** – 110-125/200-240 VAC, 50/60 Hz, 85 watts.

### MECHANICAL AND ENVIRONMENTAL

**Temperature Range** – Operating: 4°C to 50°C (40°F to 122°F); Nonoperating: -40°C to 60°C (-40°F 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, noncondensing. 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.

### PHYSICAL CHARACTERISTICS

	2505		2510S2		2520	
Dimensions	mm	in	mm	in	mm	in
Width	470	18.5	455	17.9	425	16.8
Height	225	8.85	203	8	260	10.25
Depth	502	19.75	432	17	600	23.5
<b>Weight</b>	<b>kg</b>	<b>lb</b>	<b>kg</b>	<b>lb</b>	<b>kg</b>	<b>lb</b>
Net	15.5	34	16.8	37	24.1	53





## ACQUISITION CARDS

	25AA1	25AA2	25AD3
Resolution	12 bits	10 bits	12 bits
Channels			
Analog	4 Single-ended or Differential	2 Single-ended	8 Single-ended or Differential
Digital	0	0	8, TTL
Sample Rate			
Max	100 kS/s	12.5 MS/s	100 kS/s
Min	12.5 S/s	200 S/s	1 S/min
Analog Bandwidth	50 kHz (-3 dB)	5 MHz (-3 dB)	50 kHz (-3 dB)
L-P Filter	Yes	No	No
Max Record Length			
Samples @ Channels	256K (1 channel)	64K per channel	64K per channel
Time	5.7 hr	5.5 minutes	Opt. 512K, 1M 45.5 days (64K), 728 days (1M)
Triggering			
Level Range	100% of full scale, Independent trigger level for each channel.		
Level Resolution	0.5% of full scale for all acquisition cards		
Trigger Slope	+, -, Either, and Off on all acquisition cards		
Digital Levels	Not Applicable	Not Applicable	Yes
Aux. Trigger Level for Window Triggering	No	No	Yes
Programmability	Logical OR combination of individual trigger criteria from each acquisition channel and between acquisition cards in the instrument.		
Logical "AND"	No	No	Yes (with card)
Pre-Trigger Range	0% to 100% of record	0% to 100% of record	0% to 100% of record
Input Ranges	±100 mV to ±10 V full scale	±100 mV to ±10 V full scale	±100 mV to ±100 V full scale
Volts/LSB	49 µV	195 µV	49 µV
Input Offset Voltage	±15 V	Not Available	±15 V at ranges ≤10 V ±150 V at ranges ≥20 V
Maximum Voltage Input (DC + peak AC)	±30 V	±400 V	±400 V
CMRR	At least 1000:1	Not Applicable	At least 1000:1
Channel Isolation	At least 100:1 at 1 kHz	Not Applicable	At least 100:1 at 1 kHz
External Clock Range	Up to max sample rate	Not Applicable	Up to max sample
Input Impedance	1 MΩ, 26 pF	1 MΩ, 35 pF	1 MΩ, 26 pF

## ORDERING INFORMATION

### 2505 TestLab Portable Mainframe \$8,100

Includes: one slot mainframe, software, built-in 9" monochrome monitor, 20 Mb hard disk, parallel printer COMM Pack and the Operators Manual. Requires one acquisition card to acquire data (See Acquisition Cards Below).

### 2510S1 TestLab Standard Two Slot Mainframe \$9,500

Includes: software, color monitor, 20 Mb hard disk, parallel printer COMM Pack and the Operators Manual. Requires at least one or two acquisition card(s) to acquire data (See Acquisition Cards Below).

### 2510S2 TestLab Portable Two Slot Mainframe \$10,750

Includes: software, flat panel display, 20 Mb hard disk, parallel printer COMM Pack, soft-sided case, and Operators Manual. Requires one or two acquisition card(s) to acquire data (See Acquisition Cards Below).

### 2520 TestLab Six Slot Mainframe \$10,900

Includes: software, color monitor, 20 Mb hard disk, parallel printer COMM Pack, and Operators Manual. Requires at least one acquisition card to acquire data. (See Acquisition Cards Below)

#### INSTRUMENT OPTIONS

Opt. 03 - Add RS-232C COMM Pack and manual	\$750
Opt. 10 - Add IEEE-488 (GPIB) COMM Pack and manual	\$850
Opt. 15 - Add color monitor to 2510S2 (not available on 2505)	\$695
Opt. 21 - Substitute 40 Mb Hard Disk.	\$650
Opt. 22 - Substitute 80 Mb Hard Disk.	\$1,800
Opt. 1P - HC100 Plotter, Centronics config. and cable, 110 VAC	\$940
Opt. 2P - HC100 Plotter, Centronics config. and cable, 220 VAC	\$940

### Opt. 3P - HC100 Plotter, RS-232-C config. and cable, 110 VAC \$935

### Opt. 4P - HC100 Plotter, RS-232-C config. and cable, 220 VAC \$935

### Opt. 5P - HC200 Printer, Centronics config. and cable, 110 VAC \$420

### Opt. 6P - HC200 Printer, Centronics config. and cable, 220 VAC \$420

### Opt. 11 - Transit case with wheels for 2510S2 \$550

### Opt. 1R - 2520 Mainframe Rack Mount Kit \$400

### Opt. 88 - Factory Install Companion Cards NC

#### INTERNATIONAL POWER CORD 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

#### ACQUISITION CARDS

### 25AA1 Four Differential Channels 100 KS/s, 256 KS total memory, 12-bit vertical resolution. \$3,400

### 25AA2 Two Single-Ended Channels, 12.5 MS/s, 64 KS memory per channel, 10-bit vertical resolution. \$4,700

### 25AD3 Eight Analog + Eight Digital Channels, 100 KS/s, 64 KS memory per channel, 12-bit vertical resolution. \$7,500

#### Options for 25AD3:

### 1D - Memory Expansion to 512 KS per channel \$2,200

### 2D - Memory Expansion to 1 MS per channel \$4,000

#### SIGNAL CONDITIONING ACCESSORIES

### 25BP4 Four Slot Measurement Interface Backplane for Analog Devices signal conditioning 5B Series modules. Use only with 25AA1 and 25AD3 Acquisition Cards. (Order any selection of the following modules). \$285

#### MODULES

### Order Number (Analog Devices Number, ref. only) \$150

### 119-3524-00 - (5B34-01) 100 Ω Platinum RTD input, -100° to +100°C, 0 to 5 VDC output. \$150

### 119-3527-00 - (5B34-04) 100 Ω Platinum RTD input, 0° to 600°C, 0 to 5 VDC output. \$180

### 119-3533-00 - (5B38-02) Full Bridge Amplifier, 300 to 10 KΩ input, (such as strain gages), -5 to +5 VDC output. \$150

### 119-3536-00 - (5B40-01) -10 to 10 mV input, -5 to +5 VDC output. \$205

### 119-3542-00 - (5B47-J-02) J Type thermocouple input, -100° to +300°C, linearized, 0 to 5 VDC output. \$205

### 119-3543-00 - (5B47-K-04) K Type thermocouple input, 0° to 1000°C, linearized, 0 to 5 VDC output. \$39

### 119-3546-00 - (AC1367) One-to-one non-isolated voltage feedthrough, -10 to +10 VDC maximum input and output. \$120

#### OPTIONAL ACCESSORIES

### 016-0909-01 Soft-sided Carrying Case for mainframe with flat panel or no display (Included in 2510S2 configuration) \$660

### 016-0994-00 Hard-sided transit case with flat panel or no display (Also available as Option 1T on 2510S2) \$80

### 016-0707-01 Accessory Pouch \$40

### P6103 2.0 m, 10x Probe \$65

### P6101A 2.0 m, 1x Probe \$60

### P6119 2.0 m, Switchable 1X/10x Probe \$2,200

### A6902B Voltage Isolator Amplifier \$2,200

**A**dvanced Analysis of Analog Signals in the Time and Frequency Domains, from dc to 200 kHz.

**2622/2630**  
**NEW 2641/**  
**NEW 2642**

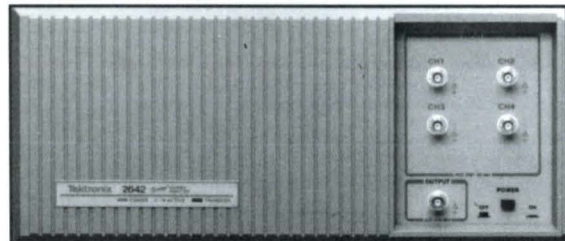
- Real time Spectrum, Network (Frequency Response), and Waveform Analysis
- Complete Modal System for Structural Analysis
- Accessory Software for Control Systems Analysis, Production Tests, 1/3 Octave Analysis, Spectral Maps, Swept Sine Measurements, Waveform Math, and More
- Easy-to-Learn Pull-Down Menus
- Up To Four Input Channels
- Optional Built-in Signal Generator with Periodic, Random, and Arbitrary Analog Signal Generation



2622 Personal Fourier Analyzer. DC-20 kHz.



2630 Personal Fourier Analyzer. DC-20 kHz.



2642 Personal Fourier Analyzer, DC-200 kHz (shown);  
2641 Personal Fourier Analyzer, DC-100 kHz.

## PERSONAL FOURIER ANALYZERS

### 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.

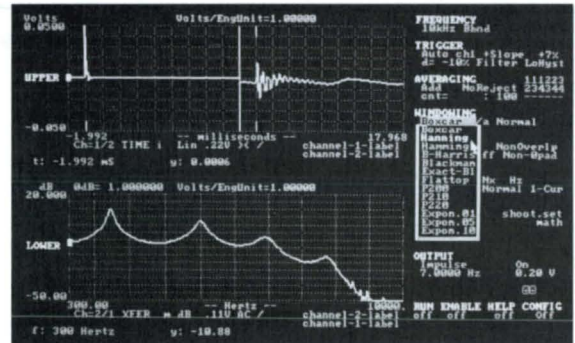
Within each Tek Personal Fourier Analyzer is a combination of precision signal-acquisition hardware and RAM-based microprocessors specifically designed for high-performance signal processing. Connected to a common PC, the Personal Fourier Analyzer's internal processors have access to the PC's display, I/O ports, mass storage, and keyboard. In short, the PC becomes the terminal for a powerful Fourier analysis system.

### FLEXIBLE

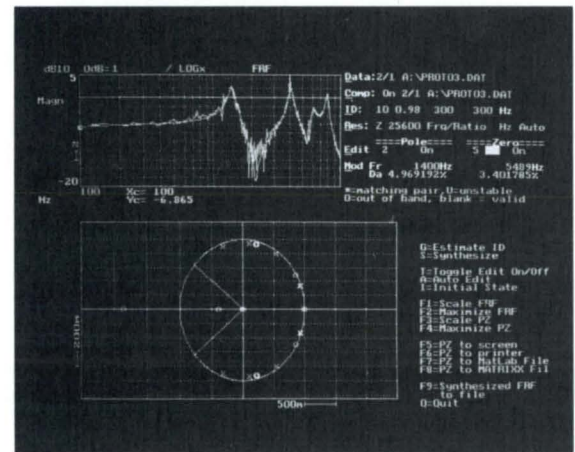
The Instrument Program (IP) supplied with the Personal Fourier Analyzer is the critical link between the analyzer and the PC. When executed from the PC, all of the Personal Fourier Analyzer's instructions are down loaded into the analyzer's internal RAM, providing the latest features and capabilities. The 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 Instrument Program provides high-quality color graphics and easy-to-learn pull-down menus for data analysis and acquisition control.*



*One of many accessory software packages, the RLS System Identification software produces pole/zero system models from measured stimulus/response data.*



*The 2622, when used with a laptop PC (Option 20), becomes a lightweight system that easily travels with you.*

## SELECTION GUIDE

	2622	2630	2641	2642
Frequency Range	20 kHz	20 kHz	100 kHz	200 kHz
Max Input Chan.	2	4	4	4
Max Realtime BW	5 kHz	10 kHz	10 kHz	10 kHz
Dynamic Range	75 dB	75 dB	75 dB	75 dB
Channel Match	$\pm 0.2$ dB, $\pm 0.5$ deg	$\pm 0.2$ dB, $\pm 0.5$ deg	$\pm 0.075$ dB*, $\pm 0.5$ deg	$\pm 0.075$ dB*, $\pm 0.5$ deg
Spectral Lines	25 to 800	25 to 1600	20 to 1600	25 to 1600
Zoom	Opt. 2H	Opt. 2H, 3H	Opt. 2H, 3H	Opt. 2H, 3H
Signal Generator	-	Opt. 4H	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)	26 lb (11.8 kg)
Price Begins At:	<b>\$6,950</b>	<b>\$10,750</b> (2-Ch)	<b>\$14,500</b> (2-Ch)	<b>\$19,500</b> (2-Ch)

\* (dc - 50 kHz)

### 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 on previous page) 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 2600MS Modal Analysis Solution provides a complete, turn-key system including PC, 2630, STARMODAL 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 78.)

#### 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 51.2 kS/s are achievable.

## ORDERING INFORMATION

2622 (2-Ch Standard)	\$6,950
2630 (2-Ch Standard)	\$10,750
2641 (2-Ch Standard)	\$14,500
2642 (2-Ch Standard)	\$19,500

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)

### INSTRUMENT OPTIONS

2622:		
Opt. 2H - 2-Ch Zoom		+\$1,000
2630:		
Opt. 1H - 4 Input Channels		+\$3,950
Opt. 2H - 2-Ch Zoom		+\$1,000
Opt. 3H - 4-Ch Zoom		+\$2,000
Opt. 4H - Signal Generator		+\$2,400
Opt. 5H - Dig Rec/Playback		+\$3,150
2641:		
Opt. 1H - 4 Input Channels		+\$6,000
Opt. 2H - 2-Ch Zoom		+\$1,000
Opt. 3H - 4-Ch Zoom		+\$2,000
Opt. 4H - Signal Generator		+\$3,000
2642:		
Opt. 1H - 4 Input Channels		+\$8,000
Opt. 2H - 2-Ch Zoom		+\$1,000
Opt. 3H - 4-Ch Zoom		+\$2,000
Opt. 4H - Signal Generator		+\$3,500

### 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 - 640 kilobytes,  
One 3 1/2" or 5 1/4" floppy drive and 20 megabyte Hard Drive,  
One RS-232-C serial port,  
Intel 8087, 80287, or 80387  
Co-processor, Enhanced Graphics Adapter (EGA), Monochrome or color EGA monitor (Second serial port and mouse recommended).



2600MS Modal Analysis Solution

## Precision Pulse Generators for Digital Device Characterization

- Up to 600 MHz Repetition Rate
- Fully Digital Implementation for Maximum Control and Flexibility
- Multi-channel Architecture—2 to 6 channels per Mainframe
- Independent Edge Placement and Channel Deskw
- Precision Channel-to-Channel Time Alignment
- 10 ps Timing Resolution
- 1 GHz Transducer Mode
- Phase Lock to External Clock
- Graphic, Intuitive Human Interface
- GPIB (IEEE-488) Programmable
- Characterize CMOS, ECL, ACL, BiCMOS, and GaAs Devices
- Modular Construction allows Future Upgrade Capability

## HFS 9000 SERIES PRECISION PULSE GENERATORS

The HFS 9000 Series is a family of high-speed pulse-signal sources characterized by performance, ease of use, and flexibility. The family consists of three fully programmable precision pulse generators for use in characterizing high-speed CMOS, BiCMOS, ECL, and GaAs digital and telecommunications devices.

The HFS 9000 Series, together with a high-speed sampling oscilloscope such as an 11801A, provides a complete digital/telecommunications device characterization and test solution with unsurpassed accuracy and repeatability.

**Digital Architecture** – The HFS 9000 Series products were designed as completely programmable digital instruments rather than being based on a traditional monostable-based analog architecture. This allows more capability and flexibility in pulse placement – without the restrictions that analog instruments commonly impose.

**Multi-channel Stimulus** – The HFS 9000 Series extends its flexibility with a multi-channel, modular construction. The mainframes can support from 2 to 6 output channels. All channels are slaved to a common clock resulting in highly accurate channel-to-channel edge placement. No other programmable pulse generator offers this degree of edge placement accuracy. The multi-channel capability makes the HFS 9000 ideal for the precise characterization and evaluation of synchronous devices having multiple, and possibly interactive, inputs.

**600 MHz Repetition Rate** – Obtaining accurate and repeatable ac measurements such as propagation delay, setup and hold time, and toggle frequency, requires fast repetition rates and edge speeds. With repetition rates up to 600 MHz, the HFS 9000 Series provides the fastest pulse generators available and is ideal for characterizing the most advanced logic families. Transition times as fast as 200 ps (20% to 80%) enable repeatable and accurate testing of the highest-speed ECL and GaAs digital devices. Variable transition time control from 1 ns to 5 ns is also available with the appropriate output levels for testing Advanced CMOS, BiCMOS and TTL logic families.

**1 GHz Transducer Mode** – When repetition rates of greater than 600 MHz are needed to test faster components, the 1 GHz Transducer Mode can be used. This function allows an external sine wave input to be converted to a square wave with 200 ps transition times and programmable levels. Transducer mode is especially useful to create a fast, programmable clock source for testing GaAs components.

**Graphic Display** – A crisp display screen can show all the major pulse parameters at a glance on a channel by channel basis. In addition, a graphic representation of the pulse waveforms provides a clear picture of the multi-channel timing relationships. The menu-driven human interface makes the HFS 9000 products easy to learn as well as helpful in reducing set-up confusion and errors.

**Fully Programmable** – The HFS 9000 offers full implementation of the new IEEE-488.2 standard and utilizes Tek Codes & Formats. Programmability is important in developing automated, repeatable tests in R&D, incoming inspection, and production of high-speed components. The instrument can be controlled over GPIB or RS-232 ports. Coupled with a high-speed acquisition system, such as the 11801A Digital Sampling Oscilloscope, a fully automated test system can be developed with unequalled accuracy and repeatability.

**Configuration Options** – The HFS 9000 Series of pulse generators are available in 2-, 4-, or 6-channel systems. Extra channels are also field installable to meet growing speed and channel-count requirements. The HFS 9010 is targeted at ECL and GaAs components, while the HFS 9020 is ideal for Advanced CMOS, BiCMOS, and TTL. The HFS 9030 combines channels of each type in a single mainframe.

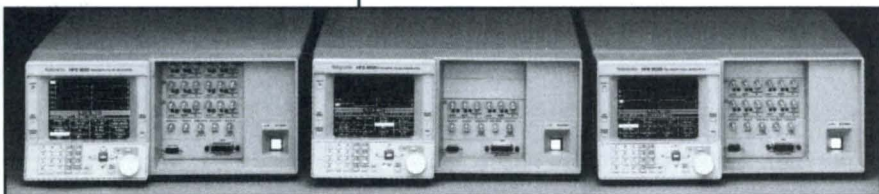
### HFS 9010

The HFS 9010 is a four-channel, 600 MHz pulse generator for use in characterizing ECL and GaAs devices. A phase-lock input allows synchronization of the HFS 9010 with other test equipment. Two- and six-channel configurations are available to tailor a solution to your specific needs.

**Applications** – The HFS 9010 is ideal for providing the stimulus in ECL and GaAs digital/telecommunications device characterization. The fast <200 ps transition time, 600 MHz repetition rate, four-channel independent

**Full Channel Deskw Capability** – All HFS 9000 channels have independent, wide deskw ranges to allow precise pulse alignment and timing at the Device Under Test. Deskw compensates for the timing differences caused by cabling and fixturing so your analysis can be concentrated on the relative timing at the DUT. There will be no unpleasant surprises when channel output timing restrictions prevent you from making the signal timing relationships at the DUT you need.

**10 ps Timing Resolution** – The 10 ps timing resolution, an order of magnitude greater than typical ECL gate delays, results in accurate and repeatable ac measurements. The multi-channel capability allows, in one setup, a complete suite of setup and hold time margin tests by providing the clock, data, set and reset signals to the device under test. Inactive signals can be held at a programmable high or low logic level, eliminating the need for external dc voltage sources and microwave switches.



edge placement (expandable up to six channels), single-ended or differential outputs make this the most powerful and flexible pulse generator on the market. With the HFS 9010 you can characterize gate delays, setup and hold times, and other device parameters of basic components, ASICS, and high-speed memory devices.

Using Transducer Mode, high-speed clocks of up to 1 GHz can be generated by using a sine wave generator as an input. The HFS 9010 transforms this sine wave into a digital pulse train ideal for testing the fastest digital components.

Using Phase-Lock Mode, the HFS 9010 can be configured with a slower test system to provide synchronized clock and data signals at any 2<sup>n</sup> multiple (or sub-multiple) of the tester clock rate. You can test faster devices without having to upgrade the performance of your entire test system.

### HFS 9020

The HFS 9020 is a 4-channel, 300 MHz precision pulse generator for use in characterizing HCMOS, ACL, BiCMOS, and other digital devices. The HFS 9020 features a 5.5 V output swing, 1 ns to 5 ns rise and fall times, and all the other features of the HFS 9010. With its large output swing and variable slew rate, the HFS 9020 can also be used for characterizing some high-frequency analog components.

**Applications** – The HFS 9020 is intended for characterization of logic and telecommunication devices with rise times of 1 ns and slower. Like the HFS 9010, this product is ideal for testing and characterizing gate delays, setup and hold times, and other device parameters.

### HFS 9030

The HFS 9030 combines two channels of the HFS 9010 with two channels of the HFS 9020 into a single 4-channel instrument. This results in a single stimulus product capable of testing a broad range of components or systems with mixed logic families. An option allows two additional channels of either type making a versatile, 6-channel product with all the precision edge placement capability of either the HFS 9010 or HFS 9020. No other product on the market provides this level of performance and configurability.

## CHANNEL CHARACTERISTICS

### HFS 9010 – HIGH SPEED

**Channels** – 4 channels, differential outputs. Add or delete options for two- and six-channel configurations. Independent levels, edge placement, and deskew on all channels.

**Signal Levels** – 3 V p-p with 10 mV Resolution.

**Transition Times** – ≤ 200 ps (20% to 80%, ≤ 1 Vp-p).

**Frequency Range** – 50 kHz to 600 MHz.

**Channel Outputs** – Active high, active low, static high, static low, or half pulse rate.

**Transducer Mode** – Up to 1 GHz square-wave output from a sine-wave input.

### HFS 9020 – VARIABLE RATE

**Channels** – 4 channels, differential outputs. Add or

delete options for two- and six-channel configurations. Independent levels, edge placement, and deskew on all channels.

**Signal Levels** – 5.5 V p-p with 10 mV Resolution.

**Transition Times** – Adjustable from 1 ns to 5 ns.

**Frequency Range** – 50 kHz to 300 MHz.

**Channel Outputs** – Active high, active low, static high, static low, or half pulse rate.

**Transducer Mode** – Up to 300 MHz square-wave output from a sine-wave input.

### HFS 9030 – COMBINATION

The HFS 9030 consists of two high-speed and two variable-rate channels. Add Option for two additional channels of either type is available.

## TIMING CHARACTERISTICS

**Timebase** – 1% accuracy, 10 ps resolution on all edge placements.

**Channel Deskew** – By default, channels are time aligned at the front panel. Independent deskew range from –60 ns to +2 μs on each channel allows precise deskew at the device under test.

**Pulse Delay** – Adjustable from 0 to 1 period with accuracy of ±300 ps ±1% of delay setting.

**Pulse Width** – adjustable from 0 to (1 period - 800 ps) with accuracy of ±300 ps ±1% of width setting.

**RMS Jitter** – 5 ps ±0.05% of interval, typical.

**Phase Lock Input** – Allows precise synchronization to an external frequency reference between 6 MHz and 600 MHz. Pulse output frequency can be any 2<sup>n</sup> harmonic or sub-harmonic of the external frequency.

## TRIGGER CHARACTERISTICS

**Auto Mode** – A free-running continuous sequence of output pulses.

**Burst Mode** – A triggered string of 1 to 65,536 pulses.

**Auto-Burst Mode** – A free-running sequence of Bursts.

**Trigger Sources** – Trigger Input connector, front panel button, or ASCII command over GPIB.

**Trigger Input** – Positive or Negative Slope, ±5 V Range, 500 mV Sensitivity, requires a 1 ns minimum input pulse width.

**Trigger Output** – Precisely timed relative to the channel outputs, provides 0 to 70 ns or Pre-trigger. Standard ECL levels into 50 Ω to ground.

## POWER REQUIREMENTS

**Line Voltage** – 90 V to 130 V and 180 V to 250 V, rms.; switches automatically. 48 Hz to 63 Hz.

**Maximum Power Consumption** – 540 watts.

## ENVIRONMENTAL AND SAFETY

**Temperature** – Operating 0°C to +50°C, non-operating –40°C to +75°C.

**Humidity** – Up to 95% RH at up to 50°C.

**Safety** – Listed UL1244; CSA Bulletin 556B, September 1973; Tektronix self-certification to comply with IEC 348 recommendations.

## ORDERING INFORMATION

**HFS 9010** 4-Channel, 600 MHz Precision Pulse Generator **\$37,495**

**HFS 9020** 4-Channel, 300 MHz Precision Pulse Generator **\$33,995**

**HFS 9030** Precision Pulse Generator, two 600 MHz channels and two 300 MHz channels **\$35,995**

Products above include: User Reference Manual, Service Reference Manual, Power Cord, RS-232 Pigtail, SMA-BNC Adapter, Zip-lock Pouch, two replacement fuses, and one 50 Ω SMA Coaxial Cable

### INSTRUMENT OPTIONS

**HFS 9010:**

**Opt. 2A** – Delete 2 channels **–\$13,800**

**Opt. 2B** – Add 2 channels **+\$12,000**

**Opt. 1R** – Rackmount **+\$275**

**HFS 9020:**

**Opt. 2A** – Delete 2 channels **–\$13,500**

**Opt. 2C** – Add 2 channels **+\$13,000**

**Opt. 1R** – Rackmount **+\$275**

**HFS 9030:**

**Opt. 2B** – Add 2 600 MHz channels **+\$12,500**

**Opt. 2C** – Add 2 300 MHz channels **+\$12,500**

**Opt. 1R** – Rackmount **+\$275**

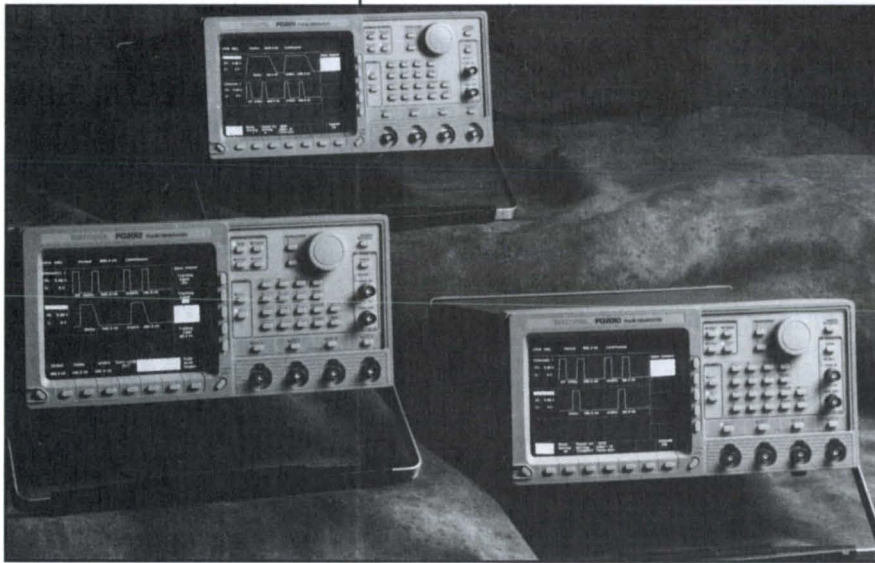
### FIELD INSTALLABLE UPGRADES

**HFS9F01** Add two 600 MHz High-speed channels **\$16,995**

**HFS9F02** Add two 300 MHz Variable-Rate channels **\$13,995**

### PHYSICAL CHARACTERISTICS

Dimensions	Cabinet		Rackmount	
	mm.	in.	mm.	in.
Width	414	16.3	483	19.0
Height	178	7.0	178	7.0
Depth	629	24.75	629	24.75
Weights	kg	lb	kg	lb
	Net	20.5 45	23.2 51	
Shipping	27.3	60	30.0	66



PG2010, PG2011 and PG2012 Pulse Generators

- New User Interface with Output Waveforms and Parameters on the Display
- Selectable 250 ps, 800 ps or 1.8 ns with 2.5 V Output into 50  $\Omega$
- Variable 5.5 ns to 10 ms Transition Time with 10 V Output into 50  $\Omega$
- 50 MHz Repetition Rate
- 1% Period Accuracy
- Dual Channel Capability

### PG2010, PG011, PG2012

The PG2010 family provides three new, fully programmable pulse generators designed for precision high performance applications in automatic test or on the bench. The products meet the needs of a wide range of applications from analog to high-speed logic or mixed technologies.

Operation, especially for oscilloscope or logic analyzer users, is made easy with a convenient CRT display utilizing a menu-driven user interface. A waveform is displayed on the CRT for each pulse generator output channel.

Members of the family provide a 50 MHz repetition rate, 1-2% accuracy depending on the parameter, 20 V output from the variable transition time units with transition times as fast as 250 ps from the selected transition products.

Each pulse generator is specified to operate over 0°C to 50°C, useful for ATE systems. The same higher accuracy specification typically limited to the 20°C to 30°C by others is covered the full temperature range in the PG2010 family.

One or two channel operation is possible. The PG2010 and PG2011 are single-channel instruments. Dual-channel products are available in the PG2010 Opt 2, PG2011 Opt 2 and PG2012. All are designed as parameter independent, synchronous outputs. Their delay capability will allow phase shifted signals.

The PG2010 and channel 1 of the PG2012 provide selection of 250 ps, 800 ps and 1.8 ns rise and fall

transition times. Fast 200 ps transitions are guaranteed for output voltages up to 1.25 V in the 250 ps mode. Each selectable fast channel provides simultaneous normal and complement outputs.

Variable transition outputs from 5.5 ns to 10 ms are available in the PG2011 and channel 2 of the PG2012.

### SPECIFICATIONS

Specifications describe the pulse generators warranted performance after a 20 minute warmup, into 50  $\Omega$  load. To maintain warranted specifications, the enhanced accuracy must be on and Internal Cal performed with  $\pm 5^\circ\text{C}$  of the current ambient operating temperature. The ambient specification covers the range of 0°C to 50°C.

### COMMON SPECIFICATIONS

(Timing with minimum transitions)

#### PERIOD

**Range** – 20 ns to 10 s.

**Accuracy** –  $\pm 1\%$  of setting  $\pm 1$  ns.

**Maximum Jitter** –  $< 0.05\%$  of setting + 30 ps rms.

#### DELAY, DOUBLE PULSE, WIDTH

**Delay Range** – 0.0 ns – 9.89990 s.

**Width Range** – 10.0 ns – 9.90000 s.

**Accuracy** –  $\pm 2\%$  of setting  $\pm 2$  ns.

**Maximum Jitter** –  $\leq 0.05\%$  of setting + 30 ps rms.

#### TRIGGER/GATE INPUT

**Sensitivity** – 150 mV p-p min., dc to 50 MHz.

**Min. Pulse Width** – 10 ns.

**Threshold** – Range:  $\pm 9.99$  V

Resolution: 3 digit (10 mV)

Accuracy:  $\pm 5\%$  of setting  $\pm 25$  mV

Slope: Positive (+) or Negative (-)

Counted burst: 2 to 999,999 cycles per burst

#### INTERNAL TRIGGER

**Resolution** – Up to 4 digits, limited to 100 ns.

**Repetition Rate** – 100 ns – 99.995 ns

**Accuracy** –  $\pm 0.01\% \pm 1$  ns.

**Jitter** –  $\leq 0.05$  of setting + 30 ps rms.

#### GENERAL

**Power** – 150 watts.

**Temperature** – Operating: 0°C to + 50°C;

Storage: -20°C to + 60°C.

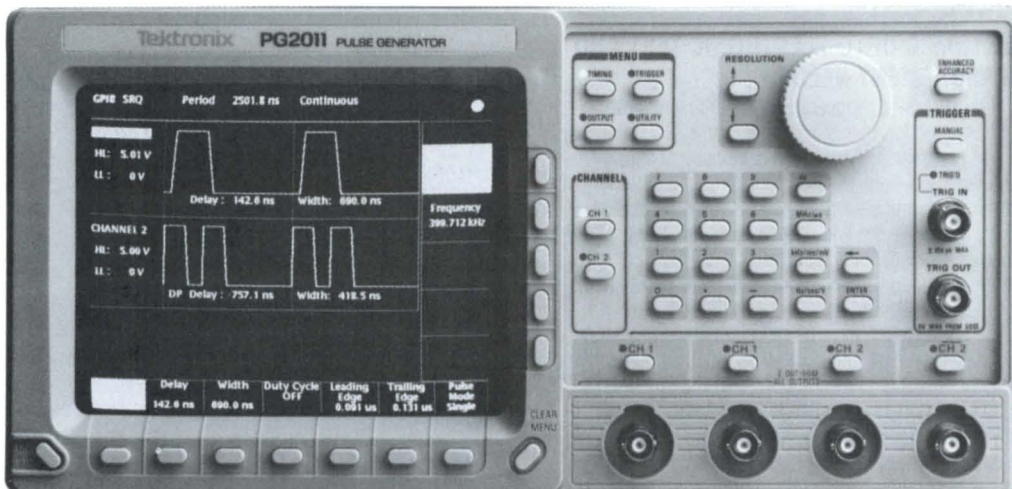
**Source Impedance** – 50  $\Omega$ .

PRODUCT SPECIFIC SPECIFICATIONS

Output Characteristics (into 50 Ω) <sup>1</sup>	PG2010	PG2011	PG2012
<b>Output Levels</b>			
High Level Range	-1.2 V to +2.5 V	-9.5 V to +10.0 V	CH 1 same as PG2010
Low Level Range	-2.5 V to +1.9 V	-10.0 V to +9.5 V	CH 2 same as PG2011
Amplitude	0.6 V min, 2.5 V max	0.5 V min, 10 V max	CH 1: 0.6 V min, 2.5 V max CH 2: 0.5 V min, 10 V max
Level Accuracy	±1% of level setting ±2% p-p amplitude	±1% of level setting ±2% p-p amplitude	±1% of level setting ±2% p-p amplitude
<b>Transition Times<sup>1</sup></b>			
Leading edge (CH 1)	Selectable 250 ps, 800 ps, 1.8 ns	Variable 5.5 ns to 10 ms <sup>2</sup>	Selectable 250 ps, 800 ps, 1.8 ns
(CH 2)	Selectable 250 ps, 800 ps, 1.8 ns	Variable 5.5 ns to 10 ms <sup>2</sup>	Variable 5.5 ns, to 10 ms <sup>2</sup>
Trailing edge (CH 1)	Same as leading edge	Variable 5.5 ns to 10 ms <sup>2</sup>	Same as leading edge
(CH 2)	Same as leading edge	Variable 5.5 ns to 10 ms <sup>2</sup>	Variable 5.5 ns to 10 ms <sup>2</sup>
<b>Preshoot, Overshoot, Ringing</b>	≤150 mV for amplitude of ≤1.25 V ≤10% of amplitude for amplitude >1.25 V	≤5%, +50 mV for pulse levels between ±5 V	CH 1 same as PG2010 CH 2 same as PG2011

<sup>1</sup> The 250 ps transition edge is specified from 20 to 80% of the pulse amplitude. All others are specified from 10 to 90%.

<sup>2</sup> Leading and trailing edge can be set independently.



The new PG2010 family has representative waveform display, important pulse parameters, and softkey menus all on the crt.

ORDERING INFORMATION

**PG2010** Single Channel Programmable Pulse Generator with selectable 250 ps, 800 ps and 1.8 ns transition times. **\$8,450**

**PG2011** Single Channel Programmable Pulse Generator with variable 5.5 ns to 10 ms transition times **\$6,950**

**PG2012** Dual Channel Programmable Pulse Generator with CH 1 like the PG2010 and CH 2 like the PG2011. **\$11,350**

INSTRUMENT OPTIONS

**PG2010** –  
**Opt. 2** – a second PG2010 channel **+\$4,450**

**Opt. 1R** – Rackmount **+\$350**

**Opt. B1** – Service Manual **+\$55**

**Opt. M7** – +2 yrs calibration **+\$300**

**Opt. M9** – +2 yrs service **+\$480**

**PG2011** –  
**Opt. 2** – a second PG2011 channel **+\$2,850**

**Opt. 1R** – Rackmount **+\$350**

**Opt. B1** – Service Manual **+\$55**

**Opt. M7** – +2 yrs calibration **+\$230**

**Opt. M9** – +2 yrs service **+\$370**

**PG2012** –  
**Opt. 1R** – Rackmount **+\$350**

**Opt. B1** – Service Manual **+\$55**

**Opt. M7** – +2 yrs calibration **+\$310**

**Opt. M9** – +2 yrs service **+\$490**

OPTIONAL ACCESSORIES

Front panel protective cover  
Order 200-3232-00 **\$10**

INTERNATIONAL POWER PLUG  
OPTIONS

**Opt. A1-A5** – Available **NC**  
See page 374 for descriptions.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width	344	13.5
Height	166	6.5
Depth	489	18.9
Weight	kg	lb
Net	8.5	19.0

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### SUMMARY OF TEK OPTO-ELECTRONIC PRODUCTS

- **Products that Extend Electronic Test and Measurement Tools into the Optical Realm**
  - Optical Front Ends for Tektronix Instruments
  - Stand-Alone Optical Front Ends
- **Stand-Alone Optical Test and Measurement Instruments**

## SOLUTIONS OFFERED

Tektronix opto-electronic product offerings fall into two categories. The first contains instruments extending electronic test and measurement tools into the optical realm. 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 includes 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.

## 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 P6711 and P6701A Optical to Electrical Converter Probes are 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 research, design and development, as well as manufacture of opto-electronic systems, modules, components, and service. 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.

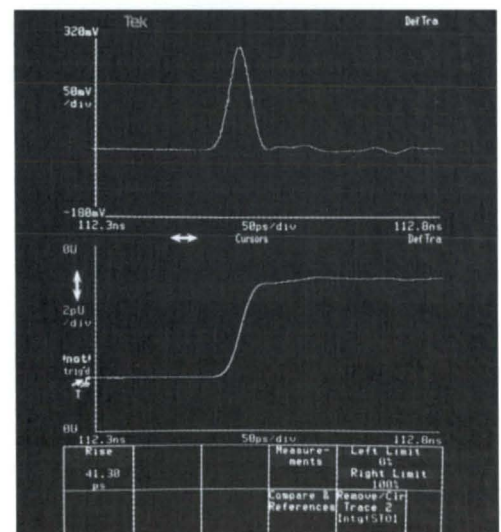
For example, the SD-42 Optical to Electrical Converter Head coupled with a Tektronix 11800 Series oscilloscope is an excellent choice for measuring the characteristics of long wavelength laser transmitters such as those found in the SONET based communication systems. If an even faster response is needed, the 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 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 aberrations
- Minimum, maximum, mean, and peak power levels
- Extinction ratios

This combination is made even more powerful when used in conjunction with Tektronix CSA 803 and the new CSA 404. These instruments provide a powerful optical waveform analysis capability for such applications as FDDI specification template testing and time domain eye pattern analysis on digital communications links. Only Tektronix offers such a powerful set of time domain waveform measurement solutions.

With the addition of the OIG501/OIG502 Optical Impulse Generators and the OCP5002/OCP5502 Optical Converter/Power Meters, fiber and fiber component analysis becomes very easy. For example, optical reflections, which can have a pronounced adverse effect on link performance, can be easily analyzed down to -50 dB with high distance resolution.



**High-Speed Optical Impulse and Calculated Optical Step Response**



### PRODUCT DESCRIPTION

The Tektronix P6701A/P6703A/P6711/P6713 are optical probes that allow the user to receive optical signals and convert them to electrical signals for convenient analysis on Tektronix oscilloscopes equipped with the TEKPROBE™ Interface or any other oscilloscope when used in conjunction with the Tektronix 1103 TEKPROBE™ Interface Power Supply.

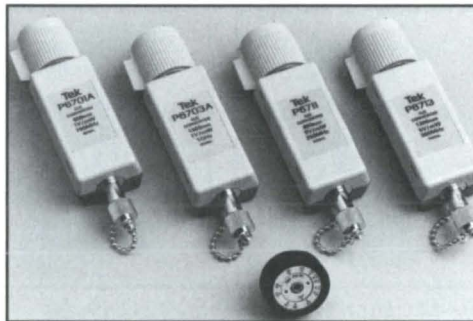
Use of the 11000 Series oscilloscope's TEKPROBE™ Interface allows the oscilloscope to supply power to the P6700 Series probes, automatically determine and display the proper scale factor (in microwatts of optical power) and set the input termination to the required 50 Ω. An oscilloscope-controlled calibrated offset of 0 to 1 mW is also available through this interface.

The P6700 Series provides a calibrated means of analog analysis of optical signals in the wavelength range 450 to 1050 nm (P6701A/P6711) and 1100 to 1700 nm (P6703A/P6713). Thus the functions of an optical power meter and the high-speed analog waveform analysis capability of an oscilloscope are combined in one instrument. The user has the capability of acquiring, displaying and analyzing mixed analog and digital, optical and electrical signals simultaneously.

The P6701A and P6703A have an added dc stable circuit from decreased offset drift ( $\leq 1 \mu\text{W}$ ). This improves the performance for extinction ratio measurements and absolute optical power levels. The P6711 and P6713 have increased gain and lower noise, thus have improved the sensitivity of the converters and are excellent choices for LED measurements.

The P6721 is an optical to electrical converter for plastic fiber. For the laser disk service, automotive optical communication and others, the P6721 is a link to the test and measurement tools. The P6721 uses Tektronix probe power or the 1101A Power Supply.

The P6751 Spatial Input Head is a tunable lens system for sampling optical energy from any collimated source and delivering it via a fiber optic cable to the P6700



P6701A, P6703A, P6711, P6713 and P6751

Series Optical to Electrical Converter. The P6751 is easily mounted using standard optical bench fixtures. This spatial input head can be adjusted (500 to 1500 nm) by the user to optimize the amount of optical energy delivered to the P6700 Series. The P6751 has a standard SMA fiber optic cable connector. Also available are a series of fiber optic jumper cables for interfacing the P6700 Series and P6751 with other industry standard optical fiber connectors.

### TYPICAL APPLICATIONS

Applications range from measuring the transient optical properties of lasers, LEDs, electro-optic modulators, flashlamps, etc., to the development, manufacturing, and maintenance of fiber optic control networks, local area networks (LANs), fiber based systems based on the FDDI and SONET standard, optical disk devices, and high-speed fiber optic communications systems. As an example, eight probes of the P6700 Series type coupled with two 11A34 Amplifier Plug-ins and an 11000 Series oscilloscope can be configured as an 8-channel optical oscilloscope.

### NEW P6701A

- 450 to 1050 nm, DC to 700 MHz, Si PIN

### NEW P6703A

- 1000 to 1700 nm, DC to 1 GHz, InGaAs PIN

### NEW P6711

- 450 to 1050 nm, DC to 250 MHz, High Gain, Si PIN

### NEW P6713

- 1100 to 1700 nm, DC to 300 MHz, High Gain, InGaAs PIN

### NEW P6721

- 450 to 1050 nm, DC to 50 MHz, Large Area Detector (3 mm), Si PIN

### P6751

#### Spatial Input Head

- 500 to 1500 nm
- Tuneable

### CHARACTERISTICS

	P6701A	P6703A	P6711	P6713	P6721
Wavelength Response	450 to 1050 nm	1100 to 1700 nm	450 to 1050 nm	1100 to 1700 nm	450 to 1050 nm
Bandwidth	dc to 700 MHz	dc to 1 GHz	dc to 250 MHz	dc to 300 MHz	dc to 50 MHz
Rise time	$\leq 700$ ps	$\leq 500$ ps	$\leq 2$ ns	$\leq 1.6$ ns	$\leq 10$ ns
Conversion Gain	1 V/mW at 850 nm	1 V/mW at 1300 nm	5 V/mW at 850 nm	5 V/mW at 1300 nm	10V/mW at 660 nm
Max Input Optical Power	2 mW	2 mW	400 $\mu\text{W}$	400 $\mu\text{W}$	0.3 mW
Noise Equivalent Power	$\leq 1 \mu\text{W}$ (rms)	$\leq 1 \mu\text{W}$ (rms)	$\leq 250$ nW(rms)	$\leq 200$ nW (rms)	$\leq 200$ nW(rms)

### ORDERING INFORMATION

**P6701A** Optical-to-Electrical Converter  
Includes: Standard SMA input connector, carrying case (016-0156-03), and Instruction Manual (070-7496-00).

**Opt. 01** – FC input connector

**Opt. 02** – ST input connector

**Opt. 03** – DIN 47256 input connector

**P6703A** Optical-to-Electrical Converter  
Includes: Standard SMA input connector, carrying case (016-0156-03), and Instruction Manual (070-7496-00).

**Opt. 01** – FC input connector

**Opt. 02** – ST input connector

**Opt. 03** – DIN 47256 connector

**P6711** Optical-to-Electrical Converter  
Includes: Standard SMA input connector, carrying case (016-0156-03), and Instruction Manual (070-7496-00).

**Opt. 01** – FC input connector

**Opt. 02** – ST input connector

**Opt. 03** – DIN 47256 connector

**P6713** Optical-to-Electrical Converter  
Includes: Standard SMA input connector, carrying case (016-0156-03), and Instruction Manual (070-7496-00).

**Opt. 01** – FC input connector

**Opt. 02** – ST input connector

**Opt. 03** – DIN 47256 connector

**P6721** Optical to Electrical Converter  
Includes: Standard TOSLINK® Connector, and Instruction Manual (070-7842-00)

**P6751** Spatial Input Head

Includes: Adjustment tool and instruction sheet.

\$445

#### OPTIONAL ACCESSORIES

Multimode Jumpers 100/140 micron (See Page 289)

\*1 Contact your local sales office.

**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

**SD-46**

**Optical to Electrical Converter**

- 22 ps Optical Pulse Response (FWHM)
- DC - 20 GHz Optical Bandwidth
- 1200 nm - 1650 nm Spectral Response
- Mean Optical Power Monitor Function

**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

**ORDERING INFORMATION**

<b>SD-42</b> Optical to Electrical Converter	<b>\$3,845</b>
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).	
<b>SD-46</b> Optical to Electrical Converter	<b>\$8,925</b>
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).	
<b>SA-42</b> Optical to Electrical Converter	<b>\$3,845</b>
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).	



*SD-42 Optical to Electrical Converter*



*SD-46 Optical to Electrical Converter*



*SA-42 Optical to Electrical Converter*

**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.

**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 60 μW/div to 6 mW/div at 1300 nm. This unit has a 28.5 ps optical pulse response (max. FWHM) with the SD-24 and SD-26 Sampling Heads.

**SA-42**

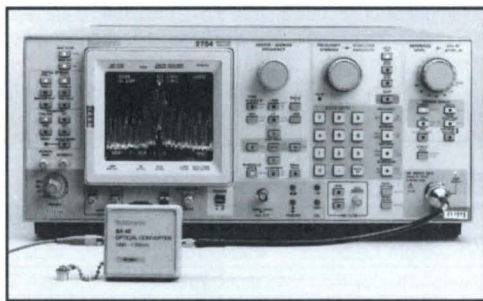
The SA-42 is a stand alone optical to electrical converter for general purpose, high frequency use. It is principally for use with the Tektronix spectrum analyzers. The optical to electrical conversion is linear up to 25 mW peak input with a calibrated conversion gain of 25 μW/mV at 1300 nm.

The SD-42 and the SD-46 Optical to Electrical Converters can be plugged into the sampling unit or attached by a sampling head extender for remote use. The head extenders come in either 1 meter (012-1220-00) or 2 meter (012-1221-00) options. Refer to next page for SD-42 and SD-46 head extenders.

Optical signal input on the SD-42, SD-46 and SA-42 are through a standard FC fiber optic connector. Other connector types can be accommodated by using fiber optic jumper cables. The SD-42 and the SD-46 also have a mean power meter function with selectable 1 V/nW and 1 V/μW ranges.

**TYPICAL APPLICATIONS**

Characterization of opto-electronic devices such as laser diodes, light emitting diodes, optical waveguides, optical detectors and electro-optic modulators is becoming more important as applications for fiber optics in telecommunications and data communications expand. The SD-42 and the SA-42 Optical to Electrical Converters offer dc to 7 GHz bandwidth performance for wavelengths from 1000 nm to 1700 nm. The SD-46 Optical to Electrical Converter gives researchers optical waveform measurement capability from dc to 20 GHz in the 1200 nm to 1650 nm wavelength range. Measurements such as risetime, aberration, optical power vs drive current and voltage, modulation bandwidth, and sensitivity can now be made at high bandwidth, accurately and easily.



*SA-42 Optical to Electrical Converter with Tektronix 2754 Spectrum Analyzer*

## CHARACTERISTICS

### PULSE CHARACTERISTICS

	<b>SD-42</b>	<b>SD-46</b>	<b>SA-42</b>
Pulse Response	55 ps Max. (FWHM)	22 ps(FWHM)* <sup>1</sup>	50 ps Max (FWHM)
Bandwidth	dc-6.4 GHz Optical	dc-20.0 GHz Optical	dc-7.0 GHz Optical
Spectral Response	1000 to 1700 nm	1200 to 1650 nm	1000 to 1700 nm
Noise Equivalent Power	≤23 pW/rtHz* <sup>2</sup> ≤33 μW* <sup>3</sup> ≤10 μW* <sup>4</sup>	≤27 pW/rtHz* <sup>2</sup> ≤45 μW* <sup>3</sup> ≤16 μW* <sup>4</sup>	23pW/rtHz* <sup>2</sup>
Linear Response Range	≤25 mW Peak Power ≤5 mW Average Power	≤25 mW Peak Power ≤5 mW Average Power	≤25 mW Peak Power ≤5 mW Average Power
Aberrations	≤15% p-p* <sup>5</sup>	≤10% p-p* <sup>5</sup>	≤15% p-p* <sup>5</sup>

\*<sup>1</sup>Calculated (.44/Optical Bandwidth)

\*<sup>2</sup>Root Hertz Into 50 Ω

\*<sup>3</sup>System specification with SD-24/SD-26

\*<sup>4</sup>System specification with SD-22

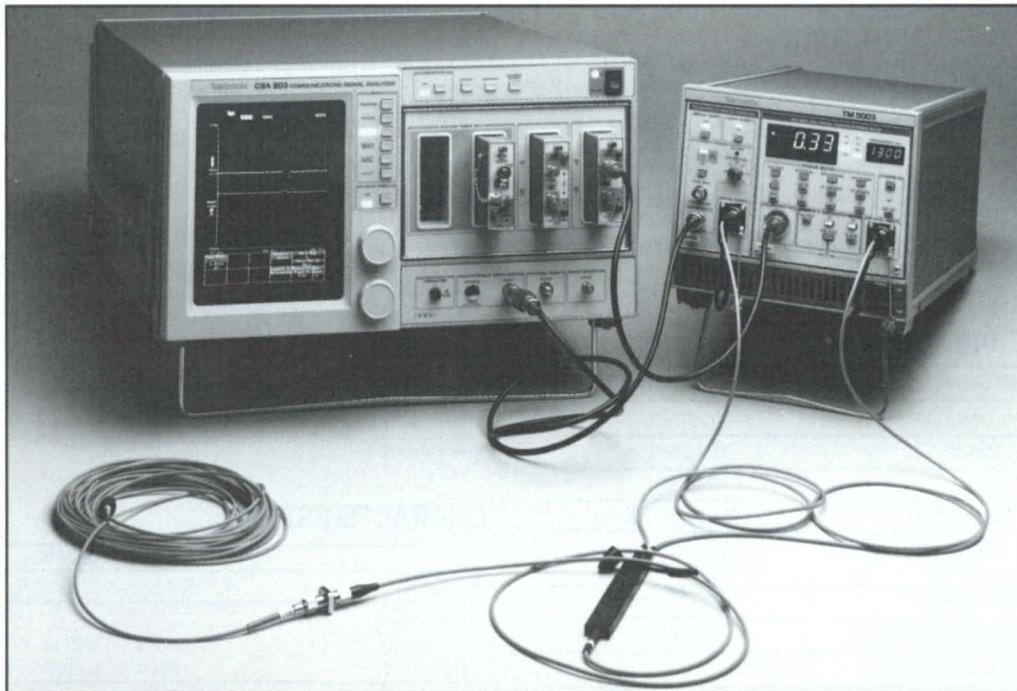
\*<sup>5</sup>Within the first 400 ps following a pulse input

### POWER METER

	<b>SD-42</b>	<b>SD-46</b>	<b>SA-42</b>
Dynamic Range	5 nW to 5 mW (60 dB)	5 nW to 5 mW (60 dB)	NA
Sensitivity			NA
Range 1	1 V/mW ±10%	1 V/mW ±10%	
Range 2	1 V/μW ±10%	1 V/μW ±10%	

### ENVIRONMENTAL

**Operating Temperature Range** - 0°C to 50°C.



High Resolution Optical Reflection Measurement using OIG502, OCP5002 and the CSA 803

### ORDERING INFORMATION

#### OPTIONAL ACCESSORIES

<b>Fiber Optic Cables</b> - 2 meter, 8/125 μm, single mode. (FC to Diamond 3.5)	
Order 174-1385-00 (FC to Diamond 2.5)	<b>\$550</b>
Order 174-1497-00 (FC to ST)	<b>\$525</b>
Order 174-1386-00 (FC to FC)	<b>\$700</b>
Order 174-1387-00 (FC to Biconic)	<b>\$400</b>
Order 174-1388-00	<b>\$500</b>

#### Multimode

<b>Fiber Optic Cables</b> - 2 meter, 62.5/125 μm, multimode. (FC/PC to Biconic)	
Order 174-2323-00 (FC/PC to FC/PC)	<b>\$250</b>
Order 174-2322-00 (FC/PC to SMA 906)	<b>\$175</b>
Order 174-2324-00	<b>\$175</b>

<b>Fiber Optic Cables</b> - 2 meter, 100/140 micron (SMA to SMA)	
Order 174-0879-00 (SMA to Diamond 3.5)	<b>\$300</b>
Order 174-0877-00 (SMA to FC)	<b>\$350</b>
Order 174-0878-00 (SMA to Biconic)	<b>\$315</b>
Order 174-0880-00 (SMA to ST)	<b>\$260</b>
Order 174-0876-00 to Diamond 2.5)	<b>\$260</b>
Order 174-1303-00	<b>\$300</b>

<b>Sampling Head Extender Cables</b> - (1 m) Order 012-1220-00 (SD-42 and SD-46)	<b>\$645</b>
(2 m) Order 012-1221-00 (SD-42 and SD-46)	<b>\$735</b>
<b>10 kHz to 21 GHz DC Block, "N" Type</b> - Order 015-0509-00	<b>\$345</b>

#### INTERNATIONAL POWER PLUG OPTIONS (SA-42 ONLY)

<b>Opt. A1</b> - Universal Euro 220 V, 50 Hz. (161-0104-06)	<b>NC</b>
<b>Opt. A2</b> - United Kingdom 240 V, 50 Hz. (161-0104-07)	<b>NC</b>
<b>Opt. A3</b> - Australian 240 V, 50 Hz. (161-0104-05)	<b>NC</b>
<b>Opt. A4</b> - North American 240 V, 60 Hz. (161-0104-08)	<b>NC</b>
<b>Opt. A5</b> - Switzerland 220 V, 50 Hz. (161-0167-00)	<b>NC</b>

# OCF 5002/OCF 5502 OIG 501/OIG 502

## OPTO-ELECTRONIC CONVERTERS/SOURCES

**OCF 5002**  
2 GHz Optical Converter/  
Power Meter 1100 to  
1650 nm, DC to 2 GHz

**OCF 5502**  
2 GHz Optical Converter/  
Power Meter 1100 to  
1650 nm, DC to 2 GHz

- 2 GHz Bandwidth
- Extinction Ratio Measurements
- Low DC Drift
- TEKPROBE™ Interface
- LED and Laser Characterization

**NEW OIG 501**  
Optical Impulse  
Generator 850 nm,  
35 ps Laser Impulse

**OIG 502**  
Optical Impulse  
Generator 1300 nm,  
35 ps Laser Impulse

- Calibration for High Speed Photodiodes
- Impulse Source for High Resolution Optical Time Domain Reflection
- Fiber Bandwidth/Dispersion

### ORDERING INFORMATION

**OCF 5002** 2 GHz Optical Converter/Power Meter  
Includes: Instruction manual (070-7817-00) **\$8,950**

**OCF 5502** 2 GHz Optical Converter/Power Meter  
Includes: Instruction manual (070-7817-00) **\$9,950**

**OIG 501** Optical Impulse Generator  
Includes: Instruction manual (070-7818-01) **11**

**OIG 502** Optical Impulse Generator  
Includes: Instruction manual (070-7818-01) **\$9750**

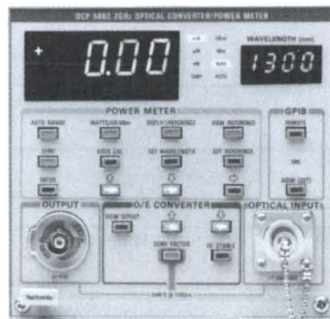
#### OPTIONAL ACCESSORIES

**Fiber Optic Cables** - (Refer to page 289 for complete list)  
**TEKPROBE™** Interface Cable (Order 012-1372-00) **\$300**

\*1 Contact your local sales office.

**GPIB\***  
IEEE-488

\*The OCF 5002 and OCF 5502 comply with IEEE Standard 488.2-1987 and Tektronix Standard Codes and Formats



### OCF 5002/OCF 5502

The OCF 5002 is an optical to electrical converter with an integral average reading optical power meter. It is a plug-in compatible GPIB controllable unit for the Tektronix TM 5000 Series power supplies. The OCF 5502 is a functionally equivalent instrument packaged as a stand-alone monolithic unit with integral power supplies. The OCF 5002 and the OCF 5502 operate over the 1100 nm to 1650 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 type of 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 CSA 803 and CSA 404, will give the user a fast response, high resolution communications measurement capability.

LED characterization, Laser characterization and other component measurements will be made simpler and more repeatable by using OCF 5000 Series instruments.

### CHARACTERISTICS

O/E Converter	OCF 5002/OCF 5502
Wavelength Response	1100 -1650 nm
Bandwidth	dc - 2 GHz
Risetime	260 ps
Conversion Gain	1 V/mW ± 8% at 1300 nm
Calibrated Offset	0 - 1 mW ± 1%
Max Input	2 mW offset at 1 mW
Optical Power	1 mW no offset
Noise Equivalent Power	<1 μW
<b>Power Meter</b>	
Dynamic Range	±7 dBm to -80 dBm
Accuracy*1	≤ 5% at 1300 nm

\*1 With FC/PC Connectors



### OIG 501/OIG 502

The OIG 501/OIG 502 Optical Impulse Generators are laser impulse sources that operate at 850 and 1300 nm respectively. The user may select either internal or external triggering. The trigger level can be adjusted from ±3 V. These units are 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 501/OIG 502 have two user selectable output pulse modes: high impulse energy or low impulse energy. In the high energy mode, the units provide an optical impulse >30 mW (OIG 502), ≥15 mW (OIG 502) with impulse widths ≤300 ps (FWHM). In the low energy mode, the units produce an optical impulse ≥15 mW (OIG 501), ≥5 mW (OIG 502) with pulse widths ≤35 ps (FWHM). The OIG 501/OIG 502 have a 60 ns pre-trigger for easy viewing of the impulses on a variety of oscilloscopes.

### TYPICAL APPLICATIONS

The OIG 501/OIG 502 are very useful in many applications. These include photodiode rise time testing, high resolution optical time domain reflectometry, and dispersion and bandwidth testing of optical fiber. The extremely fast pulse and the stabilized output provide performance in these areas never before achieved.

With pulses of ≤35 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 millimeter level resolution on OTDR measurements. This permits measurements of reflections in optical systems that were not obtainable before the OIG 501/OIG 502.

The stabilized output insures repeatable measurements for all the applications mentioned above. The tests were complicated and time consuming to insure stable levels on the test signals. Now, with the OIG 501/OIG 502, the stability is specified.

### CHARACTERISTICS

	OIG 501	OIG 502
Wavelength	850 nm <sup>2</sup>	1300 nm <sup>2</sup>
Impulse Width		
Low Energy -	≤ 35 ps	≤ 35 ps
High Energy -	≤ 300 ps	≤ 300 ps
Max Output Optical Power		
Low Energy -	≥10 mW	≥5 mW
High Energy -	≥25 mW	≥15 mW

<sup>2</sup> ± 20 nm

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.  
Toll free: 1-800-426-2200, Ext. 99.

## 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 seven 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.

Seven 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 Option 07 can be also used with a Tek MI 5010/50M30 Multifunction Interface 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 in x 20 in) for convenient mounting on a tripod or optical bench.

## J16-TV PACKAGE

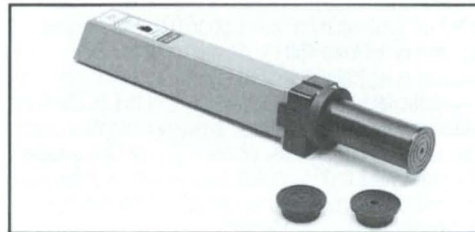
The J16-TV package is an excellent transfer mechanism which provides a simple, accurate method for adjustment of monitor screen color temperature. The primary colors are measured and adjusted to produce white color temperature balance.

The J16-TV with optional J6503 or J6523 probes measures monitor screen brightness on both color and black and white monitors. Other applications include measurement of studio lighting, camera lighting, and illumination of work areas.

The J16-TV package includes: J16 Battery-Operated Photometer, J6502-A Irradiance Probe, light occluder, probe extension cable, and battery charger. See Application Note 58A-2926-1 for additional information.



J6511 (shown), J6512-A (similar except no diffuser)



J6505 with LED adaptor and LED holders

## CHARACTERISTICS

### J16 MAINFRAME

**Display** – 3 1/2 digit LED readout and three LEDs automatically indicate correct units for probe in use. Metric version readout is also available (Option 02).

**Stability** –  $\leq 2\%$  per year.

**Linearity** –  $\leq 2\%$  over entire range (enables single point calibration).

**Integration Time** –  $\approx 100$  ms.

**Calibration** – Electrical calibration of the J16 mainframe is performed with a calibrated voltage source or DVM traceable to NIST. 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.

**Opt. 03 and Opt. 04** – AC only operation, no internal batteries.

### PHYSICAL CHARACTERISTICS

(With Probe and Battery Pack Installed)

Dimensions	mm	in.
Width	123	4.6
Height	60	2.4
Depth	203	8.0
<b>Weight</b> ≈	<b>kg</b>	<b>lb</b>
Net	1.5	3.3
Domestic Shipping	2.3	5.0
Export-packed	4.5	10.0

## FEATURES

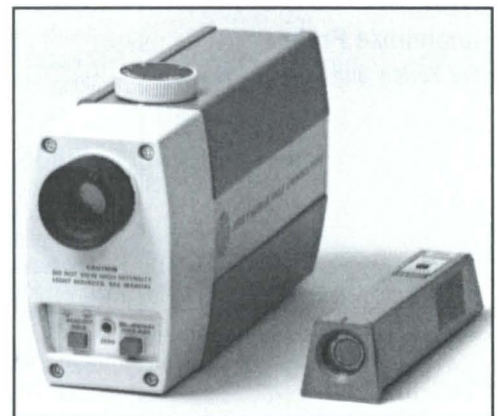
- Digital LED Readout
- Seven Silicon Sensor Probes Quickly Interchange Without Recalibration
- Accurate Spectral and Cosine Corrections
- Metric and US Versions Available
- AC or Internal Rechargeable Battery Versions
- Application Notes Available

## BENEFITS

- Easy to Read in Dark Areas
- Rugged but Accurate
- Adaptable to Many Light Measurement Needs
- Use Anywhere



J16 with optional probe.



J6523

J6501  
J6502-A  
J6503

**J6511****Illuminance Probe**

- Highway Illumination
- Luminaires 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
- Projection Screens
- Surface Reflectance

**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

**J6501 ILLUMINANCE PROBE**

Where cosine correction is unnecessary, the standard J6501 probe is available with the same photopic correction and units as the J6511. The J6501 can be used to measure green and yellow LEDs using the optional LED Adaptor (014-0047-00).

**J6502-A/J6512-A IRRADIANCE PROBE**

The J6502-A/J6512-A measure irradiance in microwatts/cm<sup>2</sup> (milliwatts/m<sup>2</sup> 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 2 mW<sup>2</sup>), neutral density filters can be used to extend the range of the J16. (An ND 1 filter has 10% transmission; ND 2 has 1%, etc.)

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  $\mu$  watts/cm<sup>2</sup> or milliwatts x 10<sup>-4</sup> instead of milliwatts/m<sup>2</sup> (Option 02).

The J6512-A has a low-profile detector head and six-foot cable.

**J6503 8° LUMINANCE PROBE**

The J6503 measures luminance in foot-lamberts (candelas/m<sup>2</sup> (nit) with Option 02) where light scattered or emitted by a surface must be measured. The probe is pointed at the emitting surface.

The probe's response is closely matched to the CIE photopic curve, ensuring accurate results even when measuring spectrally different light sources.

The acceptance angle is approximately 8 degrees, which is determined by internal field stop apertures. Providing that the 8 degrees field is uniformly filled, the probe can be held at any distance from the source. The 8 degree acceptance angle represents about a 1.7 inch diameter measurement field at one foot and is proportionately larger at greater distances. The footlambert or candelas/m<sup>2</sup> (nit) (Option 02) indicator automatically lights when the J6503 is connected.

**J6505 PROBE FOR RED LEDs**

The J6505 measures illuminance in foot candles [lumens/m<sup>2</sup> (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 in, 0.125 in, and 0.200 in diameter). These inserts are made of soft plastic that can be easily modified by the user for other LED sizes.

With the adapter in place, a reading of 1 footcandle represents 100 millicandelas of luminous intensity. With a metric version of the J16/J6505 (Option 02), 1 lumen/m<sup>2</sup> 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.

Note: For yellow or green LEDs use the J6501 probe; for infrared LEDs use the J6502-A probe.

**J6511 ILLUMINANCE PROBE**

The J6511 is an illuminance probe with readout in footcandles [lumens/m<sup>2</sup> (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 sensor 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.

**J6523 1° LUMINANCE PROBE**

The J6523 will measure the luminance in footlamberts (candelas/m<sup>2</sup> 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 locally available from 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 mounted on a tripod or an optical bench.

**J16 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 minimum (depending upon the probe used), for a full-scale readout. The analog bandwidth is approximately 0.8 Hz. A cable-end connector and cover are included.

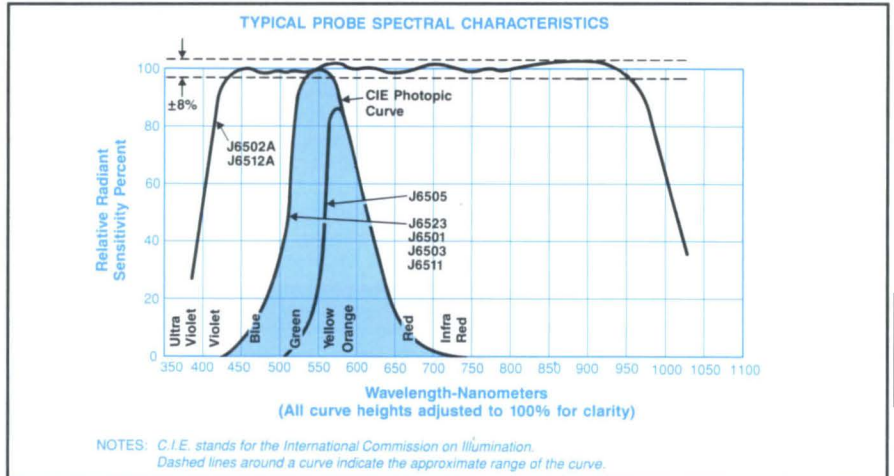
## PROBE CHARACTERISTICS

Application	Illuminance	Irradiance	Luminance		Red LED	Green/Yellow LED	
Probe	J6511	J6502-A/J6512-A	J6503	J6523	J6505	J6501	
Range	US*	0.001 to 1999 footcandles*	0.001 to 1999 microwatts/cm <sup>2</sup> *	0.1 to 199,900 footlamberts*	0.1 to 19,990 footlamberts*	0.001 to 1999 footcandles*†	0.001 to 1999 footcandles*†
	Metric (Opt. 02)	0.01 to 19,990 lumens/m <sup>2</sup> (lux)*	0.01 to 19,990 milliwatts/m <sup>2</sup> *	1 to 1,999,000 candelas/m <sup>2</sup> (nits)*	1 to 199,900 candelas/m <sup>2</sup> (nits)*	0.01 to 19,990 lumens/m <sup>2</sup> (lux)*†	0.01 to 19,990 lumens/m <sup>2</sup> (lux)*†
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 NIST standards and ±1 digit in last place. Calibrated with a 3100°K tungsten light source		Same as J6501, except calibrated with a 656 nm filter light source	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% from 600 to 950 nm 450-600 is ±8%	CIE photopic curve		CIE photopic curve from 600 to 710 nm (250 to 1200 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 Repeatability	Within 2% per year						
Linearity	Within 2% over entire range enabling single point calibration						

\* 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 d<sup>2</sup> = candelas where d is the distance from the source to the sensor in feet. (For metric readings, use lux x d<sup>2</sup> = candelas where d is distance from the source to the sensor in meters.) Request J16 Application Note 58A-2704-1 for further information.

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



## ORDERING INFORMATION

**J16 Photometer/Radiometer Battery Version**, with 115 Vac, 50 to 400 Hz  
Includes: Battery charger (119-0375-02); shoulder strap (346-0104-00); battery pack (016-0539-01); instruction manual (070-1879-00); or Opt. 02 Instruction manual (070-1880-00).  
**J16-TV Photometer/Radiometer Package for TV Color Monitor Set-Up**  
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\*** – 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 +\$150

\*1 Opt. 02 probes must be used.  
For application specific information call: 1-800-835-9433 ext. 5429 (in USA only).

### PROBES

Actual plotted spectral curve is included with each probe.  
**J6501** Illuminance Probe \$675  
**J6502-A** Irradiance Probe \$700  
**J6503** 8° Luminous Probe \$675  
**J6505** LED Probe, Includes Red LED Adapter and 3 LED holders \$695  
**J6511** Illuminance Probe, Cosine corrected (with 25-ft cable) \$695  
**J6512-A** Irradiance Probe (with 6-ft cable) \$750  
**J6523** 1° Luminance Probe \$1,895

### PROBE OPTIONS

**Opt. 02** – Metric probes required for metric readout J16s (Opt. 02). NC

### OPTIONAL ACCESSORIES

**42-Inch\*2 Probe Extender Cable** – Connects J16 to probe. Order 012-0414-02 \$145  
**Light Occluder** – For TV color CRT balancing. Order 016-0305-00 \$40  
**Filter Holder\*** – Mounts 1 in. diameter filters, of up to 3/8 in. thickness, to probes (except J6511, J6512, J6523). Order 016-0527-00 \$33

**LED Adapter** – With 3 LED holders (included with J6505). Order 014-0047-00 \$120  
**Tripod** – Order 016-0253-00 \$200

\*2 Longer length extender cables are available as a modified product by contacting your local Tektronix Sales Office.

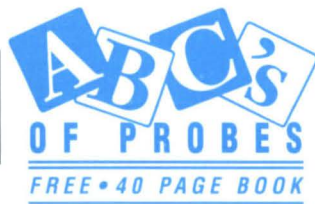
\*3 Filters available from vendors such as: ORIEL (203) 377-7877 or CORION CORP. (508) 429-5065 and others.

### 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 \$295  
 230 Vac, 50 to 400 Hz (included with Opt. 04) Order 119-0404-01 \$275  
**Spare Battery Pack** – Order 016-0539-01 \$230

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## VITAL LINKS TO TEST SYSTEM PERFORMANCE

Whether you're using a scope from our high-performance 11000 Series, our versatile 7000 family, or our 2400 and 2200 portables, you've invested in the finest line of measurement instruments available. That's why it doesn't pay to compromise performance with accessories you can't be sure of.

A dependable probe is essential to completing your test system – because even the most advanced scope can only be as precise as the signal that goes into it. Off-the-shelf general-purpose probes are frequently unreliable, and are not expressly designed for your scope. They can cost you in ways you never bargained for: greatly impaired measurement results, embarrassing errors, and expensive delays. Only genuine Tektronix probes measure up to your Tektronix scope with designed-in compatibility and identical standards for quality – for performance you can always depend on.

Of course, choosing the right kind of probe is equally important, which is why we offer the world's largest and most respected line. All are built with the kind of ruggedness, reliability, and long life that add up to the best probe value on the market. And they're complemented by an amazingly wide array of probe accessories for virtually every need.

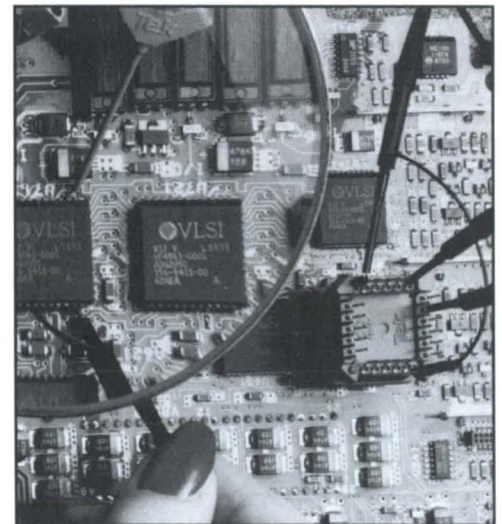


*Tek's versatile AM 503S Current Probe System lets you measure and display both ac and dc current waveforms from dc to 50 MHz. See page 325 for details.*

We also provide a complete family of products for documenting your measurement results, a step that's become almost as essential as testing itself. As with our probes, only Tek film-based cameras, printers, and plotters are precision-matched to your instrument and applications. They're exceptional values, too, as are Tek SCOPE-MOBILE® carts and workstations which free up bench space and make equipment easy to share and

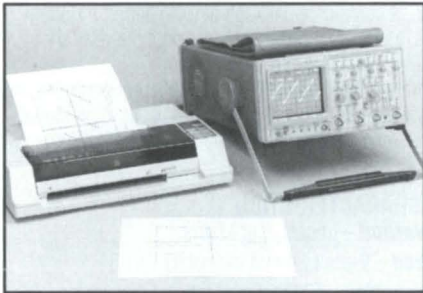


*The world's finest test equipment is as close as your phone - including the 2445B scope, C-7 camera, P6562 SMT probe, SMT interconnects and K212 cart pictured here.*



*On page 316, check out our growing family of probes and accessories designed especially for today's small geometries.*





## DIRECT WAVEFORM PLOTTING

The Tektronix HC100 Color Plotter is a low-cost, four-color plotter designed to make waveform plots directly from a variety of Tektronix digitizing instruments without requiring an external controller. Under program control from the attached instrument's front-panel or keyboard, the HC100 provides plots of digitally stored waveforms and printouts of instrument setup information.

## FUNCTIONS

Drawing Modes: Plotter (HP-GL, Epson HI 80, Graphtec commands sets), printer (Epson RX-80 compatible), self tests (HP-GL and standard plotter). The HC100 is shipped in the HP-GL mode.

Plotter operation is supported by HP-GL (Hewlett-Packard Graphics Language). Tek codes and formats are also supported on the GPIB interface.

Other modes in the HC100 include Graphtec emulation and Epson RX80 printer mode.

Printer operation is Epson RX-80 compatible and is supported by a full ASCII 96-character set. International character sets for 11 countries can be selected as well. HC100 handles printer functions to format and print text, but it does not support dot graphics.

Both graphics and text can be plotted in color. There are three types of pens used: fiber-tip pens with water-based ink for paper, fiber-tip pens with oil-based ink for overhead projection film, and ball-point pens with water-based ink for paper. Ball point pens produce a finer line than a fiber pen. Additional or replacement pens are available through Tektronix.

The HC100 pen cartridge holds four pens. The pens can be different colors, ink types, or point styles. The pen cartridge is easily changed allowing you to quickly change colors or pen types.

The HC100 cannot be used in a multi-controller environment, such as with a GPIB instrument and GPIB controller, unless attached to the controller (IBM PC or equivalent). Multiple GPIB controllers on one bus does not conform to IEEE-488 standards.

## CHARACTERISTICS

**Effective Drawing Size** – 267 mm (X-axis) x 192 mm (Y-axis)

**Maximum Drawing Speed** – 230 mm/s (along pen axis)

**Maximum Resolution** – 0.1 mm

**Pen Response Speed** – 15 times/s

**Number of Pens** – 4 (changed automatically)

**Pen Types** – Fiber pens: aqueous ink or oil-based ink; Ball-point pens: aqueous ink

**Pen Colors** – Set of black, blue, red, and green

**Paper Sizes** – ISO A4: 297 mm x 210 mm; B5: 257 mm x 182 mm; US letter size: 279 mm x 216 mm

**Paper Types** – Ordinary paper; OHJ film

**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

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 in (41.5 cm) wide, 3.2 in. (8.1 cm) high, 10.8 in. (27.2 cm) deep  
Weight 13.2 lb (6 Kg)

## TYPICAL APPLICATION

- Documentation from Digitally-Based Instrumentation for Reports or Presentations

## FEATURES

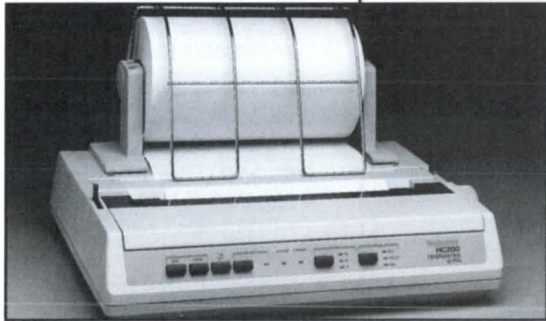
- Direct Plots from Many Tek Digitally-Based Instruments Without Using a Controller
- Standard HC100 Interfaces:
  - Centronics Parallel Interface
  - GPIB Interface
- Opt. 03 Interface:
  - RS-232C Serial Interface\*\*
- Compact Size
- Handles A4 and US Letter Size
- Makes Direct Plots in About 90 Seconds

\*\* When the RS-232C board is in the HC100, the Centronics interface is inactive.

## ORDERING INFORMATION

<b>HC100 Color Plotter</b> 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).	<b>\$950</b>	<b>Extra Pen Cartridge</b> – Order 016-0876-00	<b>\$19.50</b>
		<b>Pens</b> – Four colors (black, red, green, blue) in each package: (Fiber tip, aqueous ink) Order 016-0879-00	<b>\$10.00</b>
		(Fiber tip/oil-based ink) Order 016-0878-00	<b>\$10.00</b>
		(Ball point/aqueous ink) Order 016-0877-00	<b>\$10.00</b>
		Pens—black, four (Fiber tip, aqueous ink) Order 016-0939-00	<b>\$10.00</b>
		(Fiber tip, oil-based ink) Order 016-0940-00	<b>\$10.00</b>
		(Ball-point, aqueous ink) Order 016-0941-00	<b>\$10.00</b>
		<b>Interface Board Kits</b> – 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	<b>\$315</b>
		(RS-232C Interface Board Kit) Order 021-0458-00	<b>\$345</b>
		<b>Cables</b> – See next page for additional cables.	
		<b>HC100 Technical Manual</b> – Order 118-6688-00	<b>\$70</b>
<b>OPTIONS</b>			
<b>Opt. 01</b> – 1M GPIB Cable (012-0991-01)	<b>+\$100</b>		
<b>Opt. 02</b> – DB-25 M to Centronics M Cable (012-1250-00) for PCs (Both Opt. 01 and 02 may be ordered)	<b>+\$50</b>		
<b>Opt. 03</b> – Deletes GPIB I/F Board, and adds RS-232C I/F Board; includes DB-9 to DB-25 RS-232 Cable (012-1298-00) For a 220V/240V, 50 Hz version order one of following options:	<b>NC</b>		
<b>INTERNATIONAL POWER PLUG OPTIONS</b>			
<b>Opt. A1-A5</b> – Available, see page 374 for description	<b>NC</b>		
		<b>Product available within 24 hours through Tek Direct. Call 1-800-426-2200.</b>	

# HC200 DOT MATRIX PRINTER



HC200 Printer with Optional Roll Paper Adapter

## TYPICAL APPLICATIONS

- Documentation
- General Purpose Printer for the Lab, Office, or Home

## BENEFITS

- Ready to Use
- Custom Firmware for Enhanced Compatibility with Tek Instruments
- Setup Documentation for Tek Instruments
- Accessory Starter Package Included
- Quality Copies
- Fast Output
- Compact Size

## FEATURES

- 80 Column
- 232 cps @ 12 cpi in High Speed Draft
- 40cps in Near Letter Quality Mode
- Dual Paper Paths
- Centronics or Optional RS-232C Interface\*1
- Adjustable Stand
- Epson FX Emulation

The HC200 TEKPRINTER is a compact, low-cost 9-pin dot matrix printer. It is perfect for the lab, office, or home. Tek has taken the complexity and frustration out of getting a printer to work by providing complete instructions on how to set the HC200 up with Tek instruments and PC's, offering a wide selection of interface cables.

The HC200 handles virtually any print stock, whether continuous form paper, single sheets of letterhead, or roll paper (using the optional roll adapter). Paper can be fed from the rear or through a bottom feed slot which prevents the paper from interfering with the cables.

## INSTRUMENT COMPATIBILITY\*1

The HC200 will work with any computer, controller, or instrument that has EPSON FX compatible software or firmware. The following is a partial listing of TEK products that can be used with the HC200.

- **Centronics** – 1230 w/Opt. 02, 1240 w/Opt. 1200C11, 2252, 2402A, 2510/20, 2630, 2710(A) w/Opt. 09, 2272, 571, 11201/A, 11401, 11402/A, 11403, 11801/02, CSA803, DSA601/02.
- **RS-232C (HC200 w/Opt. 03)** – 2201 w/Opt. 12, 2211/14, 2200 DSO's w/Opt. 12, 3001/2, DSA9200 Series, 11201A, 11402A/03, 11801(A)/02, CSA803, DSA601/02

## INTERFACES/CABLES

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, see ordering information.

## 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 positions for ease of viewing and use. It allows the paper to be stored under the printer and fed through the printer's bottom paper path.

## 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, 186 cps @ 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., STD and italic, British, German, Swedish, French, Spanish, Danish, and French-Canadian.

## PAPER HANDLING

**Paper Widths** – Cut Sheet: 7.2 in. to 8.5 in. (18.3 cm to 21.6 cm). Pin Feed: Continuous 9.5 in. to 10.5 in. (24.1 cm to 26.7 cm), Roll: 8.43 in. to 8.5 in. (214 mm to 216 mm). Form Length: Selectable 5.5/8.5/11/14 inches.

**Number of Copies** – Original plus 3.

**Thickness** – 0.014 in. (0.35 mm) maximum.

**Paper Path** – Rear or bottom.

**Paper Weight** – 16 lb. to 20 lb. (for pin feed).

**Interfaces** – Parallel (STD): Centronics standard. Serial interface (Opt. 03): RS-232C (19,200 BPS max) with DB-25 female connector.\*1

**Reliability** – MTBF: 4,000 hours. MTTR: 15 minutes.

**Printhead Life** – 200 Million characters.

**Noise** – 57 dB.

## POWER REQUIREMENTS

**Input Power** – Voltage: 120 V ac  $\pm 10\%$  (US Model). 220 240 V ac  $\pm 10\%$  (A1-A5). Frequency: 50/60 Hz  $\pm 2\%$

**Power Consumption** – Operating: 40 VA, Idling: 8 VA.

## PHYSICAL SPECIFICATIONS

**Outside dimensions** – 15 in wide, 10.8 in deep, 3.2 in high.

**Weight** – 9.9 lb (4.5 kg).

\*1 Cables are not included with the HC200. Contact your TEK sales office for the correct TEK cable.

\*2 Contact your local sales office.

## ORDERING INFORMATION

<b>HC200 Printer</b> Includes: 1 ribbon cartridge; starter pack of paper, Operator's manual (070-7686-00); printer stand (118-8504-00).	☎ \$275
<b>OPTIONS</b>	
Opt. 03 – Adds RS-232C interface board.*1	☎ +\$90
<b>INTERNATIONAL POWER PLUGS</b>	
Opt. A1-A5 – See page 374 for descriptions.	NC
<b>HC200 ACCESSORIES</b>	
<b>Self-Inking Black Ribbon Cartridges</b> – (3 million characters nominal life), six cartridges per box. Order (118-8502-00).	\$60
<b>Roll Paper Adapter Kit</b> – Roll adapter, one 350 ft roll of white bond paper, installation instruction sheet. Order 016-1076-00	☎ \$57
<b>Extra Roll Paper</b> – A box of four rolls of white bond paper (about 350 ft/roll). Order 016-1075-11 (per box)	*2
<b>Universal Printer Stand</b> – Order (118-8504-00).	\$15
<b>RS232C Interface Board Kit</b> – includes the RS-232C Interface Board – mounting hardware, and instruction sheet. Order (119-3806-00).	\$90

HC100/HC200 ACCESSORIES	
<b>CENTRONICS CABLES –</b>	
36-Pin male to male centronics, 9 foot, Order 012-1284-00.	\$33
DB-25 male to 36-pin male centronics, 9 foot, Order 012-1250-00.	☎ \$50
<b>RS-232C Cables –</b>	
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
<b>GPIO Cables</b> – 1 meter, double shield, low EMI, Order 012-0991-01.	\$140
2 meter, double shield, low EMI, Order 012-0991-00.	☎ \$160
<b>Carrying Case</b> – Soft sided carrying case (not for shipping), Order 016-0707-01.	\$80
☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.	

# BLACK AND WHITE THERMAL PRINTER/ VIDEO COPIER

**HC02**

## HC02 BLACK AND WHITE THERMAL PRINTER AND VIDEO COPIER

This high resolution hardcopier provides black and white output in just 21 seconds. You have a wide choice of input which makes this hardcopier extremely versatile.

Using inexpensive thermal printing paper you can make up to 94 prints per roll 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 higher density computer graphic prints than are possible with conventional printers.

Once an image has been captured by the on-board frame memory, you can make as many copies of that stored image as you like. Other features include a remote control, selectable contrast levels, and the ability to print images reversed for negative prints or to change the print direction.

## CHARACTERISTICS

### PHYSICAL CHARACTERISTICS

	HC02	
	mm	in.
Dimensions		
Width	368	14.5
Height	119	4.7
Depth	337	13.3
Weight =	kg	lb
Net	7.7	17.0



The HC02 can make prints from video, PC CGA graphics, or printer text.

### INPUT SIGNALS:

**NTSC/PAL/SECAM Composite Video** – 1 V p-p, 75  $\Omega$  terminated, negative sync.

**RGB TTL From IBM PC (CGA)** – TTL Level, F (H) = 15.75 kHz.

**Parallel Data Interface/Teletext/Videotex** – TTL Level.

### 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

**Gray Scale** – 64 levels of gray (4 bits digital or 2 bits dithering).

### 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.

### POWER REQUIREMENTS

**Line Voltage** – 120 V ac  $\pm$  10% @ 50/60 Hz.

**Power Consumption** – 110 W.

### For A1-A5 Versions

**Line Voltage** – 220/240 V ac  $\pm$  10% @ 50 Hz.

**Power Consumption** – 120 W.



C1002 Video camera, HC02 video copier documenting a 2467B oscilloscope's display using a DX02 power supply.

### 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 (CGA only)

### ORDERING INFORMATION

**HC02** 8 x 10 in. Video Copier \$2,220  
(110 V ac.)

Includes a roll of thermal paper, 75  $\Omega$  cable, BNC to RCA adapter, and a manual.

### INTERNATIONAL POWER PLUG OPTIONS

Opt. A1–A5 – (220/240 V ac)

are available. NC

See page 374 for descriptions.

### OPTIONAL ACCESSORIES

**Super Grade Thermal Paper** –

Four rolls per box.

Order 016-0868-01 \$95

**Data Cable** – 10 foot, male-to-

male with 9-PIN DB connectors.

Order 174-0537-01 \$20

### PRINT SPECIFICATIONS

Paper – Super grade thermal type (black and white).

= Prints/roll	Side Mode	Norm. Mode
		75
Width	216 mm (8.5 in.)	
Length	21 m (85 ft.)	
Print Size	216 x 279 mm (8.5 x 11 in.)	216 x 220 mm (8.5 x 8.6 in.)
Image Size	200 x 148 mm (7.8 x 5.8 in.)	
Print Speed	= 21 s	

# FILM BASED CAMERAS

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## 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-9 Camera, 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.

#### 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.

## 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.**

## 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/ $\mu$ s 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

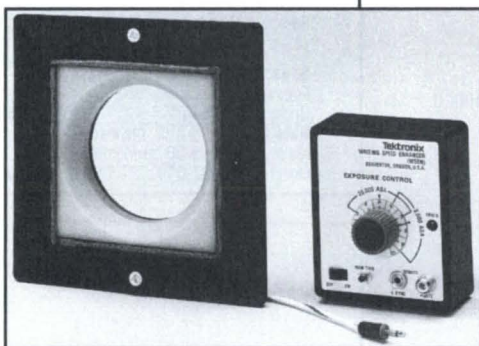
Film fogging is a technique for increasing the maximum sensitivity of photographic film by giving it a short exposure of dim, diffused light. The optional Tektronix Writing Speed Enhancer (WSEN) is designed to fill this need.

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 ASA Equivalent Speed	Type	Relative Film Writing Speed	
		Unfogged	Fogged
3,000	667, 107, 084	1 <sup>*1</sup>	3 <sup>*1</sup>
20,000	612	>2	>3.5

<sup>\*1</sup> Value depends on film, scope, CRT, camera, and the operator.



WSEN (Writing Speed Enhancer) Diffuser with Control Box.

# RECOMMENDED CAMERAS AND FILMS

## CAMERA SELECTION GUIDE

Camera	C-53P	C-30BP	C-9
Features	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.	Continuously variable magnification; Dual swing-away hinge for viewing the CRT; Easy operation; Interchangeable film backs; Compact size; OEM pricing available.	Low price. Easily interchangeable hoods. Easy to use, fixed focus. Optional motorized autofilm back.
Lens Aperture	f/1.9 to f/16	f/1.9 to f/16	fixed at f/16
Magnification	0.85	Variable: 0.7 to 1.5 (0.8 with Opt. 01)	.55 or .73
Relative Light Gathering	1.0	1.0 (0.9 with Opt. 01)	.035
Resolving Power: at center: (lines/mm)	30 or better	at 1:1 – 25 or better	6 or better
at corners: (lines/mm)	15 or better	10 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	
Film Backs	Polaroid pack standard	Polaroid pack std. with "P" models Graflok back available (016-0487-00)	
Page	304	303	302
Price Base	\$2,200	\$1,690	*1 Contact your local sales office.

## 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
<b>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</b>												
611*1	200	45	PP	20	Low Contrast, Wide Gray Scale				✓	✓		•
612*5	20,000	30	PP	20 to 25	High Contrast			✓				
			N	160 to 180								
665*4	75	30	PP	14 to 20	Medium Contrast, Wide Gray Scale	•*4	•*4		•*4			✓*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	80	4 min	CT		Includes Mounts	•			•	•	✓	
<b>AutoFilm (For C-7 only) – Actual image area 10 x 7.5 cm (4 x 3 in.), 10 prints per pack</b>												
331*1*3*5	400	60	PP	20	Med. Contrast, Extended Gray Scale	•	•		✓	✓		✓
337*1*5	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 Page 305

PP = Positive Print

N = Negative

CP = Color Positive Print

CT = Color Transparency

NT = Negative Transparency

Other films and technical support are available from Polaroid Corporation. Call 1-800-343-5000 toll free within the US.

# 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.

Oscilloscope or Display Device	Recommended Cameras	Mounting Adapter		
		C-9	C-53	C-30BP
<b>11000 Series</b>				
11301(A)	C-9	016-0357-02		
11302(A) <sup>*7</sup>	C-53 Opt. 11		016-0249-06	
11401, 11402(A) 11402(A) DSA 601/602	C-9	016-1099-00		
<b>7000 Series</b>				
8x10 cm Display, i.e., 7104 <sup>*7</sup> , 7503, R7103 <sup>*7</sup> , 7504, 7514, 7613N, 7623/B, 7633, 7704(A), 7834, 7844 <sup>*7</sup> , 7854, 7934, R7903 <sup>*7</sup> , 7904 <sup>*7</sup> , 7094(A) <sup>*7</sup> , T922R <sup>*2</sup>	C-53 C-9 C-30BP, Opt. 01 <sup>*10-13</sup>	016-0357-02	016-0249-06	016-0248-01
Large Screen Display, <sup>*1</sup> i.e., 7403, 7603, 7603N	C-9	016-0357-02		
<b>5000 Series</b>				
5100 Series Nonstorage, <sup>*1*3</sup> i.e., 5110, 5112, D10, D12, 577/D1, 5116	C-9	016-0357-02		
5100 Series Storage, <sup>*1*2</sup> i.e., 5111, 511A, 5113, 5115, D11, D13, D15, 577/D2	C-9	016-0357-02		
5400 Series Nonstorage, <sup>*1*2</sup> i.e., 5403/D40, 5440, 5444, D40	C-9	016-0357-02		
5400 Series Storage, <sup>*2*4</sup> i.e., 5403/D41, 5441, D41	C-53 C-9 C-30BP, Opt. 01 <sup>*10</sup>	016-0357-02	016-0249-06	
<b>Portables</b>				
Older with 0.8 cm. Graticule, <sup>*5</sup> i.e., 422, 453, 454, 485, 491	C-30BP			016-0306-01
Newer with 1 cm Graticule, <sup>*5</sup> i.e., 2235/A, 2240A Series, 2400 Series, 455, 464, 465, 465B, 465M, 466, 468, R468, 475, 475A, 432, 434, 442, 2467B <sup>*7</sup>	C-9 C-30BP, Opt. 01	016-0359-02		016-0269-03
1 cm Nonilluminated Graticule <sup>*5</sup> 2200 Series	C-9	016-0359-02		
1/4-inch Graticule, <sup>*4*5*12</sup> i.e., 305, 314, 326, 355, 336A, 1501, 1502.	C-30BP			016-0327-01
TM 500, <sup>*5</sup> i.e., SC 502, SC 503, SC 504 <sup>*4</sup>	C-30BP			016-0327-01
Nonilluminated Graticule <sup>*5*8</sup> 2335, 2336, 2336YA, 2337	C-9	016-0359-02		
<b>Display Monitors</b>				
8 x 10 cm, <sup>*3</sup> i.e., 601, 602, 605, 606, 606B, 607	C-9 C-30BP, Opt. 01 <sup>*10</sup>	016-0357-01		016-0248--01
Large screen 10 x 12 cm, <sup>*1</sup> i.e., 603, 694, 608, 620, 624, 634	C-9	016-0357-01		

# RECOMMENDED CAMERAS AND ADAPTERS

## CAMERA AND MOUNTING-ADAPTER SELECTION GUIDE

Oscilloscope or Display Device	Recommended Cameras		Mounting Adapter	
	C-9	C-53	C-9	C-53
<b>Older 5 inch Round</b>				
502, 503, 504, 515, 516, 519 530/540/550/580 Series, 575	C-53**10		016-0225-04	
<b>Older 5 inch Rectangular</b>				
560 Series,**2 i.e. 561, 564, 567, 568	C-53**10		016-0224-01	
<b>Television Products</b>				
380, 381	C-30BP, Opt. 01**10			016-0327-01
528A, 1420, 1421, 1422, 1424**1	C-9	016-0357-02		
1705, 1701B, 1711B, 1720/21, 1730/31, 1740, 1741, 1742, 1750, WFM300	C-30BP, Opt. 01; C-9	016-0359-02		016-0269-03**15
<b>Spectrum Analyzers</b>				
2710	C-30BP, Opt. 01			016-0269-03
491	C-30BP			016-0306-01
490 and 2750 Series	C-30BP, Opt. 01; C-9			016-0248-08
<b>Other Products</b>				
370/A, 371 Curve Tracers	C-9	016-0357-02		
OF150, OF151, OF152, OF235, OF192 Optical TDRs	C-9	016-0357-02		
1240 Optical TDR**6*14				
T900 Series Oscilloscope**6 excluding T922R (see 7000 Series)				

\*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. 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 T-900 hood must be ordered separately as 016-0358-01.

\*7 The Digitizing Camera System (DCS01) can be used with these scopes. See Pages 159

\*8 These scopes have no CRT bezel; therefore, a camera cannot be mounted.

\*9 Use with 016-0288-01 adapter.

\*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.

NR Not recommended.

## ORDERING INFORMATION

### Camera Mounting Adapter and Hoods

016-0224-01	\$165	122-0894-01**7	\$70
016-0225-04	\$115	122-0895-01**8	\$70
016-0226-01	\$105	122-0896-01**9	\$70
016-0248-01	\$125	**1	Included with C-50 Series Cameras.
016-0249-06**1	\$140	**2	Adapter and lens included with C-31B Opt. 01 Cameras.
016-0269-03	\$125	**3	Adapter and lens kit included with C-30B Opt. 01 Cameras.
016-0269-04**2	\$125	**4	Included with Standard C-30B
016-0295-01	\$110	**5	Included with C-5C and C-5C Opt. 01 Cameras.
016-0299-00	\$120	**6	Included with C-5C Opt. 02 and Opt. 04 Cameras.
016-0301-01**3	\$160	**7	Included with C-4 (Standard).
016-0306-01**4	\$125	**8	Included with C-4 Opt. 02.
016-0327-01	\$220	**9	Included with C-4 Opt. 02 and Opt. 03.
016-0357-01**5	\$26		
016-0358-01	\$24		
016-0359-01**6	\$26		

# C-9 SERIES LOW COST CAMERA

## TYPICAL APPLICATIONS

- Oscilloscopes
- Small Video Displays
- Medical Imaging/Ultrasound
- Class 100 Clean Rooms

## BENEFITS

- Lightweight, Easy to Use
- Focusing Not Required
- Fits Most Tek and Non-Tek Scopes
- Low Priced, Yet Versatile

## FEATURES

- Uses Polaroid 3 1/4 x 4 1/4 Pack Films
- Graticule Flash Available
- Autoback Available
- Auto Power-On

## ORDERING INFORMATION

**C9 Camera** \*1  
Includes: adapter hood (016-0357-02); adapter hood (016-0359-02); Instruction Manual (070-8105-00).

### OPTIONS

**Opt. 01** – 016-0642-00 Flash Unit. \*1  
**Opt. 02** – 122-1014-01 Auto-Film Motorized Film Back \*1  
**Opt. 03** – 016-1099-00 11000 Series Hood \*1

\*1 Contact your local sales office.



C-9 Low Cost Camera

## VERSATILE PERFORMANCE AT LOW PRICE

The C-9 is a low priced yet remarkably versatile CRT film camera. It uses Polaroid 3 1/4 in. x 4 1/4 in. Pack Film; i.e. 667, 669, etc. See page 299 for compatible films that are available from Tektronix.

## CAMERA-TO-PRODUCT COMPATIBILITY

The C-9 can be used with most Tek and non-Tek scopes. It covers most widely used CRT displays; 8 x 10 cm and 9.8 x 12.2 cm. The C-9 comes standard with adapter hoods which fit most Tek 7000 series and portable scopes. An optional 11000 series hood is available. Additional hoods can be ordered separately. See the adapter selection guide on page 301.

## GRATICULE FLASH

For scopes with non-illuminated graticule, an optional flash is available. The variable intensity xenon flash makes the CRT phosphor glow, which evenly backlights the graticule. A door on the flash unit provides direct viewing of the CRT. Non-flash models have a large viewing door in place of the flash.

## OPTIONAL MOTORIZED FILM BACK

A motorized film back is available which incorporates Polaroid's Autofilm™ system. After each exposure the film automatically ejects and self-develops to a clean dry print. No peeling, waiting, or coating is necessary. There is no need to handle the prints while they are developing. This is especially important in medical and clean-room applications where film handling could cause chemical contamination. Polaroid™ type 337 3,200 ASA Autofilm™ is now available when a fast film is required.

## CHARACTERISTICS

**Aperture** – Fixed at f/16

**Lens** – Fixed focus three element

**Magnification** – .55 or .73

**Relative Light Gathering Ability** – .035

**Shutter** – Electronic; .1-5 sec.

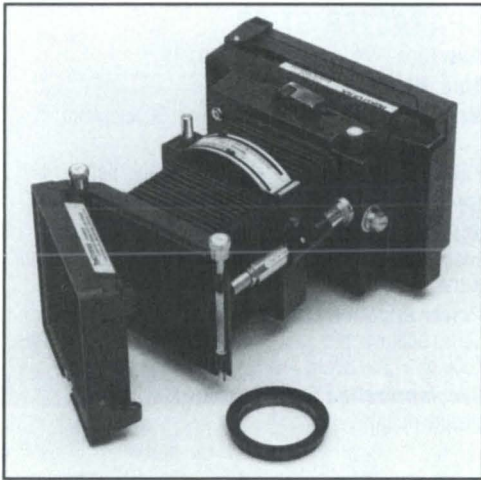
**Field of View** – 29.3° (Std. Hood); 26.1° (11k Hood)

**Power** – Four AA alkaline batteries (not included)

### Adapter Hoods –

	016-0357-00		016-0359-02		016-1099-00	
Dimensions	cm	in	cm	in	cm	in
Height:						
Inside	13	5.13	10.5	4.13	12.3	4.84
Outside	13.7	5.38	11.2	4.4	12.8	5.04
Width:						
Inside	14.2	5.6	12.0	4.7	15.8	6.2
Outside	14.9	5.85	12.7	4.99	16.3	6.4





C-30BP Option 01 with corrector lens off.

### C-30BP FILM BASED CAMERA

The C-30BP camera is an easy to use, compact, high resolution CRT documentation product. It provides versatility with large image size.

The C-30BP camera features dual swing-away hinges which allow it 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 camera will mount on a variety of scopes, spectrum analyzers, display monitors and other CRT-based products. See pages 300 and 301.

The C-30BP comes standard with 3 1/4 x 4 1/4 in. pack film back. 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 C-30BP is primarily for use on the older 400 Series portables 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-30BP is recommended for the 453, 454, 485, and 491.

The C-30BP 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

**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-30BP set to 1.0 magnification).

**Resolving Power** – (At 1:1 magnification) At Center: At least 25 lines/mm. At Corners: At least 10 lines/mm.

**Relative Light-Gathering Ability** – 1.0 (0.9 on Option 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-30BP

### BENEFITS

- *Adaptable to Many Instruments*
- *High Resolution Lens*
- *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** **\$2,045**

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) **+\$90**

See page 305 for C-30BP accessories and for Polaroid films.

## C-53 FILM BASED CAMERA

### C-53

- Medium Speed
- General-Purpose Camera With 0.85 Mag
- Remotely Controllable Shutter
- Foot Switch Available
- Writing Speed Enhancer Available

#### ORDERING INFORMATION

C-53P Camera	\$2,560
Includes: Same as C-51P.	
Opt. 11 - Corrector lens for 11302(A).	+\$110



C-53P (Shown with Option 11 corrector lens off.)

### C-53 HIGH PERFORMANCE CAMERA

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 305).

**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

# FILM BASED CAMERA ACCESSORIES

## FILM BASED CAMERA ACCESSORIES

Product	Application	Order No.	Price
<b>Replacement Film Backs</b>			
Polaroid 3 1/4" x 4 1/4" Pack Film Backs	C-30, C-30 A/B Series	122-0752-02	\$245
	C-50 Series	122-0926-02	\$225
<b>Slit-Image Focus Plate</b>	Fits inside pack back	387-0893-02	\$8.25
<b>Polaroid Replacement Roller Assemblies for Pack Film Backs</b>	If your roller assembly is solid gray or two-tone gray	401-0304-00	\$40
<b>Graflok Type Film Backs</b>			
Polaroid #545 Film Holder	C-30 Series	016-0487-00	\$300
	C-50 Series	122-0931-01	\$285
Polaroid #550 Pack Film Holder	Polaroid 4 x 5" Single Exposure Film Packets	016-0201-01	\$320
Polaroid #550 Pack Film Holder	For Polaroid 4 x 5" pack films	Available only through Polaroid	
Polaroid #405 Pack Film Holder	For Polaroid 3 1/4 x 4 1/4 inch pack films	1-800-343-5000 In United States	
<b>Writing Speed Enhancers</b>			
Increases film's effective writing speed about three times for ASA 3000 film	C-30A/B, C-31A/B	016-0284-02	\$320
	C-51	016-0279-02	\$300
	C-53	016-0300-02	\$350
	C-59A	016-0290-02	\$335
<b>Polaroid Pack Films Available From Tek</b>			
<b>Polaroid 3 1/4" x 4 1/4" Pack Films</b> (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	☎ \$51
	25 twin packs (400 prints)	006-6825-00	\$417
Type 612 - B&W print, high contrast (20,000 ASA)	3 single packs (24 prints)	006-6822-00	☎ \$42
Type 669 - Color print (80 ASA)	3 twin packs (48 prints)	006-6826-00	☎ \$77
	25 twin packs (400 prints)	006-6827-00	\$575
<b>Polaroid AutoFilm™ (for C-7 only)</b>			
Type 337 - B&W print, similar to 667 pack film (3200 ASA)	3 twin packs (60 prints)	006-7349-00	☎ \$63
	10 twin packs (200 prints)	006-7350-00	\$210
Type 331 - B&W print, with extended gray scale (400 ASA)	3 twin packs (60 prints)	006-6815-00	☎ \$70
	10 twin packs (200 prints)	006-6816-00	\$210
<b>C-4 Optional Accessories</b>			
<b>For Color CRTs</b>	Color Filter Kit	122-0909-00	\$19
<b>Scope Hoods</b>	9.1 cm x 11.87 cm field of view	122-0894-01	\$70
	10.4 cm x 13.5 cm field of view	122-0895-01	\$70
	8.0 cm x 10.0 cm field of view	122-0896-01	\$70
<b>Video Hoods</b>	7.2 in diagonal	122-0897-01	\$120
	8.3 in diagonal	122-0898-01	\$120
	12.5 in diagonal	122-0899-01	\$140
<b>C-5C Optional Accessories</b>			
<b>Hoods</b> (Requires either a viewing door or flash, see above)	Large viewing door for hoods	016-0630-00	\$11
	Graticule Flash Unit	016-0642-02	\$200
	5K, 7K, 11K and T-922R	016-0357-01	\$26
	T900 Series except T-922R	016-0358-01	\$24
	2400, 2200, 46X and 475 Series	016-0359-01	\$26

Product	Application	Order No.	Price
<b>C-7 Optional Accessories</b>			
<b>Polaroid AutoFilm™ (For C-7 only)</b>	Type 337 - B&W print (3,200 ASA)		See films on left
	Type 331 - B&W print with extended grey scale (Like Type 611) (400 ASA)		
	Extra Print Holding Chamber	122-1039-00	\$24
	Foot Switch with 8 ft. Cable	260-1189-02	\$25
<b>Extra AC Power Supply with Lemo Connector and a 8 ft cable Hoods/Flash/Viewing door</b>	Extra Battery Pack (8 AA alkaline batteries not included)	016-0799-01	\$49
	Service (only) manual	070-5051-00	\$10
	110 V ac 50 Hz to 60 Hz (w/Opt. 31)	119-1847-02	\$100
<b>C-9 Optional Accessories</b>			
<b>Scope Hoods, see page 301</b>			
<b>Pistol Grip</b>		122-0186-00	*1
<b>C-30 Series Optional Accessories</b>			
	Carrying Case	016-0587-00	\$200
	Portra Lens (C-30A/B only)	016-0246-02	\$45
	X-sync Cable	012-0364-01	\$37
<b>Converting Option 01 Model to Standard Model</b>	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.		\$125
<b>Converting Standard Model to Option 01 Model</b>	Std C-30B to Opt. 01. Includes 016-0269-03 adapter and C-30B corrector lens (352-0341-01)	016-0301-01	\$160
	Std C-31B to Opt. 01. Includes 016-0269-03 adapter and C-31B corrector lens (122-0980-00)	016-0269-04	\$125
	Film Backs		See "Backs" sect.
<b>C-50 Series Optional Accessories</b>			
	Carrying Case	016-0177-00	\$395
	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	\$450
	C-59A Adapter Frame/Corrector lens kit for the 576 Curve Tracer (Includes corrector lens 352-0293-00)	016-0288-01	\$265
	Film Backs		See "Backs" sect.
	Foot switch with 8 ft. Cable (C-51, C-53 only)	260-1189-02	\$25
<b>11301(A)/11302(A)</b>	C-51/11301(A)	122-1043-00	\$105
<b>Corrector Lenses</b> These lenses easily screw in or snap on the camera lens.	C-51/11302(A)	122-1044-00	\$105
	C-53/11302(A)	122-1045-00	\$105
	C-59A/11301(A)	122-1046-00	\$105

\*1 Contact your local sales office.

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

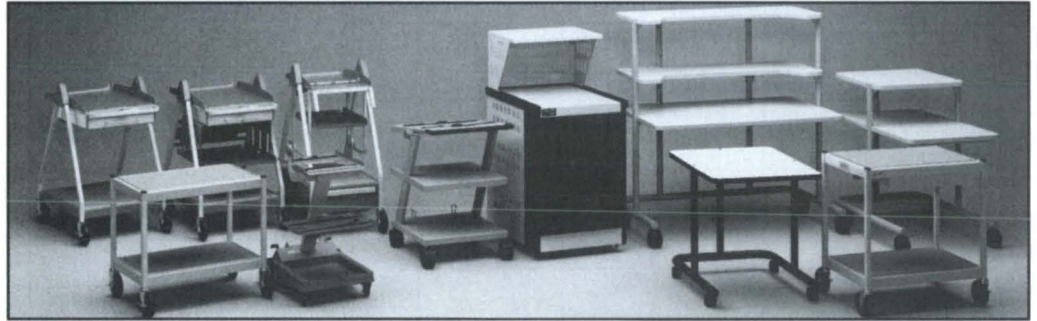
# INSTRUMENT CARTS/WORKSTATIONS

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Tek can free up your valuable work space, make sharing and moving equipment easy, and get 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.



### Instrument Compatibility

	206/K318	K212	K213	K213 Shelf	K217	K217S	K220	K332WH	K335BN	K336BN	K501	K636
<b>Terminals/Copiers/Monitors/Plotters</b>												
4000 Series	•	•						•	•	•		
4600 Series	•	•						•	•	•		
4900 Series	•	•						•	•	•		
60X/62X Series	•	•						•	•	•		
65X/67X Series	•	•						•	•	•		
<b>Television/Spectrum Analyzers/Cable Testers</b>												
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	•	•						•	•	•		
<b>Logic Analyzers</b>												
1230/1240/1241	•	•						•	•	•		R
DAS 9100	•	•						•	•	•		
DAS 9200	•	•						•	•	•		
LV500	•	•						•	•	•		
Prism 3000	•	•						•	•	•		

✓ - Recommended      • - Compatible

	206/K318	K212	K213	K213 Shelf	K217	K217S	K220	K332WH	K335BN	K336BN	K501	K636
<b>Curve Tracers</b>												
370A/371	•	•										
576/577	•	•										
5370 FA	•	•										R
<b>Oscilloscopes/Digitizers/Controllers</b>												
11000 Series	•	•										R
DSA 601/602	•	•										R
2200/2300	•	•										R
2400	•	•										R
2600	•	•										R
305/314/336	•	•										R
390AD	•	•										R
400 Series	•	•										R
5XX Series (Cabinet)	•	•										R
5XX Series (Rackmount)	•	•										R
5000/7000 Series (Cabinet)	•	•										R
5000/7000 Series (Rackmount)	•	•										R
7612/7912	•	•										R
7020T	•	•										R
T900 Series	•	•										R
<b>TM500/TM5000 Series</b>												
TM503/TM504/TM5003	•	•										R
TM506/TM515/TM 5006	•	•										R

R - Suitable for rackmounting applications

### Cart Selection Guide

Features	K212		K213		K217		K217S		K220		K318/206		K332WH		K335BN		K336BN		K501		K636		
	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	
Load Capacity	36	80	34	75	45	100	45	100	45	100	45	100	68	150					23	50	104	230	
Top Tray																							
Base	45	100	11	25	45	100	45	100	45	100	45	100					9	20					
Middle Tray	18	40	18	40			18	40	45	100													
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	135	300	90	200	68	150	68	150	68	150	23	50	180	400	
Net Weight	9	20	26	57	20	43	21	45	30	65	14	30	17	37	25	55	35	77	.8	1.8	65	145	
Shipping Weight	13	28	34	75	26	57	27	60	32	70	17	38	18	40	26	58	36	80	1.0	2.2	72	160	
Page	307		307		307		307		307		308		309		309		309		309		308		
Prices	\$385		\$700		\$625		\$725		\$1		\$455/\$285		\$205		\$340		\$380		\$60		\$1,075		

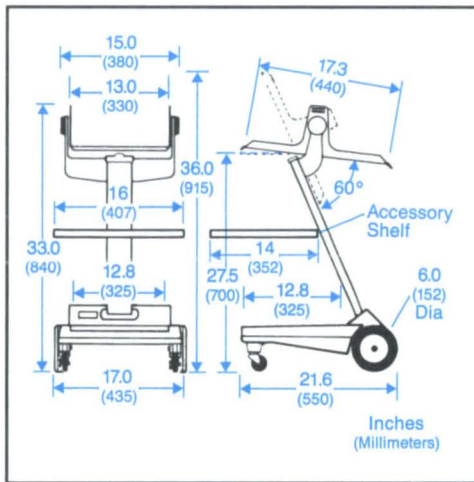
NOTE: For dimensions, see dimensional drawings

\*1 Contact your local sales office.

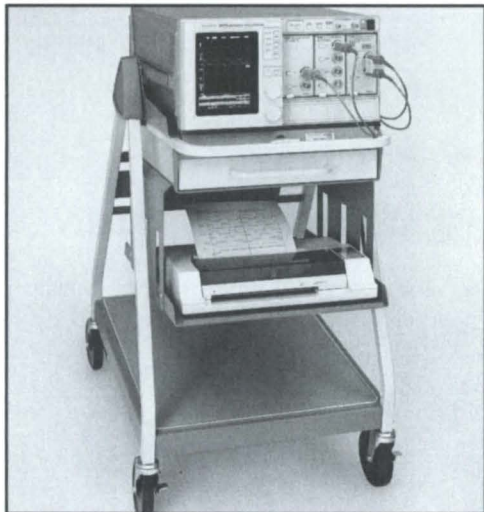
To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.



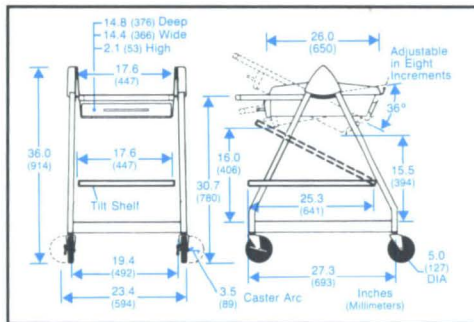
K212 Option 22 with HC100 and 2440



The K212 base is made of thermoset polyester; the column and trays, high-strength aluminum. The base and trays are Tek Blue; column and yoke, silver grey.



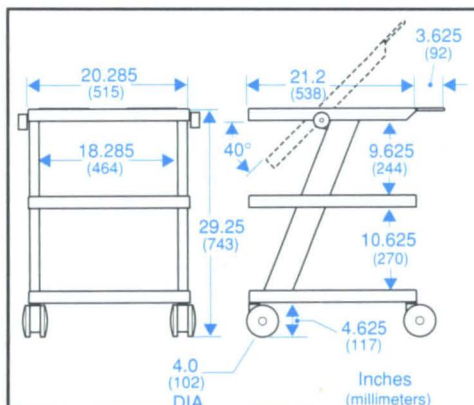
K217S shown. K217 is similar in appearance, but does not have the middle tray.



These sturdy, portable carts are ideal for manufacturing, research and design environments. The tiltable middle tray on the K217S is rack width to accommodate additional instruments.



K220



This rugged cart is ideal for R&D and manufacturing environments. All trays accommodate rack-width instruments. Rotating friction of tiltable top shelf is user adjustable.

### K212

- For All Portable Instruments
- Sturdy and Mobile Platform
- Enhances Sharing and Work Space
- Tiltable Top Tray
- Locking Front Casters
- Four Outlet Power Strip Option

### K213

- For Laboratory Instruments
- Still available but not shown
- See Data Sheet 56W-7131-1

### K217/K217S

- For Rack-Width Instruments
- Stable/Mobile Platform
- Four Outlet Power Strip
- Accessories Drawer

### NEW K220

- Sturdy, Mobile Instrument Platform
- 3 Rack-width trays
- User Friendly, Ergonomic Design
- 4 Outlet Surge Protector
- 4 Locking Wheels
- 4 Securing Straps

### ORDERING INFORMATION

- K212** Portable Instrument Cart ☎ **\$385**  
Includes: Two 1 in. x 5 ft. securing straps, retaining bar, instruction sheet, and probe holders.
- Opt. 10** - Add Four Outlet Power Strip ☎ **+\$75**
- Opt. 12** - Add Second Tray ☎ **+\$80**
- Opt. 22** - Combines Opt. 10/12 Power Strip Retrofit Kit. \*1 ☎ **+\$145**  
Order 016-1025-00 ☎ **\$95**
- Middle Tray Retrofit Kit. \*1**  
Order 016-1026-00 ☎ **\$110**
- K213** Lab Instrument Cart ☎ **\$700**  
Securing strap included
- K217S** Rack Instrument Cart ☎ **\$625**  
Probe holders, securing strap included.
- Opt. 01** - Brown finish **NC**  
To order additional 1 1/2" x 53" Securing Strap for top tray, (Blue) Order 346-0070-01 **\$55**  
(Brown) Order 346-0070-03 **\$55**
- K217S** Rack Instrument Cart ☎ **\$725**  
Probe Holders, securing strap included
- K220** 3-Shelf Rack Instrument Cart ☎ **^2**  
Cart, Probe holders and 4 securing straps included
- Opt. 05** - Delete surge protector **^2**
- \*1 Everything you need to retrofit these options is included.
- \*2 Contact your local sales office.
- ☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

**K318**

- *Designed for Computers, Peripherals, Test and Measurement Equipment and Industrial Uses*
- *Plastic Laminate on Both Surfaces*
- *Four Outlet Power Strip*
- *Locking Wheels*
- *200 lb Load Capacity*
- *Keyboard/Accessories Drawer*
- *Strong/Stable Slide-out Shelf*

**206**

- *Low Profile Cart (25 in Height Std.; 30 in Height Optional)*
- *Plastic Laminate on Both Surfaces*
- *Locking Wheels*
- *Stable/Sturdy Platform*

**K636**

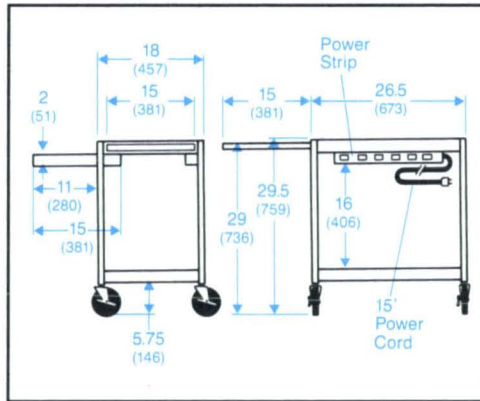
- *Rugged Mobile Workstation for Rackmount Applications*
- *Extremely Soft Ride with Balloon Cushion-Back Wheels*
- *Standard Top Shelf*
- *Pop-out Side and Back Panels*
- *Surge Protector*
- *3 1/2 Inch Recessed Front Vertical Supports*
- *Optional Side Shelf Pops On and Off Either Side*

**ORDERING INFORMATION**

<b>K318 P.C. Cart</b>	<b>\$455</b>
Opt. 05 - Delete power cord	-\$25
<b>206 Utility Cart</b>	<b>\$285</b>
Opt. 05 - 30 in height	NC
Probe holders included in the K213, K318, and 206.	
<b>K636 Mobile Work Station</b>	<b>\$1,075</b>
Probe holder and securing strap included.	
Opt. 05 - Flush-Mount Adaptor Kit	+\$70
Opt. 06 - Delete Power Strip	NC
Opt. 10 - Side Shelf	+\$130
Opt. 11 - 23 1/2 in high smoked plastic door**	+\$180
Opt. 12 - 26 in high smoked plastic door**	+\$190
Opt. 13 - 3 1/2 in deep drawer**	+\$215
Opt. 14 - 7 in Deep Drawer**	+\$225
Opt. 15 - Keyboard Platform**	+\$135
Opt. 19 - Blower Cut-Out	+\$90
<b>Back Panel -</b>	
(1 3/4 in high cover plate)	
Order 333-1351-07	\$25
(3 1/2 in high cover plate)	
Order 333-0997-06	\$35
(5 1/4 in high cover plate)	
Order 333-0999-06	\$40

\*1 Includes drawer slides and hardware.

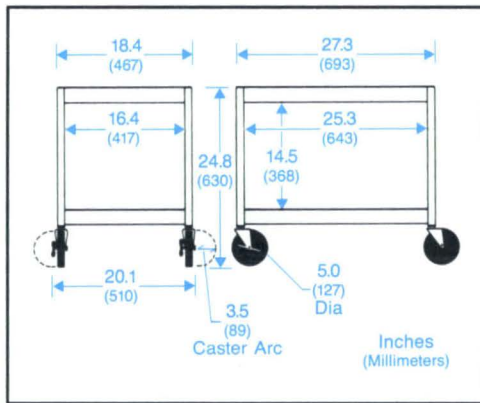
\*\*2 Door includes popout hinges, attractive handle, and lock.



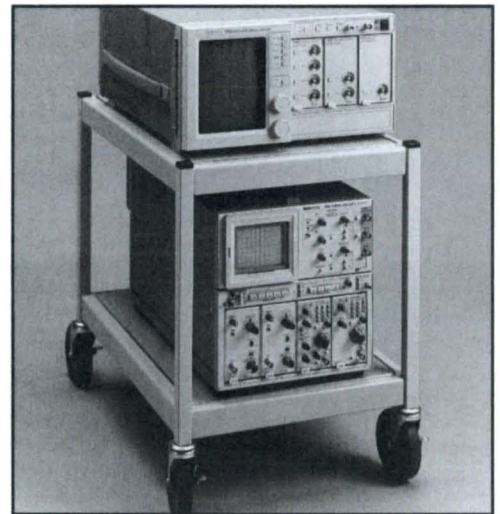
This table height platform includes keyboard drawer and pull-out shelf. The K318 is a handsome, sturdy addition to your work environment.



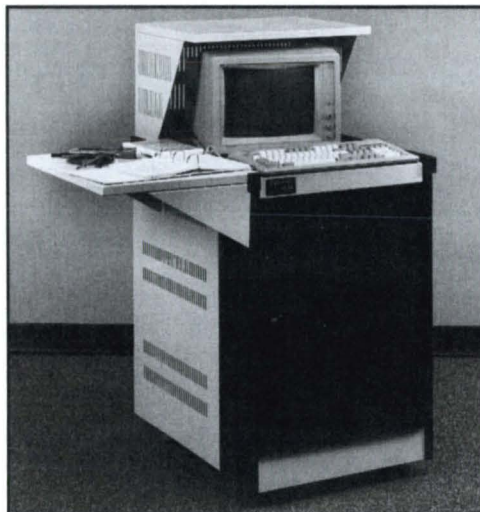
**K318**



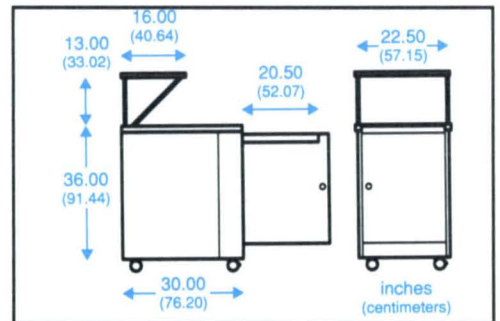
The quality and workmanship is evident in this general purpose utility cart. If you need a cart that lasts, the 206 is the one for you.



**Model 206**



**K636**



This handsome rackmount workstation provides up to 26 in of rack space, 24 1/2 in with keyboard platform.\*1 The optional side shelf attaches to the extrusion, is easily removable, and can be mounted on either side. (The side shelf is rated at 40 lbs. and measures 16 in x 22 1/2 in.) The K636 cart breathes from the sides and back eliminating any vacuum-cleaner-effect.

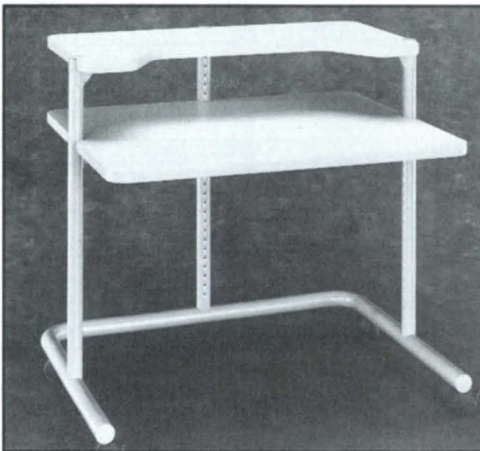
\*1 Includes drawer slides and hardware.

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center. Toll free: 1-800-426-2200, Ext. 99.



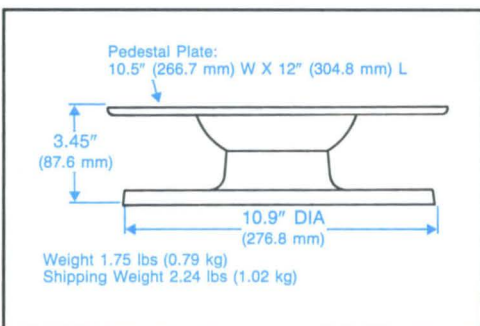
**K332WH**

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 in. laminated with an attractive molding edge.



**K336BN**

The K336BN is bone in color with putty grey legs and base. A 1 in. laminated top and molding edge complement the high level of quality and value.



**K501**

### CART DIMENSIONS

	K332WH	K335BN	K336BN
<b>Height</b>	29 in. 73.66 cm.	35 in. 88.9 cm.	35 in. 88.9 cm.
<b>Width</b>	23.75 in. 60.32 cm.	25 in. 63.5 cm.	35.75 in. 90.8 cm.
<b>Depth</b>	30 in. 76.2 cm.	30 in. 76.2 cm.	30 in. 76.2 cm.



**K335BN**

K335BN is bone in color with putty grey legs and base. A 1 in. laminated top and molding edge make the K332BN an attractive addition to any work area. Add options to best solve your platform needs.



**K501 Tek-Tilt™ Pedestal**

### K332WH

- A Low-Cost, No-Frills, Mobile, Compact Workstation
- Large, Sturdy Work Shelf
- Optional Swing-out Shelf (18 in x 14 in) with 4 Inch Deep Paper Holder Able to Attach at Any Height
- Black, Hard-Plastic Castors
- 5-Year Warranty

### K335BN/K336BN

- Incredibly Strong and Attractive
- Adjustable Height and Configuration
- Four 2-3/8 Inch Castors (2 Locking)
- Cable Management Clips; Tools for Assembly Included
- Optional Slide-out Shelf, Wire Base, and 5 Inch Extension Tubes Add Versatility and Functionality.
- 5-Year Warranty

### K501

- Provides 30° Tilt, and 360° Swivel to Portable Instruments
- Tension Adjustment
- Enhances Visual and Postural Viewing Angles

### ORDERING INFORMATION

K332WH P.C./Instrument Cart	\$205
Opt. 10 - Swing Out Shelf	+\$90
K335BN Compact P.C./Instrument Cart	\$340
Opt. 10 - Slide Out Shelf	+\$105
Opt. 11 - Wire Base	+\$55
Opt. 14 - (3) 5" Extension Tubes	+\$50
K336BN Midsize P.C./Instrument Cart	\$380
Opt. 12 - Keyboard Holder	+\$150
Opt. 14 - (3) 5" Extension Tubes	+\$50
To order these options separately order:	
Swing out shelf 118-8494-00	\$75
Wire base*1 118-8493-00	\$50
5" Extension tubes**2 118-8492-00	\$43
Keyboard holder**2 118-8496-00	\$140
Slide out shelf**3 118-8495-00	\$95
K501-Tek-Tilt™ Pedestal.	☎ \$60

\*1 K335BN only

\*\*2 K335BN or K336BN only

\*\*3 K335BN and K336BN only (Do not use with keyboard holder.)

Tools included for assembly of K332 wH, K335BN, K336BN.

# TEK SCOPES TO TEK PROBES CROSS REFERENCE

## RECOMMENDED PROBES

Highlighted probes are those normally shipped with the scope. For non-highlighted probes, the scope bandwidth may be limited by the probe shown. Use scope's bandwidth and probe specification chart to determine overall probe/scope bandwidth.

	PASSIVE 1X	PASSIVE 10X	PASSIVE 1X/10X	Low-Z	HIGH VOLT. 100X	HIGH VOLT. 1000X	ACTIVE
<b>11000 SERIES</b>							
11201A	P6101A	P6134C	P6063B		P6009		P6204
11A32	P6101A	P6134C	P6063B		P6009		P6204
11A33		P6135A					
11A34	P6101A	P6134C	P6063B		P6009		P6204
11A52				P6156* <sup>2</sup>			P6204
11A71				P6156* <sup>2</sup>			P6204
11A72				P6156* <sup>2</sup>			P6204
SD20/22/24/26				P6150			
<b>7000 SERIES</b>							
7A13		P6135A					
7A15A	P6101A	P6105A	P6062B		P6009	P6015	P6202A* <sup>1</sup>
7A16A	P6101A	P6106A	P6063B		P6009	P6015	P6202A* <sup>1</sup>
7A18/A	P6101A	P6105A	P6062B		P6009		P6202A* <sup>1</sup>
7A19				P6156* <sup>2</sup>			P6201* <sup>1</sup>
7A22		P6135A					
7A24				P6156* <sup>2</sup>			P6201* <sup>1</sup>
7A26	P6101A	P6106A	P6063B		P6009		P6202A* <sup>1</sup>
7A29/P				P6156* <sup>2</sup>			P6201* <sup>1</sup>
7A42	P6101A	P6131	P6063B	P6156* <sup>2</sup>	P6009		P6202A* <sup>1</sup>
7D15	P6101A	P6106A	P6063B				
7D20	P6101A	P6105A	P6053C				
<b>5000 SERIES</b>							
5A14N	P6101A	P6006/P6102A	P6062B		P6007	P6015	
5A15N	P6101A	P6006/P6012A	P6062B		P6007		
5A18N	P6101A	P6006/P6102A	P6062B		P6007		
5A21N		P6135A					
5A22N		P6135A					
5A26		P6135A					
5A38N	P6101A	P6105A	P6062B		P6009		
5A45	P6101A	P6105A	P6062B		P6009	P6015	
5A48	P6101A	P6105A	P6062B		P6009	P6015	
5D10	P6101A	P6105A	P6062B		P6007	P6015	
<b>2400 SERIES</b>							
2430/A/M	P6101A	<b>P6133 Opt. 25</b>	P6063B	P6156* <sup>2</sup>	P6009	P6015	P6202A* <sup>1</sup>
2431L	P6101A	<b>P6136 Opt. 25</b>	P6063B	P6156* <sup>2</sup>	P6009	P6015	P6201A* <sup>1</sup>
2432/A/M	P6101A	<b>P6137</b>	P6063B	P6156* <sup>2</sup>	P6009	P6015	P6201A* <sup>1</sup>
2439	P6101A	<b>P6136 Opt. 25</b>	P6063B	P6156* <sup>2</sup>	P6009	P6015	P6202A* <sup>1</sup>
2440/M	P6101A	<b>P6137</b>	P6063B	P6156* <sup>2</sup>	P6009	P6015	P6201A* <sup>1</sup>
2445	P6101A	<b>P6131</b>	P6063B	P6156* <sup>2</sup>	P6009	P6015	P6202A* <sup>1</sup>
2445A	P6101A	<b>P6133 Opt. 25</b>	P6063B	P6156* <sup>2</sup>	P6009	P6015	P6202A* <sup>1</sup>
2445B	P6101A	<b>P6133 Opt. 25/P6137*<sup>3</sup></b>	P6063B	P6156* <sup>2</sup>	P6009	P6015	P6202A* <sup>1</sup>
2455A/B	P6101A	<b>P6136 Opt. 25</b>	P6063B	P6156* <sup>2</sup>	P6009	P6015	P6202A* <sup>1</sup>
2465	P6101A	<b>P6131</b>	P6063B	P6156* <sup>2</sup>	P6009	P6015	P6201* <sup>1</sup>
2465A	P6101A	<b>P6136 Opt. 25</b>	P6063B	P6156* <sup>2</sup>	P6009	P6015	P6201* <sup>1</sup>
2465B	P6101A	<b>P6137</b>	P6063B	P6156* <sup>2</sup>	P6009	P6015	P6201* <sup>1</sup>
2467	P6101A	<b>P6136 Opt. 25</b>	P6063B	P6156* <sup>2</sup>	P6009	P6015	P6201* <sup>1</sup>
2467B	P6101A	<b>P6137</b>	P6063B	P6156* <sup>2</sup>	P6009	P6015	P6201* <sup>1</sup>
<b>2300 SERIES</b>							
2335	P6101A	<b>P6108A</b>	P6119		P6009 Opt. 14	P6015	
2336	P6101A	<b>P6108A</b>	P6119		P6009 Opt. 14	P6015	
2336YA	<b>P6101A</b>	<b>P6108A</b>	P6119		P6009 Opt. 14	P6015	
2337	P6101A	<b>P6108A</b>	P6119		P6009 Opt. 14	P6015	

<sup>1</sup> The P6201 and P6202A active probes require probe power, which is normally supplied by the scope (either standard or optional to the scope). If probe power is unavailable, an 1101A power supply may be used to supply probe power.

<sup>2</sup> The P6156 is standard with 10X attenuation. Other attenuations are available. Order Option 25 for 10X plus 100X and see ordering information on page 323 for separate 1X and 20X attenuator tips.

<sup>3</sup> 2445B shipped with P6133 Option 25 probe until BW changed to 200 MHz, then P6137 shipped.



# TEK SCOPES TO TEK PROBES CROSS REFERENCE

## RECOMMENDED PROBES

Highlighted probes are those normally shipped with the scope. For non-highlighted probes, the scope bandwidth may be limited by the probe shown. Use scope's bandwidth and probe specification chart to determine overall probe/scope bandwidth.

	PASSIVE 1X	PASSIVE 10X	PASSIVE 1X/10X	Low-Z	HIGH VOLT. 100X	HIGH VOLT. 1000X	ACTIVE
<b>2200 SERIES</b>							
2201	P6101A	P6103	P6119		P6007	P6015	
2205	P6101A	P6103	P6119		P6007	P6015	
2210	P6101A	P6103	P6119		P6009 Opt. 14	P6015	
2211	P6101A	P6109 Opt. 01	P6062B		P6009	P6015	
2213	P6101A	P6122	P6119		P6009 Opt. 14	P6015	
2213A	P6101A	P6122	P6119		P6009 Opt. 14	P6015	
2214	P6101A	P6103	P6119		P6007	P6015	
2215	P6101A	P6122	P6119		P6009 Opt. 14	P6015	
2215A	P6101A	P6122	P6119		P6009 Opt. 14	P6015	
2220	P6101A	P6109 Opt. 01	P6119		P6009 Opt. 14	P6015	
2221/A	P6101A	P6109 Opt. 01	P6062B		P6009	P6015	
2224	P6101A	P6109 Opt. 01	P6062B		P6009	P6015	
2225	P6101A	P6103	P6119		P6009 Opt. 14	P6015	
2230	P6101A	P6109 Opt. 01	P6062B		P6009	P6015	
2232	P6101A	P6109 Opt. 01	P6062B		P6009	P6015	
2235/A	P6101A	P6109 Opt. 01	P6119		P6009 Opt. 14	P6015	
2235L	P6101A	P6122	P6119		P6009	P6015	
2236/A	P6101A	P6109 Opt. 01	P6062B		P6009	P6015	
2245/A	P6101A	P6109 Opt. 01	P6062B		P6009	P6015	
2246/A	P6101A	P6109 Opt. 01	P6062B		P6009	P6015	
2247/A	P6101A	P6109 Opt. 01	P6062B		P6009	P6015	
2252	P6101A	P6109 Opt. 01	P6062B		P6009	P6015	
<b>400 SERIES</b>							
434	P6101A	P6105A	P6062B		P6007	P6015	P6202A*1
455	P6101A	P6105A	P6062B		P6009	P6015	P6202A*1
464	P6101A	P6105A	P6062B		P6009	P6015	P6202A*1
464/M	P6101A	P6105A	P6062B		P6009	P6015	P6202A*1
465	P6101A	P6105A	P6062B		P6009	P6015	P6202A*1
465B	P6101A	P6105A	P6062B		P6009	P6015	P6202A*1
465/M	P6101A	P6105A	P6062B		P6009	P6015	P6201*1
466	P6101A	P6105A	P6062B		P6009	P6015	P6202A*1
468	P6101A	P6105A	P6062B		P6009	P6015	P6202A*1
475/A	P6101A	P6106A	P6063B	P6156*2	P6009	P6015	P6201A*1
485	P6101A	P6106A	P6063B	P6156*2	P6009	P6015	P6201*1
<b>300 SERIES</b>							
305/314	P6101A	P6149A					
308		P6107A					
309AD	P6101A	P6105A	P6062B		P6009	P6015	
336/A	P6101A	P6148A					
<b>T20X SERIES</b>							
201/202	P6115						
<b>TM500/5000 SERIES</b>							
AM 502		P6135A					
DC 503A	P6101A	P6125					
DC 504A/5004	P6101A	P6125					
DC 509/5009	P6101A	P6125					
DC 510/5010	P6101A	P6125					
DC 505/A	P6101A	P6108A					
DC 508/A	P6101A	P6125					
SC 501/2/3	P6101A	P6006	P6062B		P6007	P6015	
SC 504	P6101A	P6105A	P6062B		P6009	P6015	
SI5010				P6156*2			P6202A*1

# VOLTAGE PROBES SPECIFICATION CHART

This selection chart provides specifications for Tektronix' line of voltage probes. Refer to pages 322 and 323 for ordering information. More detail for the P6562 SMT Probe is provided on page 316; active probes on page 320; differential probes on page 327; low capacitance probes on page 321; and specialty probes on page 315. The photograph on page 314 gives representative examples of the size and shape of various tip styles.

## PROBE SPECIFICATIONS

Type	Attenuation	Length	Loading $R_{in}$ $C_{in}$	BW MHz <sup>*1*2</sup> at -3dB	DC+pk AC* Maximum	Scope C in pF or	Readout/ Identify/Grd Ref	Tip/Head Style (Page 314)	Page
<b>1X Passive Probes</b>									
P6101A Opt 01	1X	1m	1 M $\Omega$ 32 pF	34	500 V	Any	N/A (1X)/No/No	G	322
P6101A	1X	2m	1 M $\Omega$ 54.0 pF	15	500 V	Any	N/A (1X)/No/No	G	322
<b>10X Passive Probes</b>									
P6006	10X	6 ft	10 M $\Omega$ 8.5 pF	25	600 V	15 to 55	No/No/No	K	322
P6006 Opt 03	10X	9 ft	10 M $\Omega$ 11.0 pF	25	600 V	15 to 55	No/No/No	K	322
P6006 Opt 04	10X	12 ft	10 M $\Omega$ 15.0 pF	12	600 V	15 to 55	No/No/No	K	322
P6053C Opt 01	10X	3.5 ft	10 M $\Omega$ 9.5 pF	250	500 V	15 to 35	Yes <sup>*3</sup> /Yes/No	E	322
P6053C	10X	6 ft	10 M $\Omega$ 12.5 pF	250	500 V	15 to 35	Yes <sup>*3</sup> /Yes/No	E	322
P6053C Opt 03	10X	9 ft	10 M $\Omega$ 13.5 pF	250	500 V	15 to 35	Yes <sup>*3</sup> /Yes/No	E	322
P6102A	10X	2m	10 M $\Omega$ 13.2 pF	60	500 V	36 to 55	Yes/No/No	G	322
P6103 Opt 01	10X	1m	10 M $\Omega$ 10.9 pF	50	500 V	15 to 35	No/No/No	J	322
P6103	10X	2m	10 M $\Omega$ 13.2 pF	50	500 V	15 to 35	No/No/No	J	322
P6103 Opt 03	10X	3m	10 M $\Omega$ 15.5 pF	50	500 V	15 to 30	No/No/No	J	322
P6105A Opt 01		1m	10 M $\Omega$ 8.7 pF	100	500 V	15 to 35	Yes/No/Yes	G	322
P6105A	10X	2m	10 M $\Omega$ 11.2 pF	100	500 V	15 to 35	Yes/No/Yes	G	322
P6105A Opt 03		3m	10 M $\Omega$ 13.2 pF	90	500 V	15 to 30	Yes/No/Yes	G	322
P6106A Opt 01	10X	1m	10 M $\Omega$ 8.7 pF	250	500 V	15 to 35	Yes/No/Yes	G	322
P6106A	10X	2m	10 M $\Omega$ 11.2 pF	250	500 V	15 to 35	Yes/No/Yes	G	322
P6106A Opt 03	10X	3m	10 M $\Omega$ 13.2 pF	150	500 V	15 to 30	Yes/No/Yes	G	322
P6107A	10X	2m	10 M $\Omega$ 13.0 pF	100	500 V	20 to 51	Yes/No/Yes	G	322
P6108A	10X	2m	10 M $\Omega$ 11.2 pF	100	500 V	15 to 35	No/No/No	G	322
P6109 Opt 01	10X	1.5m	10 M $\Omega$ 11.8 pF	150	500 V	15 to 35	Yes/No/No	J	322
P6109	10X	2m	10 M $\Omega$ 13.2 pF	150	500 V	15 to 35	Yes/No/No	J	322
P6109 Opt 03	10X	3m	10 M $\Omega$ 15.5 pF	100	500 V	15 to 30	Yes/No/No	J	322
P6121	10X	1.5m	10 M $\Omega$ 11.0 pF	100	500 V	20 to 26	Yes/No/No	F	322
P6122	10X	1.5m	10 M $\Omega$ 11.0 pF	100	500 V	15 to 35	No/No/No	F	322
P6130 Opt 01	10X	1.5m	10 M $\Omega$ 12.7 pF	250	500 V	15 to 35	Yes/No/No	B	322
P6130	10X	2m	10 M $\Omega$ 13.2 pF	250	500 V	15 to 35	Yes/No/No	B	322
P6130 Opt 03	10X	3m	10 M $\Omega$ 14.5 pF	150	500 V	15 to 30	Yes/No/No	B	322
P6131 <sup>**4</sup>	10X	1.3m	10 M $\Omega$ 10.8 pF	300	500 V	14 to 18	Yes/No/No	B	322
P6131 Opt 02 <sup>**4</sup>	10X	2.0m	10 M $\Omega$ 13.5 pF	250	500 V	14 to 18	Yes/No/No	B	322
P6131 Opt 03 <sup>**4</sup>	10X	3.0m	10 M $\Omega$ 14.5 pF	150	500 V	14 to 18	Yes/No/No	B	322
P6133 Opt 01 <sup>**4</sup>	10X	1.3m	10 M $\Omega$ 11.4 pF	150	500 V	10 to 25	Yes/No/No	B	322
P6133 <sup>**4</sup>	10X	2m	10 M $\Omega$ 12.7 pF	150	500 V	10 to 25	Yes/No/No	B	322
P6133 Opt 03 <sup>**4</sup>	10X	3m	10 M $\Omega$ 14.5 pF	120	500 V	10 to 25	Yes/No/No	B	322
P6133 Opt 25 <sup>**4</sup>	10X	1.3m	10 M $\Omega$ 10.8 pF	150	500 V	10 to 25	Yes/No/No	D	322
P6134C	10X	1.5m	10 M $\Omega$ 11.3 pF	400	500 V	12 to 18	Yes/Yes/No	E	322
P6136 <sup>**4</sup>	10X	1.3m	10 M $\Omega$ 10.8 pF	350	500 V	12 to 18	Yes/No/No	B	322
P6136 Opt 25 <sup>**4</sup>	10X	1.3m	10 M $\Omega$ 10.8 pF	350	500 V	12 to 18	Yes/No/No	D	322
P6137 <sup>**4</sup>	10X	1.5m	10 M $\Omega$ 10.8 pF	400	500 V	12 to 18	Yes/Yes/No	E	322
P6148A	10X	2m	10 M $\Omega$ 13.0 pF	50	500 V	20 to 51	Yes/No/No	G	322
P6149A	10X	2m	10 M $\Omega$ 13.0 pF	50	500 V	20 to 51	No/No/Yes	G	322
P6562	10X	1.5m	10 M $\Omega$ 10.3 pF	350	42 V	15 to 30	Yes/No/No	A	316

<sup>\*1</sup> 25  $\Omega$  source

<sup>\*2</sup> 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  $\approx 20$  pF for the P610XA and P612X or  $\approx 15$  pF for the P613X and P6562.

<sup>\*3</sup> Trace identify button.

<sup>\*\*4</sup> P6131, P6133, P6136, P6137 probes are designed for 2400 series and provide optimum performance to these scopes.

<sup>\*5</sup> Probe pair, designed for differential inputs. Includes three different probe tips for compensation ranges from 13-49 pF.

\* Derating

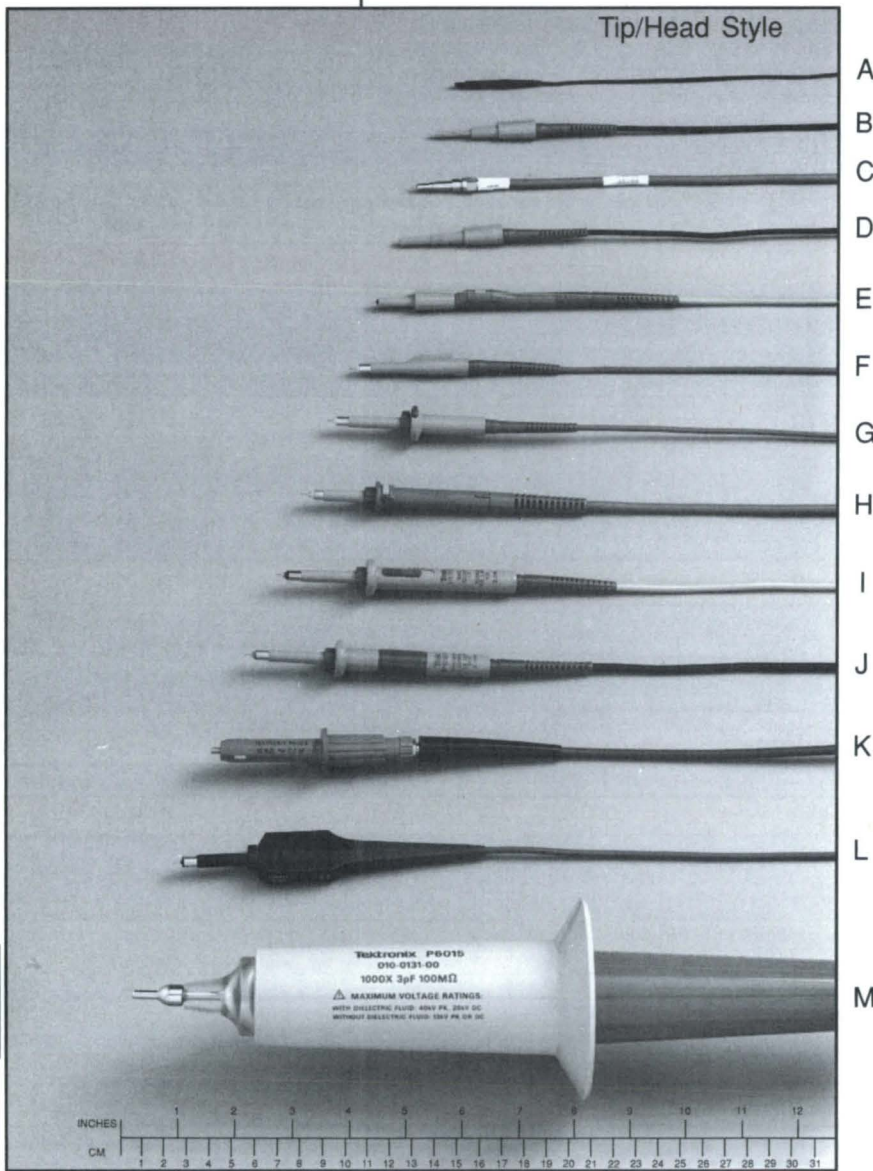
# VOLTAGE PROBES SPECIFICATION CHART

This selection chart provides specifications for Tektronix' line of voltage probes. Refer to pages 322 and 323 for ordering information. More detail for the P6562 SMT Probe is provided on page 316; active probes on page 320; differential probes on page 327; low capacitance probes on page 321; and specialty probes on page 315. The photograph on page 314 gives representative examples of the size and shape of various tip styles.

## PROBE SPECIFICATIONS

Type	Attenuation	Length	Loading $R_n$ $C_n$	BW MHz <sup>*1*2</sup> at -3dB	DC + pk AC Maximum	Scope C in pF or <Offset>	Readout/ Identify/Grd Ref <Linear Range>	Tip/Head Style (Page 308)	Page
<b>1X/10X Switchable Passive Probes</b>									
P6062B	10X or	6 ft	10 M $\Omega$ 14.0 pF	100	500 V	15 to 47	Yes/No/Yes	L	323
	1X	6 ft	1 M $\Omega$ 105.0 pF	7	500 V	N/A	Yes/No/Yes		
P6062B Opt 03	10X or	9 ft	10 M $\Omega$ 17 pF	95	500 V	15 to 47	Yes/No/Yes	L	323
	1X	9 ft	1 M $\Omega$ 135 pF	4.5	500 V	N/A	Yes/No/Yes	L	
P6063B	10X or	6 ft	10 M $\Omega$ 14.0 pF	200	500 V	15 to 24	Yes/No/Yes	L	323
	1X	6 ft	1 M $\Omega$ 105.0 pF	6	500 V	N/A	Yes/No/Yes		
P6119	10X or	2 m	10 M $\Omega$ 15.3 pF	100	500 V	15 to 35	No/No/Yes	I	323
	1X	2 m	1 M $\Omega$ 120.0 pF	8	350 V	N/A	No/No/Yes		
P6119 Opt 3	10X or	3 m	10 M $\Omega$ 17.5 pF	100	500 V	15 to 35	No/No/Yes	I	323
	1X	3 m	1 M $\Omega$ 145 pF	6.7	350 V	N/A	No/No/Yes	I	
<b>High Voltage Passive Probes (100X/1000X)</b>									
P6007 Opt 01	100X	3.5 ft	10 M $\Omega$ 2.0 pF	25	1.5 kV	15 to 55	No/No/No	K	323
P6007	100X	6 ft	10 M $\Omega$ 2.2 pF	20	1.5 kV	15 to 55	No/No/No	K	323
P6007 Opt 03	100X	9 ft	10 M $\Omega$ 2.4 pF	15	1.5 kV	15 to 55	No/No/No	K	323
P6007 Opt 04	100X	12 ft	10 M $\Omega$ 2.6 pF	13	1.5 kV	15 to 55	No/No/No	K	323
P6009	100X	9 ft	10 M $\Omega$ 2.5 pF	120	1.5 kV	15 to 47	Yes/No/No	K	323
P6009 Opt 14	100X	9 ft	10 M $\Omega$ 2.5 pF	120	1.5 kV	15 to 47	No/No/No	K	323
P6015	1000X	10 ft	100 M $\Omega$ 3.0 pF	75	20 kV	12 to 47	No/No/No	M	323
<b>Active Probes (see page 320 for probe styles)</b>									
P6201	1X	6 ft	100 k $\Omega$ 3.0 pF	>900	$\pm$ 100 V	< $\pm$ 5.6 V>	< $\pm$ 0.6 V>	not shown	320
	10X	6 ft	1 M $\Omega$ 1.5 pF	>900	$\pm$ 200 V	< $\pm$ 56 V>	< $\pm$ 6.0 V>	not shown	320
	100X	6 ft	1 M $\Omega$ 1.5 pF	>900	$\pm$ 200 V	< $\pm$ 200 V>	< $\pm$ 60 V>	not shown	320
P6202A	10X	2 m	10 M $\Omega$ 2.0 pF	>500	$\pm$ 200 V	< $\pm$ 55 V>	< $\pm$ 6.0 V>	not shown	320
	100X	2 m	10 M $\Omega$ 2.0 pF	>500	$\pm$ 200 V	< $\pm$ 200 V>	< $\pm$ 60 V>	not shown	320
P6203	10X	1.5 m	>10 k $\Omega$ 2.0 pF	1000	$\pm$ 40 V	< $\pm$ 10 V>	< $\pm$ 10 V>	H	320
P6204	10X	1.5 m	10 M $\Omega$ 1.9 pF	1000	$\pm$ 40 V	< $\pm$ 15V>	< $\pm$ 10 V>	H	320
P6230	10X	1.6 m	450 $\Omega$ 1.3 pF	1500	$\pm$ 30 V	< $\pm$ 5 V>	< $\pm$ 5 V>	B	320
P6231	10X	1.5 m	450 $\Omega$ 1.6 pF	1500	$\pm$ 30 V	< $\pm$ 5 V>	< $\pm$ 5 V>	not shown	320
<b>Differential Probes (see page 327 for illustrations)</b>									
P6046 (CMRR 10,000:1)	1X	6 ft	1 M $\Omega$ 10.0 pF	100	$\pm$ 25 V	N/A	N/A	not shown	327
(CMRR 800:1)	10X	6 ft	10 M $\Omega$ 3.0 pF	100	$\pm$ 250 V	N/A	N/A	not shown	327
P6135A*5 (CMRR 10,000:1)	10X	1.5 m	1 M $\Omega$ 10.5 pF	150	500 V	13 to 17	Yes/Yes/No	E	327
(CMRR 20,000:1)	10X	1.5 m	1 M $\Omega$ 11.0 pF	105	500 V	18 to 22	Yes/Yes/No	E	327
(CMRR 20,000:1)	10X	1.5 m	1 M $\Omega$ 13.7 pF	1	500 V	45 to 49	Yes/Yes/No	E	327
<b>Low Capacitance Passive Probes</b>									
P6150	10X $\pm$ 2%	1 m	500 $\Omega$ <0.15 pF	9 GHz	12.5 V rms	50 $\Omega$	No/No/No	C	321
	1X $\pm$ 2%	1 m	50 $\Omega$ N/A	$\geq$ 3 GHz	42 V rms	50 $\Omega$	No/No/No	C	321
P6156	10X $\pm$ 3%	1.5 m	500 $\Omega$ <1 pF	$\geq$ 3.5 GHz	15 V rms	50 $\Omega$ /1 M $\Omega$	Yes/No/No	E	321
	100X $\pm$ 3%	1.5 m	5000 $\Omega$ <1.1 pF	$\geq$ 3.0 GHz	50 V rms	50 $\Omega$ /1 M $\Omega$	Yes/No/No	E	321
	20X $\pm$ 3%	1.5 m	1000 $\Omega$ <1 pF	$\geq$ 3.5 GHz	22 V rms	50 $\Omega$ /1 M $\Omega$	Yes/No/No	E	321
	1X $\pm$ 5%	1.5 m	50 $\Omega$ N/A	$\geq$ 1.5 GHz	50 V rms	50 $\Omega$ /1 M $\Omega$	Yes/No/No	E	321
<b>Specialty Probes</b>									
P6008 (Environmentalized)	10X	6.0 ft	10 M $\Omega$ 7.5 pF	100	600 V	12 to 47	No/No/No	K	315

# PROBE STYLES AND INCLUDED ACCESSORIES



Representative Tip Styles of Voltage Probes

## PROBE STYLES

Probing applications vary from general purpose digital/analog design and debug to testing components mounted on hybrids.

To meet these varying needs, Tektronix probes come in a wide variety of shapes and sizes, from our newest SMT PROBE (P6562) (page 316) to our 40 kV peak pulse P6015 High Voltage Probe.

The photograph to the left gives a representative example of the various tip styles listed in the voltage probes specification chart on pages 312-313. Match the tip style listed on the chart with that in the photograph to determine the size and shape of the probe in which you are interested. For example, if you selected the P6106A passive probe from the Tek Scopes to Tek Probes Cross Reference Chart, looking at the Voltage Probe Specifications Chart you would find that the probe's 'tip/head' style is G. The P6106A probe tip/head style would then be similar to G in the photograph at the left.

## PROBE ACCESSORIES

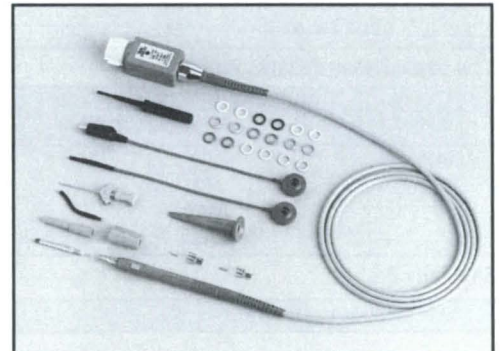
Each Tektronix probe comes with a standard set of accessories for attachment to the device under test.

The accessory sets vary from probe to probe. The P6103 is shown with a basic complement of accessories. The P6137 is shown with a complement of accessories for higher frequency probing applications.

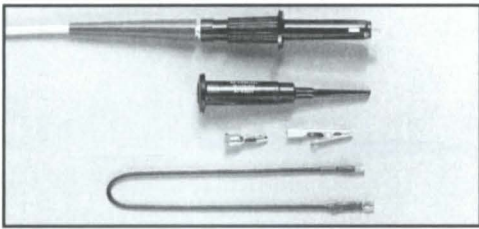
Standard accessories are listed in the ordering information for each probe. Also, on pages 330-333 is a list of recommended probe accessories to meet your application needs and ways of interconnecting them.



P6103 shown with standard accessories

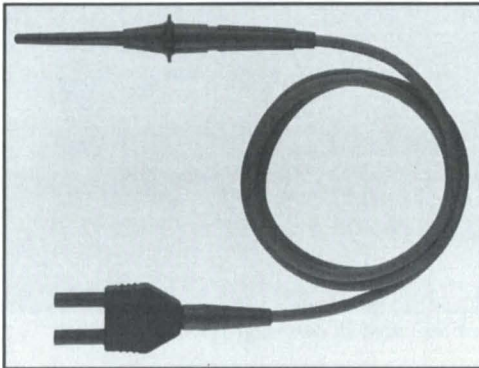


P6137 shown with standard accessories.



## 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.

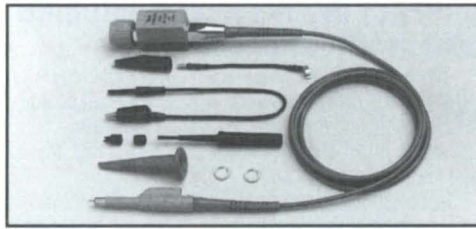


P6602 (shown).

## FOR DMM INPUT

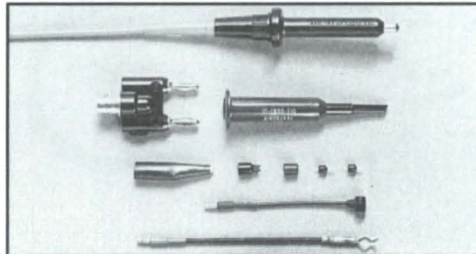
The P6601 and P6602 are temperature-measuring devices designed to operate with the DM5110, DM511 (P6602) and DM501A, DM502A (P6601) Digital Multimeters or with the 2236A oscilloscope and the 2465B, 2445B, 2455B with DMM (opt 01) (P6602). The temperature-sensing element consists of a thin-film platinum resistor on the tip of the probe. Measurements are made by touching the probe tip to the test surface. The thermal signal is transmitted to the associated digital multimeter through a two-conductor cable.

The probes are totally immersible except in liquids that are incompatible with 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.



## 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.

## P6008

- 100 MHz, Environmental

## P6601/P6602

- Temperature Probes
- For Tek DMMs
- Measure up to 240°C

## P6125

- 250 MHz, Counter/Timer

## P6420

- 1 GHz, RF DMM

## ORDERING INFORMATION

<b>P6008</b> 100 MHz Environmental Probe 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.	<b>\$370</b>
<b>P6601</b> Temperature Probe Includes: Instruction manual (070-2620-00)	<b>\$315</b>
<b>P6602</b> 1.5 m Temperature Probe Includes: Instruction manual (070-4377-00)	<b>\$320</b>
<b>P6125</b> 250 MHz Counter Probe 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	<b>\$110</b>
<b>P6420</b> 2 m RF DMM Probe 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.	<b>\$195</b>

# SURFACE MOUNT DEVICE PROBING AND INTERCONNECTS

## P6562 SMT Probe 350 MHz

### 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 Inch Lead Centers

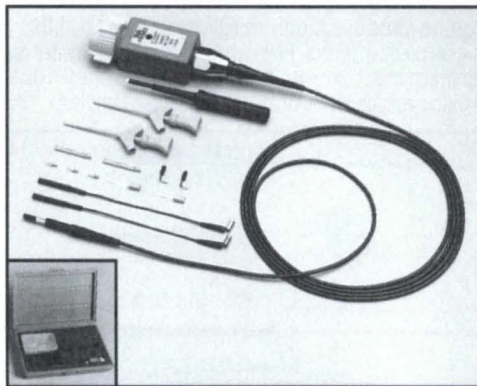
### ORDERING INFORMATION

**P6562 10X**, 350 MHz, 1.5 m SMT Probe **\$250**  
Includes: Adjustment tool (003-1433-00); 2 each KlipChip™ Adapters (206-0364-00); 2 each 4 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; 2 each circuit board connectors; instruction sheet (070-7792-00)

## SURFACE MOUNT DEVICE PROBING AND INTERCONNECTS

The increasing use of surface mount technology (SMT) brings many benefits to electronic circuit board (ECB) design and manufacture. Among these are increased circuit density, increased product reliability, and lower assembly costs.

Troubleshooting and device interconnection, however, have become more difficult due to decreased device size, tighter lead spacing and increased ECB densities. Tek's new offering of the following SMT probing and interconnect devices meets these demanding requirements.



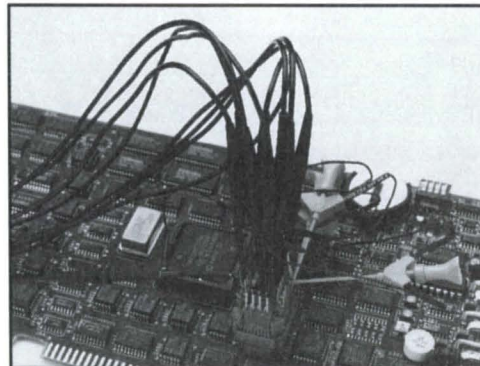
P6562 SMT Probe (specifications on page 312)

## P6562 SMT PROBE

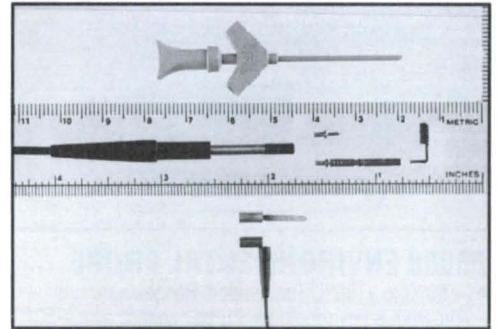
The P6562 SMT probe features a low-mass probe head and ultra-lightweight cable for easier, quicker and more stable circuit attachment. Multiple probes can now be attached to PLCC, SOIC, Tektronix KLIPKIT, and DIP IC Test Clips. The probe's light weight prevents it from disconnecting from the DUT (device under test), a common problem with heavier probes.

The P6562 features modular construction, hybrid and SMT circuitry, a readout pin which activates the readout encoding circuitry of so equipped oscilloscopes, and a small geometry probe tip that easily negotiates dense circuitry and tight spaces.

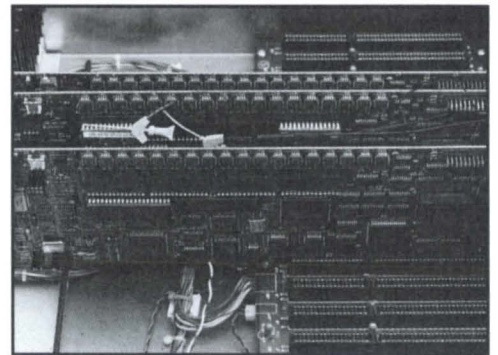
It is designed for use in digital circuitry and telecommunication/computer backplanes.



P6562 used with PLCC Clip (0.025" square pin adapter).



P6562 with typical accessories

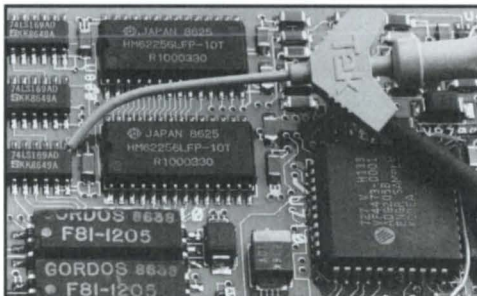


P6562 used in card cage application.

# SURFACE MOUNT DEVICE PROBING AND INTERCONNECTS

## SMT KlipChip™

The SMT KlipChip™ is an interface device for attachment of logic and analog probes to today's SMD's, DIP's, and discrete components. The SMT KlipChip™ is capable of attaching to components with maximum lead diameters of 0.095 in and stackable on lead centers of 0.050 in. Dual sided 0.025 in lead contacts allow this grabber to be used in multiple signal insertion/acquisition.



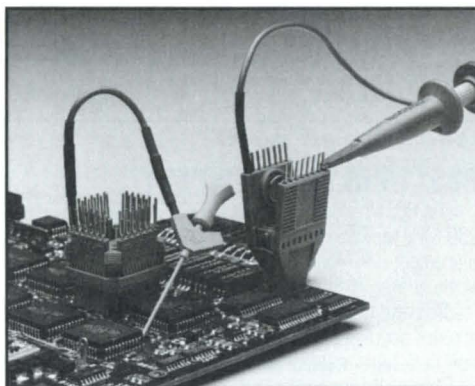
SMT KlipChip™

## PLCC QUAD CLIPS

The Snap-Ring design allows quick and easy interconnection to Plastic Leaded Chip Carriers (PLCC) with "J" leads on 0.050 in 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 in centers. Features gold-plated beryllium copper contacts with glass-filled nylon insulation. Upper contact pins: 0.64 mm (0.025 in) square pins.



PLCC Quad Clip (left) and SOIC Clip (right).

## SMT KlipChip™ SMG50/SMGK51/SMGK52

## SOIC Clips SMC8/SMC14/SMC16/SMC20/ SMC24

## PLCC Quad Clips SMQ20/SMQ28/SMQ44/ SMQ52/SMQ68 SMQ84

## Engineering Kits PLCC - SMQK1/SOIC - SMCK1

### 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 in Centers PLCC, SOIC, and other Packages with the SMT KlipChip™ Adapter
- Signal Insertion and Temporary Lead Jumpers without Soldering

## ORDERING INFORMATION

<b>SMG50 SMT KlipChip™</b> Includes: 20 SMT KlipChip™	<b>\$89</b>	<b>SMC16 SOIC Twin Pack</b> Includes: 2 each 16 Pin SOIC Clips; 2 each SMT KlipChip™ Adapter; 4 Electrical Leads.	<b>\$47</b>	<b>SMQ28 PLCC Twin Pack</b> Includes: 2 each 28 Pin PLCC Clips; 2 each SMT KlipChip™ Adapter; 4 Electrical Leads.	<b>\$100</b>
<b>SMGK51 SMT KlipChip™ Adapter Leads</b> Includes: 4 KlipChip™ Adapters; 3 Electrical Leads.	<b>\$40</b>	<b>SMC20 SOIC Twin Pack</b> Includes: 2 each 20 Pin SOIC Clips; 2 each SMT KlipChip™ Adapter; 4 Electrical Leads.	<b>\$48</b>	<b>SMQ44 PLCC Twin Pack</b> Includes: 2 each 44 Pin PLCC Clips; 2 each SMT KlipChip™ Adapter; 4 Electrical Leads.	<b>\$105</b>
<b>SMGK52 SMT KlipChip™ Adapters</b> Includes: 5 SMT KlipChip™ Adapter; 3 Electrical Leads; 1 Dual Lead Adapter; 1 Flex Tip Adapter.	<b>\$70</b>	<b>SMC24 SOIC Twin Pack</b> Includes: 2 each 24 Pin SOIC Clips; 2 each SMT KlipChip™ Adapter; 4 Electrical Leads.	<b>\$50</b>	<b>SMQ52 PLCC Twin Pack</b> Includes: 2 each 52 Pin PLCC Clips; 2 each SMT KlipChip™ Adapter; 4 Electrical Leads.	<b>\$110</b>
<b>SMCK1 SOIC Engineering Kit</b> Includes: 1 each of 8, 14, 16, 20, 24 Pin SOIC Clips plus 4 SMT KlipChip™ Adapter, 8 Electrical Leads w/ (0.025") Square Pin Connectors.	<b>\$99</b>	<b>SMQK1 PLCC Engineering Kit</b> Includes: 1 each of 20, 28, 44, 52, 68, 84 Pin PLCC Clips plus 4 SMT KlipChip™ Adapter, 8 Electrical Leads w/(0.025") Square Pin Connectors.	<b>\$270</b>	<b>SMQ68 PLCC Twin Pack</b> Includes: 2 each 68 Pin PLCC Clips; 2 each SMT KlipChip™ Adapter; 4 Electrical Leads.	<b>\$115</b>
<b>SMC8 SOIC Twin Pack</b> Includes: 2 each 8 Pin SOIC Clips; 2 each SMT KlipChip™ Adapter; 4 Electrical Leads.	<b>\$42</b>	<b>SMQ20 PLCC Twin Pack</b> Includes: 2 each 20 Pin PLCC Clips; 2 each SMT KlipChip™ Adapter; 4 Electrical Leads.	<b>\$97</b>	<b>SMQ84 PLCC Twin Pack</b> Includes: 2 each 84 Pin PLCC Clips; 2 each SMT KlipChip™ Adapter; 4 Electrical Leads.	<b>\$120</b>
<b>SMC14 SOIC Twin Pack</b> Includes: 2 each 14 Pin SOIC Clips; 2 each SMT KlipChip™ Adapter; 4 Electrical Leads.	<b>\$43</b>				

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

# SPRING CONTACT FIXTURED PROBES

## 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 M $\Omega$ , < 3.8 pF for P6511/P6513) (< 4.0 pF for P6515/P6517)
- Drives 50  $\Omega$  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. **\$270**  
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. **\$270**  
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 **\$14**

**System Interface Kits -**  
To interface P6513 or P6517 probes to test systems such as the TSI family (see page 194).

**ITA Probe Scanner Kit -**  
Support for one fixture. Order 021-0443-00 **\$145**

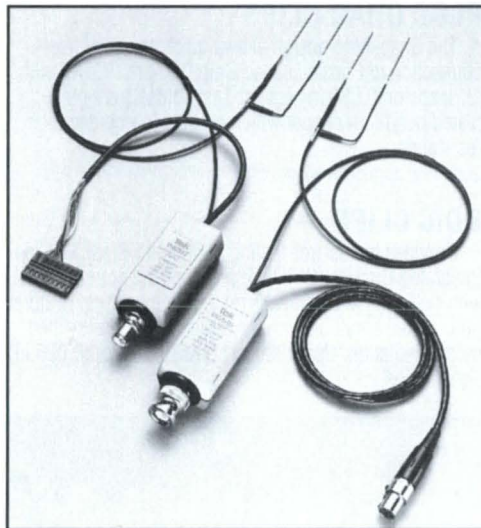
**ITA/Rcvr/Power Probe Scanner Kit -**  
Support for one TSI System. Order 021-0444-00 **\$400**

**1102 Power Supply -** for P6511 and P6515 probes **\$300**

\*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 Co.

\*3 For 1 GHz bandwidth see the A6501 on the next page.



P6515 and P6517 shown.

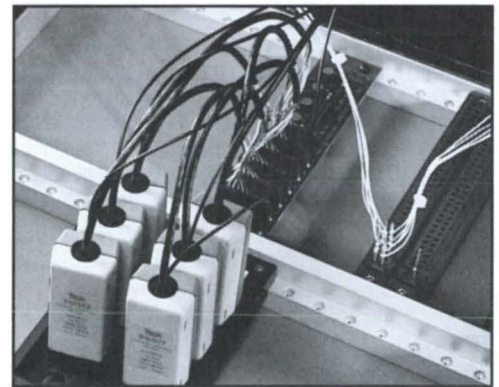
### P6511/P6513/P6515/P6517

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  $\Omega$  transmission line. The probe's spring contact receptacle

### CHARACTERISTICS

Electrical	P6511/P6513	Common To All	P6515/6517
Bandwidth	300 MHz <sup>*3</sup>		250 MHz <sup>*3</sup>
Rise Time	< 1.17 ns		< 1.4 ns
Attenuation		10X	
Input R		1 M $\Omega$	
Input C	$\leq$ 3.8 pF		$\leq$ 4.0 pF
Dynamic Range		$\pm$ 15 V	
Max. Nondestructive Input Voltage		$\pm$ 30 V at dc	
Power Supply Requirements		$\pm$ 15 V at 30 mA/ $\pm$ 5 V at 45 mA	
Low-Frequency Compensation		Fixed, flat $\pm$ 3%	
Propagation Delay		3.8 ns $\pm$ 100 ps	
Probe Aberrations	$< \pm$ 6%, 8% p-p in the first 4 ns; $< \pm$ 2%, 3% p-p after 4 ns		
Output Zero		$< \pm$ 2 mV	
DC Thermal Drift		$< 50 \mu$ V/ $^{\circ}$ C	
<b>Physical</b>			
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) $\pm$ 20% 5.5 oz (155 g) $\pm$ 20%		1.26 oz (36 g) $\pm$ 20% 3.5 oz (99 g) $\pm$ 20%
Mounting Hole Diameter	.067" to .069" (1.70 to 1.75 mm)		.037 to .038" (.940 to .965 mm)
Receptacle (outside diameter)	.066" (1.68 mm)		.036" (.914 mm)



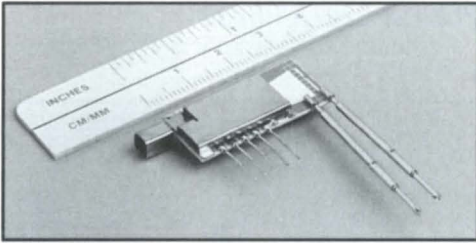
P6513 and P6517 in test fixture.

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 page 194). 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.

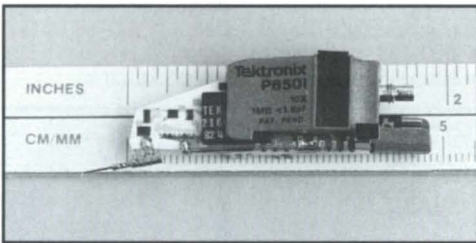
Programmable P6513/P6517 scanning is provided by the TSI family of products (see page 194). Complete support packages including probe power, are available for 12 probes. These packages facilitate use of the probes in automated testing applications such as functional board test. The probe receptacle's diameter permits mounting on 100 MIL (50 MIL for P6515/P6517) centers, used in most circuit board testing.





## A6501

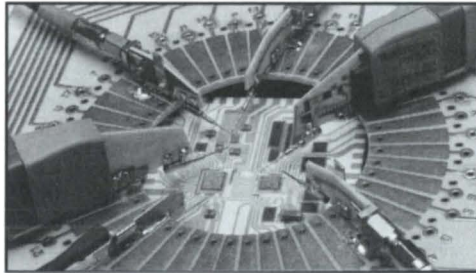
The A6501 is a high performance 10X, dc-to-1.0 GHz FET input buffer amplifier designed for placement onto a circuit board, probe card or bed-of-nails test fixture. The A6501's versatile connection design provides connection to the circuit board or fixture by either twisted wires, spring loaded contacts, 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 connector at the probe end and a BNC connector 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

## 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, 50 Ω, 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

## ORDERING INFORMATION

<b>A6501</b> 1GHz, 1M Ω, 10X Buffer Amplifier 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).	<b>\$410</b>
<b>P6501</b> 750 MHz, 1M Ω, 10X Microprobe Includes: Two tungsten probe tips (206-0371-01); Ground lead (196-3141-00); Instruction sheet (070-6300-00). <b>Opt. 01</b> – Add 115 V ac, 60Hz power supply and 1.5 m 50 Ω cable. <b>+\$165</b> <b>Opt. 02</b> – Add TEKPROBE™ cable. <b>+\$165</b> Order 015-0540-00	<b>\$515</b>
<b>P6507</b> 1GHz, 50 Ω, 1X Microprobe Includes: One tungsten probe tip (206-0371-01); instruction sheet (070-6301-00). <b>Opt. 01</b> – Add 0.5 m 50 Ω cable. <b>+\$45</b>	<b>\$65</b>

OPTIONAL ACCESSORIES	
<b>A6501</b>	
<b>2x3 Power Connector</b> – For Male, Order 131-3941-00 <b>\$22</b> For Female, Order 131-3821-01 <b>\$50</b>	<b>\$8.25</b>
<b>Peltola-to-BNC adapter</b> – Order 131-1315-01 <b>\$8.25</b> <b>100 MIL Centers Spring Contacts</b> – Pkg of 10. Order 016-0946-00 <b>\$50</b>	<b>\$50</b>
<b>P6501</b>	
<b>Manual</b> – Order 070-6188-00 <b>\$10</b> <b>50 Ω Cable</b> – Miniature to BNC, 1.5 m. Order 174-0538-00 <b>\$35</b> <b>Ground Lead Assembly</b> – Order 196-3141-00 <b>\$7</b>	<b>\$7</b>
<b>P6507</b>	
<b>50 Ω Cable</b> – Miniature to BNC 0.5 m. Order 174-0668-00 <b>\$35</b> <b>Ground Lead Assembly</b> – Order 196-3141-00 <b>\$7</b>	<b>\$7</b>

REPLACEABLE TIPS	
The P6501/6507 tips can be easily replaced as they wear or for different applications.	
<b>Standard Length</b> – 0.20" (5.08 mm) <b>\$30</b> <b>Tungsten Probe Tip</b> – Pkg of 5. Order 206-0371-02 <b>\$30</b> <b>Palladium Probe Tip</b> – Pkg of 5. Order 206-0370-02 <b>\$38</b> <b>Long Length</b> – 0.46" (11.6 mm) <b>\$30</b> <b>Tungsten Probe Tip</b> – Pkg of 5. Order 206-0371-03 <b>\$30</b> <b>Palladium Probe Tip</b> – Pkg of 5. Order 206-0370-03 <b>\$38</b>	
<b>POWER SUPPLY</b>	
<b>Power Supply</b> – Order 119-2461-00 <b>\$145</b> <b>1102 Power Supply</b> – for A6501 and P6501 probes <b>\$300</b> <b>Power Cable</b> – To connect probe to 1102 power supply. Order 174-0943-00 <b>\$120</b>	

# ACTIVE VOLTAGE PROBES FOR 50 $\Omega$ , 1 M $\Omega$ INPUTS, OR TEKPROBE™ INTERFACE

## P6201 FET Probe

- 900 MHz (Typically 1.1 GHz\*)

## P6202A FET Probe

- 500 MHz, Miniature Tip

## P6230 Bias/Offset Probe

- 1.5 GHz, Subminiature Tip

## P6203 Bipolar Probe

- 1 GHz, Miniature Tip

## P6204 FET Probe

- 1 GHz (Typically 1.1 GHz\*) Miniature Tip

## P6231 Bias/Offset Probe

- 1.5 GHz, Subminiature Tip

### 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, P6203, P6204)
- Variable DC Offset  
Allows Correction for dc Levels to Bring the Signal into the Probe's Dynamic Measurement Range
- Internal/External 50  $\Omega$  Terminations (P6201, P6202A, P6230)  
Allows Connection to 50  $\Omega$  or 1 M $\Omega$  Inputs
- Wide Range of Accessories  
Compatibility and Easy Circuit Attachment
- Easily Replaceable Probe Tips
- Readout Coding for Attenuation  
Reduces Measurement Reading Errors

\* At room temperature.

### ORDERING INFORMATION

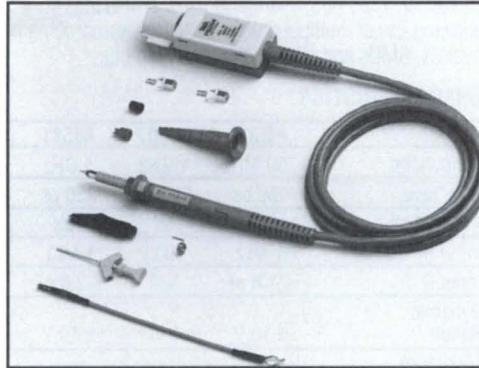
See page 322.

## ACTIVE PROBES

Active probes are used in measurements where high input resistance and low input capacitance are needed without loss of signal, and where frequencies are above 250 MHz. The dynamic range and measurement capability are substantially increased through the dc voltage offset control. 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. Since active probes have a selectable 50  $\Omega$  output impedance, the distance from the probe tip to the instrument is only limited by the bandwidth limit of the 50  $\Omega$  coaxial cables between the probe and instrument.

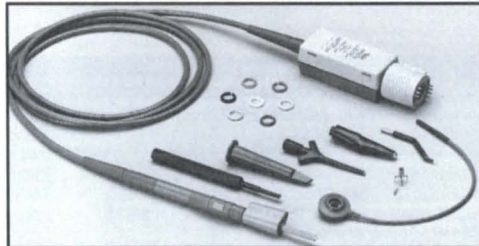
## P6204/P6203/P6231

For use with TEKPROBE™ Interfaces or 1103 TEKPROBE™ Power Supply.



## P6204/P6203 DC TO 1 GHz

- P6204 10 M $\Omega$ /1.9 pF, 10X (shown above)
- P6203 10 k $\Omega$ / 2 pF, 10X
- DC Offset
- Identify Button Allows Remote Sequencing of Oscilloscope Programs
- Automatic 50  $\Omega$  Termination
- Easily Replaceable Probe Tips/Probe Heads

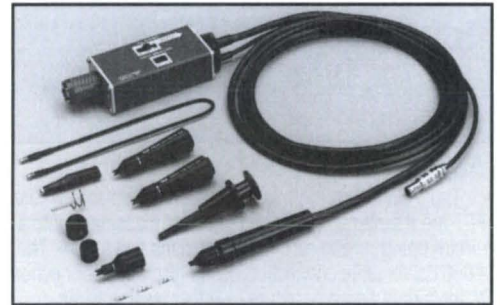


## P6231 DC TO 1.5 GHz

- 500  $\Omega$ /1.6 pF, 10X
- Bias/Offset provides adjustable tip "nulling" voltage ( $\pm 5.0$  V dc)
- Identify Button, Allows Remote Sequencing of Oscilloscope Programs
- Automatic 50  $\Omega$  Termination
- Easily Replaceable Attenuator Tip

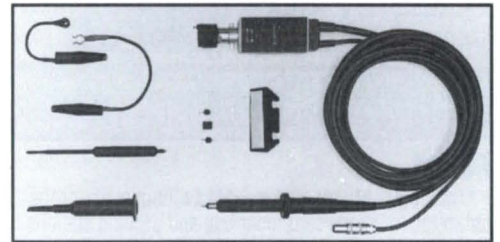
## P6201/P6202A/P6230

For use with BNC Inputs and Scope Probe Power Jacks or 1101A Power Supply



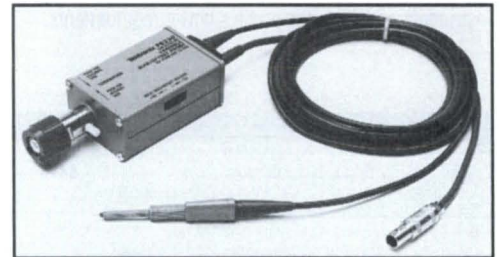
## P6201 DC TO 900 MHz (TYP 1.1 GHz\*)

- 100 k $\Omega$ /3 pF (1X); 1 M $\Omega$ /1.5 pF (10X and 100X)
- Unity Gain (1X) with Readout
- Two Plug-on Attenuator Heads (10X and 100X) that Maintain Scope Readout Factor
- DC Offset, ac-dc Coupling Switch
- Internal/External 50  $\Omega$  Termination Switch



## P6202A DC TO 500 MHz

- 10 M $\Omega$ /2 pF (10X)
- Optional 10X Plug-on Attenuator Head for 100X Attenuation
- DC Offset, ac-dc Coupling Switch
- Internal/External 50  $\Omega$  Termination Switch



## P6230 DC TO 1.5 GHz

- 500  $\Omega$ /1.3 pF, 10X
- Bias/Offset provides adjustable tip "nulling" voltage ( $\pm 5.0$  V DC)
- Internal/External 50  $\Omega$  Termination Switch
- Easily Replaceable Attenuator Tip

For specifications see chart on page 313.

# LOW CAPACITANCE (LOW IMPEDANCE $Z_0$ ) AND TDR PASSIVE PROBES

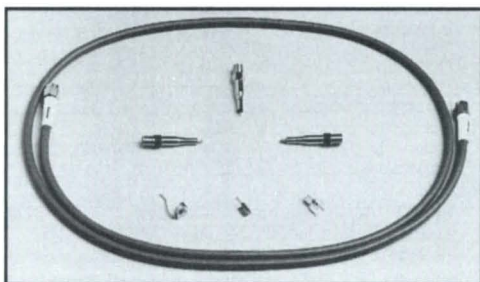
## SAMPLING

Two characteristics are essential in a system for sampling repetitive high frequency signals: high bandwidth and low input capacitance. Tek's low impedance  $Z_0$  passive voltage probes give you both – without the added cost of an active probe. However, if you need low resistive loading, you should choose one of the active probes on page 320.

With bandwidths of up to 9 GHz on the P6150 and 3.5 GHz on the P6156, these probes get you as close as possible to your scope's maximum bandwidth. Accurate risetime and propagation delay readings are possible with less than 0.15 pF Input C (less than 1.0 pF with the P6156).

## 1X ATTENUATOR FOR TDR

With 1X attenuation available, these probes are also a quick and easy solution to circuit board impedance testing of Time Domain Reflectometry (TDR) without the hassles of soldering or fixturing.



P6150 with Typical Accessories

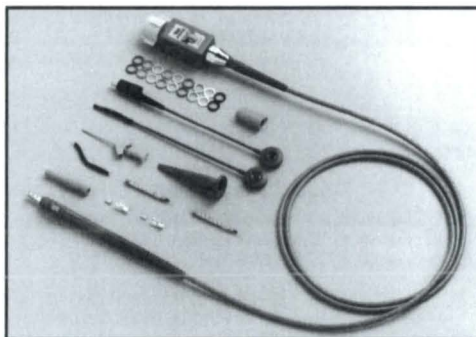
## P6150 DC TO 9 GHz

- 10X Attenuating Probe, Low Impedance  $Z_0$  with 1X Accessory Tip
- Small Size
- Ideal for 50  $\Omega$  Environments
- Interchangeable Probe Tips (1X, 10X)
- Recommended Probe for 11800/CSA800/SD2X/7000 Family Sampling Plug-Ins
- SMA Cable Connectors for Optimum Signal Integrity
- High Quality, Flexible Probe Cable

## CHARACTERISTICS

Probe Type	Nominal Length	Attenuation	Bandwidth	Rise Time	Loading Input R/C	Max V In	Instrument Input R/C	Propagation Delay	Interface/Readout/Identify
P6150	1 m	10X $\pm 2\%$	9 GHz	<38.8 ps	500 $\Omega$ / $<0.15$ pF	12.5 V rms	50 $\Omega$	4.40 ns $\pm 0.1$ ns	S/N/N
		1X $\pm 2\%$	$\geq 3$ GHz	$\leq 170$ ps	50 $\Omega$ /N/A	*1	50 $\Omega$	4.40 ns $\pm 0.1$ ns	S/N/N
P6156	1.5 m	10X $\pm 3\%$	$\geq 3.5$ GHz	<100 ps	500 $\Omega$ / $\leq 1$ pF	15 V rms	50 $\Omega$ /1 M $\Omega$	7.75 ns $\pm 0.07$ ns	B/Y/Y
		100X $\pm 3\%$	$\geq 3.0$ GHz	$\leq 120$ ps	5000 $\Omega$ / $\leq 1.1$ pF (Typically 1 pF)	50 V rms	50 $\Omega$ /1 M $\Omega$	7.75 ns $\pm 0.07$ ns	B/Y/Y
		20X $\pm 3\%$	$\geq 3.5$ GHz	<100 ps	1000 $\Omega$ / $\leq 1$ pF	22 V rms	50 $\Omega$ /1 M $\Omega$	7.75 ns $\pm 0.07$ ns	B/Y/Y
		1X $\pm 5\%$	$\geq 1.5$ GHz	<300 ps	50 $\Omega$ /N/A	*2	50 $\Omega$ /1 M $\Omega$	7.75 ns $\pm 0.07$ ns	B/Y/Y

Interface/Readout/Identify: Interface: B=BNC; S=SMA  
Readout/Identify: Y=Yes; N=No



P6156 Opt. 25 with Standard Accessories

## P6156 DC TO 3.5 GHz

- 10X Attenuating, Low Impedance  $Z_0$  Probe, with Identify and Readout.
- Interchangeable Probe Tips 1X, 10X, 20X, 100X.

The P6156 is a 3.5 GHz, low impedance  $Z_0$  probe which comes standard with a 10X (500  $\Omega$ ) attenuator tip. The 100X attenuation value is available as an option and the 1X and 20X attenuators may be purchased as replaceable subassemblies. The P6156 probe may be used with 11000-Series plug-ins, the 11800-Series SD2X Sampling/TDR plug-ins, 7000-Series plug-ins and Sampling/TDR units, 2400 Series, or other 50  $\Omega$ /1 M $\Omega$  input channel amplifiers and oscilloscopes (with the proper adapters).

The P6156 may be directly connected to a 50  $\Omega$  input, but requires a 50  $\Omega$  termination when used with 1 M $\Omega$  amplifiers. Check the instruction sheet for proper usage. This probe gives you a handy identify button for accessing many of the functions of your 11000 or DSA600 Series scopes from the probe. The compact tip size is perfect for accessing small geometry circuits. The attenuator tips are color-coded to a switch on the compensation box of the P6156 to help in properly setting the readout scale factor.

*Note: The P6156 attenuator tip must be changed and the compensation box readout switch changed to provide the various 1X, 10X, 20X, and 100X attenuation values.*

\*1 Limited by scope input or 42 V rms.

\*2 Limited by scope input or 50 V rms.

## 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

See page 323.

# ORDERING INFORMATION 1X AND 10X PASSIVE VOLTAGE PROBES FOR 1 MΩ INPUTS

## ORDERING INFORMATION 1X AND 10X PASSIVE VOLTAGE PROBES

For specifications see pages 312-313.

For probe accessories see pages 330-333.

Instrument compatibility chart is on pages 310-311.

These pages list ordering information for Tek passive and active voltage probes. See the voltage probes specification chart on pages 312-313 for specifications. More detail for the P6562 SMT Probe is provided on page 316; active probes on page 320; differential probes on page 327; low capacitance probes on page 321; and specialty probes on page 315. The photograph on page 314 gives representative examples of the size and shape of the various tip styles.

### 1X and 10X Passive Voltage Probes

<b>P6006</b> 10X, 35 MHz, 1.8 m rugged probe. 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 (070-0381-00).									
<b>Opt. 03</b> - 9 ft Cable		\$20							
<b>Opt. 04</b> - 12 ft Cable		\$25							
<b>P6053C</b> 10X, 250 MHz, Trace Identify Compact Includes: Bayonet ground tip (013-0085-01); Retractable hook tip (013-0107-06); 6 in Ground lead w/ square pin receptacle (196-3113-02); Ground collar (343-1003-01); 2 in ground lead (195-4240-00); Two each circuit board connectors; 2 each of black, white, silver, gray, blue, orange, red, green and yellow cable markers; SMT KlipChip™ (206-0364-00); adjustment tool (003-1433-00); 6 in Ground lead w/ alligator clip (196-3305-00); Ground cover (166-0404-01); Hook tip (206-0114-00); Probe holder (352-0351-00); IC TEST TIP; Miniature adapter (013-0202-02); Instruction sheet (070-7843-00).		\$180							
<b>Opt. 01</b> - 3.5 ft Cable		+\$15							
<b>Opt. 03</b> - 9 ft. Cable		+\$25							
<b>P6101A</b> 1X, 15 MHz, 2 m Modular Probe 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).			\$65						
<b>Opt. 01</b> - 1 m Cable				\$10					
<b>P6102A</b> 10X, 60 MHz, 2 m Modular Probe Same as the P6105A; Instruction sheet (070-5824-00).					\$95				
<b>P6103</b> 10X, 50 MHz, 2 m Modular Probe Includes: Adjustment tool (003-1433-00); Retractable hook tip (013-0107-06); Replaceable probe tip (131-3723-00); 6 in Ground lead (196-3120-00); IC test probe tip; Two each of white, yellow, red and green cable markers; Instruction sheet (070-6156-01).						\$40			
<b>Opt. 01</b> - 1m Cable							\$10		
<b>Opt. 03</b> - 3 m Cable							\$20		
<b>P6105A</b> 10X, 100 MHz, 2 m Modular Probe Includes: Same as the P6101A plus adjustment tool (003-1433-00); Instruction sheet (070- 5516-00).								\$135	
<b>Opt. 01</b> - 1 m Cable									\$10
<b>Opt. 03</b> - 3 m Cable									\$10
<b>P6106A</b> 10X, 250 MHz, 2 m Modular Probe Includes: Same as the P6105A except 3 in Ground lead (175-0263-01) instead of 12 in Ground lead; Instruction sheet (070-5517-00).									\$180
<b>Opt. 01</b> - 1 m Cable									+\$10
<b>Opt. 03</b> - 3 m Cable									+\$20
<b>P6107A</b> 10X, 100 MHz, 2 m Modular Probe Includes: Same as the P6105A; Instruction sheet (070-5518-00).	\$155								
<b>P6108A</b> 10X, 100 MHz, 2 m Modular Probe Includes: Same as the P6105A; Instruction sheet (070-5519-00).									\$114
<b>P6109</b> 10X, 150 MHz, 2 m Modular Probe Includes: Same as the P6103; Instruction sheet (070-6157-02).									\$70
<b>Opt. 01</b> - 1.5 m cable									+\$10
<b>Opt. 03</b> - 3 m Cable									+\$20
<b>P6121</b> 10X, 100 MHz, 1.5 m Modular Probe Includes: Same as the P6122; Instruction sheet (070-5511-00).									\$155
<b>P6122</b> 10X, 100 MHz, 1.5 m Modular Probe 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 (196-3286-00); 3.5 in Ground lead (195-6176-00); Alligator clip (344-0046-00); two silver cable marker bands; Instruction sheet (070-5512-00).									\$80
<b>P6130</b> 10X, 250 MHz, 2 m Modular Subminiature Probe 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 (352-0351-00); Two each of white, gray, red and green cable markers; Instruction sheet (070-5513-00).									\$170
<b>Opt. 01</b> - 1.5 m cable									+\$15
<b>Opt. 03</b> - 3 m cable									+\$25
<b>P6131</b> 10X, 300 MHz, 1.3 m Modular Subminiature 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 (352-0351-00); 2 each of white, gray, red and green cable markers; Instruction sheet (070-5514-00).									\$170
<b>Opt. 02</b> - 2 m cable									+\$20
<b>Opt. 03</b> - 3 m cable									+\$25
<b>P6133</b> 10X, 150 MHz, 2 m Modular Subminiature Includes: Same as P6131; except for Instruction sheet (070-5795-01).									\$140
<b>Opt. 01</b> - 1.3 m cable									+\$15
<b>Opt. 03</b> - 3 m cable									+\$25
<b>Opt. 25</b> - 1.3 m cable compact tip - Includes: Same as P6137 except Instruction sheet (070-5795-00).									NC
<b>P6134C</b> 10X, 400 MHz, 1.5 m Passive Probe, Compact. Includes: Adjustment Tool (003-1433-00); Retractable hook tip (013-0107-06); 2 circuit board connectors; 2 in ground lead (195-4240-00); 6 in ground lead (196-3305-00); Miniature alligator clip (344-0398-00); SMT KlipChip™ (206-0364-00); 2 each of black, white, silver, gray, blue, orange, red, green and yellow cable markers; Instruction manual (070-7676-00).									\$180
<b>P6136</b> 10X, 350 MHz, 1.3 m Modular Subminiature Includes: Same as P6131; except instruction sheet (070-6025-01).									\$175
<b>Opt. 25</b> - 1.3 m cable compact tip Includes: Same as P6137; except Instruction sheet (070-6025-01).									NC
<b>P6137</b> 10X, 400 MHz, 1.5 m Modular Compact Includes: 2 in ground lead (195-4240-00); low inductance lead ground collar (343-1003-01); Retractable hook tip (013-0107-06); SMT KlipChip™ (206-0364-00); 6 in ground lead w/square pin receptacle (196-3113-02); 6 in ground lead w/alligator clip (196-3305-00); Adjustment tool (003-1433-00); 2 circuit board connectors; 2 each of black, white, silver, gray, blue, orange, red, green and yellow cable markers; Instruction manual (070-6432-00).									\$180
<b>P6148A</b> 10X, 50 MHz, 2 m Modular Probe Includes: Same as the P6105A; Instruction sheet (070- 5516-00).									\$175
<b>P6149A</b> 10X, 50 MHz, 2 m Modular Probe Includes: Same as the P6105A; Instruction sheet (070-5510-00).									\$170
<b>P6562</b> 10X, 350 MHz, 1.5 m SMT Probe Includes: Adjustment tool (003-1433-00); 2 each SMT KlipChip™ (206-0364-00); 2 each 4 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; 2 each circuit board connectors. Instruction sheet (070-7792-00)									\$250
<b>OPTIONAL ACCESSORIES</b>									
<b>Conversion Kit</b> - Subminiature Tip to Compact Tip									
(P6130)		Order 040-1252-02							\$55
(P6131 1.3 m)		Order 040-1251-02							\$55
(P6133 Opt. 01 - 1.3 m)		Order 040-1250-02							\$55
(P6136 1.3m)		Order 040-1253-02							\$60
☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.									

# ORDERING INFORMATION PASSIVE VOLTAGE PROBES 1M $\Omega$ /50 $\Omega$ INPUTS ACTIVE VOLTAGE PROBES

## ORDERING INFORMATION 1X – 10X SWITCHABLE PASSIVE VOLTAGE PROBES

For specifications see pages 312-313.

For probe accessories see pages 330-333.

Instrument compatibility chart is on pages 310-311.

### 1X – 10X SWITCHABLE PASSIVE VOLTAGE PROBES

<p><b>P6062B</b> 100 MHz, 6 ft (1.8 m) Switchable 1X/10X Probe 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); Hook tip (206-0114-00); Two replaceable tips (see 206-0191-03); Probe holder (352-0351-00); Two alligator clips(344-0046-00); Instruction sheet (062-2927-00) <b>Opt. 03</b> – 9 ft Cable <span style="float: right;">+\$20</span></p>	<p><b>P6063B</b> 200 MHz, 6 ft (1.8 m) Switchable 1X/10X probe Includes: Same as P6062B except 3 in Ground lead (175-0263-01) instead of the 12 in Ground lead; Instruction sheet (062-2928-01); <span style="float: right;">\$290</span></p>	<p><b>P6119</b> 100 MHz, 2 m Switchable 1X/10X probe Includes: Screwdriver adjustment tool (003-1433-00); Retractable hook tip (013-0107-06); Replaceable probe tip (131-3723-00); 6 in Ground lead (196-3120-00); 1 IC test probe tip; Two each of white, yellow, red, and green markers; Instruction sheet (070-7432-00). <b>Opt. 03</b> – 3 m <span style="float: right;">\$65 +\$15</span></p>
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### 100X – 1000X HIGH VOLTAGE PROBES

<p><b>P6007</b> 100X, 6 ft (1.8 m) High Voltage Probe 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). <b>Opt. 01</b> – 3.5 ft cable <span style="float: right;">+\$10</span> <b>Opt. 03</b> – 9 ft cable <span style="float: right;">+\$25</span> <b>Opt. 04</b> – 12 ft cable <span style="float: right;">+\$30</span></p>	<p><b>P6009</b> 100X, 9 ft (2.8 m) High Voltage Probe with Readout Includes: Same as the P6007 plus Bayonet ground assembly (013-0052-01); 3 in Ground lead (175-0263-01); Instruction manual (070-0401-01). <b>Opt. 14</b> – 9 ft without Readout <span style="float: right;">NC</span></p>	<p><b>P6015</b> 1000X, 10 ft (3.1 m) High Voltage Probe Includes: Carrying case (016-0128-02); Alligator clip (344-0005-00); Instruction manual (070-0373-02). <b>Opt. 10</b> – without CFC 114 freon charge, Max. 13 kV. <span style="float: right;">NC</span> <b>Opt. 25</b> – 25 ft cable (8 MHz B/W) <span style="float: right;">+\$125</span> <b>Opt. 26</b> – without CFC 114 freon charge, Max. 13 kV. <span style="float: right;">+\$125</span></p>
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### LOW CAPACITANCE PASSIVE VOLTAGE PROBES

<p><b>P6150</b> 10X, 9 GHz, 1.0 m, Low Impedance Probe 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). <span style="float: right;">\$1,295</span></p>	<p><b>P6156</b> 3.5 GHz (10X), (3.0 GHz w/100X), 1.5 m Low Impedance Probe, Compact Includes: 10X Attenuator head (206-0380-00), 100X Attenuator head (206-0382-00), 6 in ground lead w/alligator clip (196-3305-00), 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); SMT KlipChip™ (206-0364-00); 2 each cable markers various colors: gray, white, green, red; Probe tip holder (352-0670-00); Instruction sheet (070-6430-00). <b>Opt. 25</b> – Adds 100X Attenuator <span style="float: right;">+\$60</span></p>	<p style="text-align: center;"><b>P6156 OPTIONAL ACCESSORIES</b></p> <table border="0" style="width: 100%;"> <tr> <td><b>Probe Tips</b></td> <td></td> </tr> <tr> <td>(1X) Order 206-0379-00</td> <td style="text-align: right;">\$65</td> </tr> <tr> <td>(10X) Order 206-0380-00</td> <td style="text-align: right;">\$65</td> </tr> <tr> <td>(20X) Order 206-0381-00</td> <td style="text-align: right;">\$65</td> </tr> <tr> <td>(100X) Order 206-0382-00</td> <td style="text-align: right;">\$65</td> </tr> </table> <p style="text-align: center;"><b>OPTIONAL ACCESSORIES</b></p> <table border="0" style="width: 100%;"> <tr> <td><b>SMA Male to BNC Female</b> – Order 015-0554-00</td> <td style="text-align: right;">\$33</td> </tr> <tr> <td><b>SMA Female to BNC Male</b> – Order 015-0572-00</td> <td style="text-align: right;">\$19.25</td> </tr> <tr> <td><b>SMA to Probe Tip</b> – Order 013-0237-00</td> <td style="text-align: right;">\$345</td> </tr> </table>	<b>Probe Tips</b>		(1X) Order 206-0379-00	\$65	(10X) Order 206-0380-00	\$65	(20X) Order 206-0381-00	\$65	(100X) Order 206-0382-00	\$65	<b>SMA Male to BNC Female</b> – Order 015-0554-00	\$33	<b>SMA Female to BNC Male</b> – Order 015-0572-00	\$19.25	<b>SMA to Probe Tip</b> – Order 013-0237-00	\$345
<b>Probe Tips</b>																		
(1X) Order 206-0379-00	\$65																	
(10X) Order 206-0380-00	\$65																	
(20X) Order 206-0381-00	\$65																	
(100X) Order 206-0382-00	\$65																	
<b>SMA Male to BNC Female</b> – Order 015-0554-00	\$33																	
<b>SMA Female to BNC Male</b> – Order 015-0572-00	\$19.25																	
<b>SMA to Probe Tip</b> – Order 013-0237-00	\$345																	

### ACTIVE VOLTAGE PROBES

<p><b>P6201</b> 1X, 900 MHz FET Probe Includes: Retractable probe tip (013-0135-00); 10X Attenuator head (010-0376-00); 100X Attenuator head (010-0377-00); 3 Probe tips (206-0200-00); Miniature probe tip adapter (103-0164-00); 12 in Ground lead (175-0848-02); Ground contact (131-1302-00); Alligator clip (344-0046-00); Electrical insulating sleeve (166-0557-00); Ground contact insulator (342-0180-00); Probe holder (352-0351-00); Carrying case; Instruction manual (070-1306-00). <span style="float: right;">\$1,395</span></p>	<p><b>P6203</b> 10X, 1 GHz Bipolar Probe Includes: retractable hook tip (013-0107-06); 6 in ground lead (196-3198-00); SMT KlipChip™ (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). <span style="float: right;">\$950</span></p>	<p><b>P6231</b> 10X, 1.5 GHz Bias/Offset Probe 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); 6 in Ground lead w/alligator (196-3305-00); SMT KlipChip™ (206-0364-00); 2 each white, black, silver, gray, blue, orange, red, green, and yellow cable markers; manual (070-6027-00). <span style="float: right;">\$525</span></p>										
<p><b>P6202A</b> 10X, 500 MHz FET Probe Includes: Retractable probe tip (013-0097-01); 2 alligator clips (344-0046-00); Probe holder (352-0351-00); 3 in Ground (175-0849-00); Probe adjustment tool (003-0675-01); Carrying case; 6 in Ground lead (175-1017-00); 2 Replaceable probe tips(206-0230-00); Electrical Insulating sleeve (166-0404-01); Instruction manual (070-3642-00). <span style="float: right;">\$825</span></p>	<p><b>P6204</b> 10X, 1 GHz FET probe Includes: Same as P6203; except Instruction sheet (070-6949-00) <span style="float: right;">\$1,470</span></p>	<p><b>1101A</b> Accessory Power Supply for P6201, P6202A, P6230. Powers 2 probes. <span style="float: right;">\$500</span></p>										
<p><b>10X Attenuator</b> – For total 100X attenuation. Order 010-0384-00 <span style="float: right;">\$100</span></p>	<p><b>P6230</b> 10X, 1.5 GHz Bias/Offset Probe 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 Ground lead (195-4240-00); SMT KlipChip™ (206-0364-00); 2 in Probe holder (352-0351-00); 2 each of white, gray, red, and green cable markers; Instruction manual (070-4211-00). <span style="float: right;">\$525</span></p>	<p><b>1103</b> TEKPROBE™ Power Supply for P6203, P6204, P6231, P6701, P6702, P6703. Powers 2 probes and provides offset control <span style="float: right;">\$415</span></p>										
<p><b>AC Coupling Cap</b> – Order 010-0360-00. <span style="float: right;">\$43</span></p>	<p><b>1102</b> Power Supply for P6501/A6501/P6511/P6515 <span style="float: right;">\$300</span></p>	<p style="text-align: center;"><b>INTERNATIONAL POWER PLUG OPTIONS</b></p> <table border="0" style="width: 100%;"> <tr> <td><b>Opt. A1</b> – Universal Euro 220 V, 50 Hz</td> <td style="text-align: right;">NC</td> </tr> <tr> <td><b>Opt. A2</b> – United Kingdom 240 V, 50 Hz</td> <td style="text-align: right;">NC</td> </tr> <tr> <td><b>Opt. A3</b> – Australian 240 V, 50 Hz</td> <td style="text-align: right;">NC</td> </tr> <tr> <td><b>Opt. A4</b> – North American 240 V, 60 Hz</td> <td style="text-align: right;">NC</td> </tr> <tr> <td><b>Opt. A5</b> – Switzerland 220 V, 50 Hz</td> <td style="text-align: right;">NC</td> </tr> </table>	<b>Opt. A1</b> – Universal Euro 220 V, 50 Hz	NC	<b>Opt. A2</b> – United Kingdom 240 V, 50 Hz	NC	<b>Opt. A3</b> – Australian 240 V, 50 Hz	NC	<b>Opt. A4</b> – North American 240 V, 60 Hz	NC	<b>Opt. A5</b> – Switzerland 220 V, 50 Hz	NC
<b>Opt. A1</b> – Universal Euro 220 V, 50 Hz	NC											
<b>Opt. A2</b> – United Kingdom 240 V, 50 Hz	NC											
<b>Opt. A3</b> – Australian 240 V, 50 Hz	NC											
<b>Opt. A4</b> – North American 240 V, 60 Hz	NC											
<b>Opt. A5</b> – Switzerland 220 V, 50 Hz	NC											

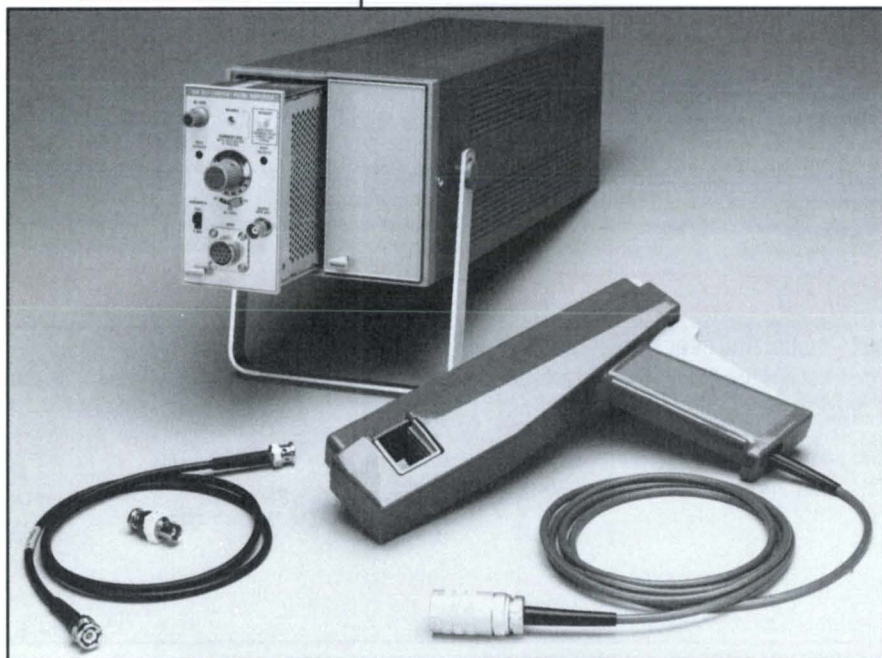
Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

**OPTIONAL ACCESSORIES (for 1103)**

<b>36 in Precision 50 <math>\Omega</math> BNC cable</b> – Order 012-0482-00	\$35
<b>50 <math>\Omega</math> Feedthru Termination</b> – Order 011-0049-01	\$35

To order, call your local Tektronix Sales Office, or call Tek's National Marketing Center.  
Toll free: 1-800-426-2200, Ext. 99.

# CURRENT PROBES



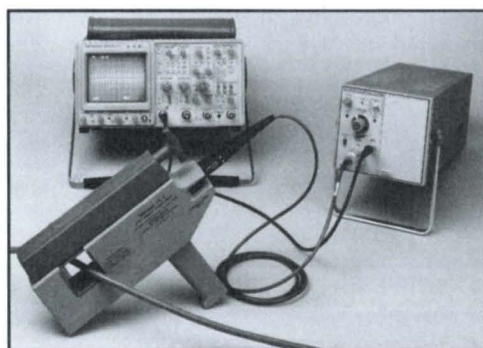
AM503S Current Probe System, Option 03 (A6303 Probe)

## TEKTRONIX CURRENT PROBES

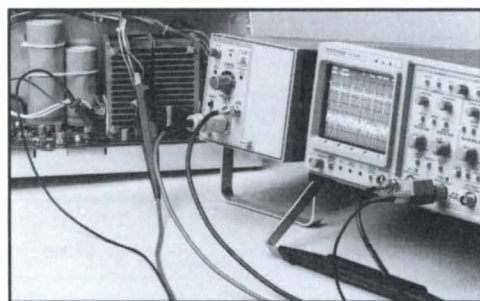
Most of the probes described in the previous sections are for measuring voltage signals. While current amplitudes can be calculated from a measured voltage drop through a known resistance value by using Ohm's Law, current probes enable you to directly observe and measure the current waveform which may be very different from the voltage signal. Tektronix current probes are unique in that they not only measure but, with an oscilloscope, actually display current waveforms from dc to 1 GHz. Two types of current probes are available: probes that measure ac current only and ac/dc probes which can measure both the dc and ac components of a mixed ac/dc signal. AC only current probes use a transformer to convert ac current flux into a voltage signal to the oscilloscope. These have a frequency response from less than 100 Hz up to 1 GHz. AC/DC current probes also 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  $m\Omega$  to low  $\Omega$  range, they are especially useful where low loading of the circuit is important.

If you need to make highly accurate current measurements, especially at high frequencies, Tektronix current probes are your clear choice.



AM503S with CT-4



AM 503S (in use)

## CURRENT PROBE SELECTION GUIDE

Type	Bandwidth Hz to MHz	Peak Pulse	Max AC P-P	Derate		Max DC	Amp-S Product	Current/Div Display Range	Rise Time	Max insertion Z	Max Barewire Voltage	Max Conductor Diameter
				Below	Above							
A6302/AM 503 with CT-4	DC to 50 0.5 to 20	50 A 1 kA	40 A 1 kA	20 Hz	20 kHz 1.2 kHz	20 A	$100 \times 10^{-6}$ 0.1	1 mA to 5 A <sup>*1</sup> 20 mA to 5 kA <sup>*1</sup>	7 nS 17.5 nS	0.1 $\Omega$ @ 5 MHz 30 m $\Omega$ @ 1 MHz	500 V 3 kV	0.15" 1.50"
A6303/AM 503	DC to 15	500 A	200 A		20 kHz	100 A	$10,000 \times 10^{-6}$	10 mA to 50 A <sup>*1</sup>	23 nS	0.02 $\Omega$ @ 1 MHz	700 V	0.83"
P6021 with Passive Termination	120 to 60	250 A	15 A	300 Hz	5 MHz	0.5 A	$500 \times 10^{-6}$	20 mA <sup>*1</sup> or 100 mA <sup>*1</sup>	5.8 nS	0.03 $\Omega$ @ 1 MHz	600 V	0.15"
P6021 with CT-4	120 to 20	1 kA	1 kA	300 Hz	1.2 kHz	20 A	0.5	400 mA or 100 A <sup>*1</sup>	17.5 nS	30 m $\Omega$ @ 1 MHz	3 kV	1.50"
P6021 with 134	12 to 38	250 A	15 A	230 Hz	5 MHz	0.5 A	$500 \times 10^{-6}$	1 mA to 1 A <sup>*2</sup>	9.2 nS	0.03 $\Omega$ @ 1 MHz	600 V	0.15"
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 <sup>*2</sup>	17.5 nS	30 m $\Omega$ @ 1 MHz	3 kV	1.50"
P6022 with Passive Termination	935 to 120	100 A	6 A	3 kHz	10 MHz	0.2 A	$9 \times 10^{-6}$	10 mA or 100 mA <sup>*1</sup>	2.2 nS	0.03 $\Omega$ @ 1 MHz	600 V	0.10"
P6022 with 134	100 to 65	100 A	6 A	1.3 kHz	10 MHz	0.2A	$9 \times 10^{-6}$	1 mA to 1 A <sup>*2</sup>	5.4 nS	0.03 $\Omega$ @ 1 MHz	600 V	0.10"
CT-1	25 k to 1000	12 A	1.4 A			0.2 A	$1 \times 10^{-6}$	2 mA <sup>*1</sup> (5 mV/mA)	0.35nS	1 $\Omega$ @10 MHz	1000 V	0.070"
CT-2	1.2 k to 200	36 A	7 A			0.2A	$50 \times 10^{-6}$	10 mA <sup>*1</sup> (1 mV/mA)	0.5nS	0.1 $\Omega$ @ 10 MHz	1000 V	0.052"

\*1 Scope set at 10 mV/div.

\*2 Scope set at 50 mV/div.

# CURRENT PROBE SYSTEM 1 M $\Omega$ OR 50 $\Omega$ INPUTS

## AM 503S CURRENT PROBE SYSTEM

With the AM 503S Current Probe System you can measure both AC and DC current with one probe. The AM 503S 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 AM 503. Simultaneously, the AM 503 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. The DC and AC currents are summed in the AM 503 providing the total current magnitude to be displayed on your oscilloscope. 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 maximum accuracy.

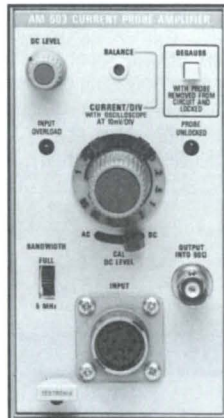
To achieve optimum performance, the current probes and current probe amplifier should be calibrated as a system. The AM 503S system provides a fully calibrated system.

## AM 503 CURRENT PROBE AMPLIFIER

The AM 503 operates in any 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 noise 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.

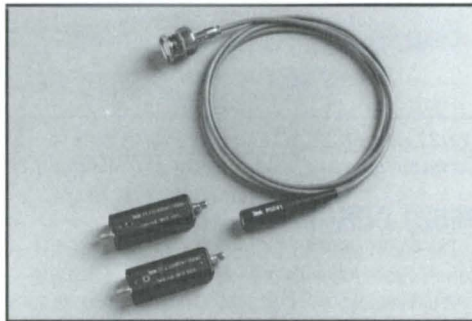
The output of the A6303/AM 503 can be displayed on any oscilloscope that has at least a 50-MHz bandwidth and a 10 mV sensitivity. The A6302/AM 503 requires a 100 MHz oscilloscope with 10 mV sensitivity to display the probe's full bandpass. The AM 503 output can also be plugged directly into a 50  $\Omega$  recording instrument.



AM 503

## A6302/A6303 CURRENT PROBES

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.



CT-1/CT-2 Current Probes with P6041 BNC Probe Cable

## CT-1/CT-2 CURRENT PROBES

The CT-1 and CT-2 Current Probes are designed for permanent or semipermanent in-circuit installation. Each probe consists of a current transformer and an interconnecting cable. The current transformers have a small hole through which a current carrying conductor is passed during circuit assembly. 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  $\Omega$  termination is required to terminate the cable at a high impedance (1 M $\Omega$ ) oscilloscope input.

The P6040 Probe Cable is also available to connect the CT-1 to a GR scope input.

## 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 or DC Coupling
- Minimal Loading
- For 50  $\Omega$  Inputs (from AM 503)

## CT-1

- 25 kHz to 1 GHz
- 12 A Max Pulse Current
- 450 mA Max CW Current
- For 50  $\Omega$  Input

## CT-2

- 1.2 kHz to 200 MHz
- 36 A Max Pulse Current
- 2.5 A Max CW Current
- For 50  $\Omega$  Input

## ORDERING INFORMATION

<b>AM 503S</b> Current Probe System Includes: AM 503 Current Probe Amplifier; TM 502A Power Module; A6302 Current Probe; Plug-in tool box (016-0362-02).	\$2,400	<b>A6303</b> 2 m Current Probe Includes: Carrying case(016-0622-00); Instruction manual (070-3906-01).	\$1,340
<b>Opt. 01</b> - Adds A6303 Current Probe	+\$1,310	<b>CT-1</b> Current Probe, Current Transformer and Probe Cable (42 inch).	\$270
<b>Opt. 03</b> - Substitute A6303 for A6302	+\$630	Includes: Instruction manual (070-0375-01).	
<b>AM 503</b> Current Probe Amplifier Includes: BNC cable (012-0057-01); 50 $\Omega$ 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 241.	\$1,450	<b>Opt. 08</b> - Substitute P6040 GR connector Probe Cable.	+\$65
<b>A6302</b> 2 m Current Probe Includes: 5-in (130 mm) Ground lead (175-0124-01); 3 in (75 mm) Ground lead (175-0263-01); 2 Miniature alligator clips (344-0046-00); Instruction manual (070-3905-01).	\$725	<b>Opt. 09</b> - Current Transformer only. <b>P6040</b> Probe Cable (18 inch) only	-\$80 \$150
		<b>CT-2</b> Current Probe, Current Transformer and Probe Cable. Includes: instruction manual (070-0406-01).	\$240
		<b>Opt. 09</b> - Current Transformer only	-\$80
		<b>P6041</b> - Probe Cable (42 inch) only.	\$85

Product available through Tek Direct.  
Call 1-800-426-2200.

# CURRENT PROBES

## P6021

- 120 Hz to 60 MHz
- 15 A Peak
- For 1 M $\Omega$  Inputs
- Clip-on Capability
- Shielded Probe Heads

## P6022

- 935 kHz to 120 MHz
- 6 A Peak
- For 1 M $\Omega$  Inputs
- Clip-on Capability
- Shielded Probe Heads

## CT-4

- Pulsed Currents to 1,000 A
- Continuous Currents Up to 370 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



P6021 and 6022 AC Current Probes with Terminations and 134 Current Probe Amplifier

## 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.

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 mV/mA to 10 mV/mA.

## P6022 CURRENT PROBE

With a head size of 0.47 in. x 0.25 in. (10mm x 6mm) and a bandwidth of 935 Hz to 120 MHz, the P6022 is ideal for measuring currents in compact high performance circuits. Passive termination output is switchable between 1 mV/mA or 10 mV/mA.

## 134 CURRENT PROBE AMPLIFIER

The 134 is used to extend the low frequency measurement capabilities and sensitivity of the P6021 or P6022 Current Probes. Using the 134 Amplifier extends the initial P6021 measurement capability of 120 Hz down to 12 Hz. The P6022/134 combination goes to 100 Hz from 935 Hz. The Current/Div switch provides calibrated current steps from 1 mA/div to 1 A/div (with the oscilloscope or plug-in unit adjusted for a deflection factor of 50 mV/div). When using a 134 with a P6021 or P6022, the passive termination is not required.

The 134 can also be used as an auxiliary voltage amplifier by placing the Current/Div switch in the Volts position.

## CT-4 CURRENT PROBE

The CT-4 is a robust clip-on high current transformer that extends the measurement capability of the P6021 and A6302 clip-on current probes. Maximum low frequency performance down to 0.5 Hz is obtained using the AM 503S. Current amplitudes to 1,000 amps may be measured using the A6302 or P6021 (with passive termination) provided the amp-second 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 14 kV with the included 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.

## ORDERING INFORMATION

**P6021** 5 ft Current Probe with Termination  
Includes: 5 in. (130 mm) Ground lead (175-0124-01); 3 in. (75 mm) Ground lead (175-0263-01); Two miniature alligator clip (344-0045-00); Instruction manual (070-0947-00).

☎ \$520

**P6022** 5 ft. Current Probe with Terminator  
Includes: Same as the P6021; Instruction manual (070-0948-00).

☎ \$570

**Opt. 03** - 9 ft. with termination

+\$37

**Opt. 12** - 5 ft. without termination

-\$34

(P6021)

(P6022)

-\$57

**Opt. 13** - 9 ft. without termination

-\$34

(P6021)

(P6022)

-\$57

☎ Product available within 24 hours through Tek Direct.  
Call 1-800-426-2200.

**134 Current Probe Amplifier**

☎ \$780

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

\$85

**CT-4 Current Probe With DC Bucking Coil.**

\$1,550

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).

## 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 016-0087-02

\$40

**Passive Termination** -

(P6021) - Order 011-0105-00

\$140

(P6022) - Order 011-0106-00

\$170

**Power Supply** - (110 V AC) Order 015-0058-02

\$180

**Power Supply** - (230 V AC) Order 015-0059-02

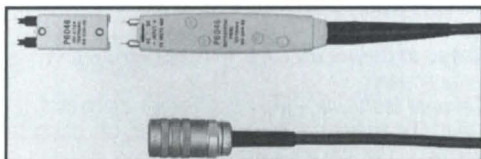
\$305



# DIFFERENTIAL PROBES FOR 1 MΩ INPUTS (AND 50 Ω INPUTS, P6046)

## DIFFERENTIAL MEASUREMENTS

Differential measurement systems enable you to simultaneously measure two voltage points in a circuit and provide as an output the difference between the two voltages. Tektronix offers two types of differential measurement probes: the active differential probe and the passive matched pair of probes. The P6046 is a 100 MHz differential amplifier in probe form which connects to one channel of a standard scope amplifier. With differential amplifiers the P6135A matched probe pair provides CMRR ratios up to 20,000:1. Since a single 10X probe with accuracy of 1% or less gives a scope-to-probe CMRR of no better than 50:1, the P6135A is essential to obtain accurate results from your differential amplifier.



P6046 with 10X Attenuator



P6046 Amplifier with Power Supply

## P6046

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. The differential probe-tip signal processing of the P6046 minimizes the measurement errors caused by differences in standard 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.

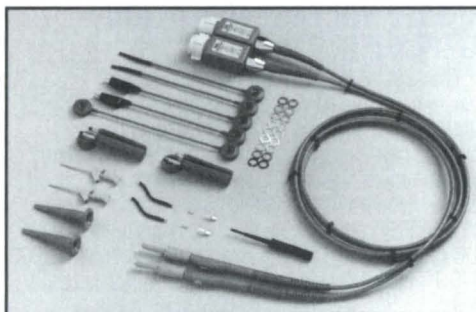
**Input Coupling** – AC or DC, selected by a switch on the probe. Low frequency response AC-coupled is –3 dB at 20 Hz, 2 Hz with 10X attenuator.

**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 the manual for use.

**Output Impedance** – 50 Ω through a BNC-connector. 50 Ω termination supplied with amplifier for use with 1 MΩ systems.

**Probe Cable** – 6 ft. long, terminated with special nine-pin connector.



P6135A Passive Probe Pair

## P6135A

• DC to 150 MHz Differential Probe Pair, 10X, 1.5 m  
The P6135A is a compact-sized, high-impedance, 10X probe with identify function. It includes three pairs of matched tips which allow it to be used with all Tektronix differential amplifiers. The attenuation ratio is adjustable to compensate for differences in amplifier input resistances as well as individual probe attenuation. This ability to precisely match the attenuation for each channel maximizes CMRR.

The P6135A is compatible with the 11000 Series TEKPROBE™ Interface and standard BNC interfaces.

## CHARACTERISTICS

**CMRR** – On 11A33: 10,000:1 from DC to 1 kHz, derating to 100:1 at 20 MHz. On 7000-Series: 20,000 to 1 from dc to 1 kHz derating to 100:1 at 20 MHz.

**Attenuation** – Adjustable to 10X.

**Input Resistance** – 1 MΩ ±0.32%

**Input Capacitance** – 10.5 pF on instrument with 15 pF input capacitance; 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** – On 11A33: DC to 150 MHz; On 7A13: DC to >90 MHz.

**Typical Probe Rise Time** – On 11A33: <2.33 ns; 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.

## 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

## P6135A

- DC to >150 MHz
- Attenuation Adjustable to 10X
- 10,000:1 CMRR on 11A33 Differential Comparator; 20,000:1 on 7A13 Differential Comparator
- ±500 V Maximum Voltage
- Matched Pair

## ORDERING INFORMATION

**P6046** 1X, 6 ft. FET Differential Probe with Amplifier and Power Supply ☎ \$2,150

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. 09**—Without Accessories —\$560

**Opt. 11**—Probe Without Amplifier and Power Supply —\$740

**Order (015-0106-00) \$1,070**

**P6135A** Pair of 10X, 150 MHz Differential Probes \$695

Includes: Adjustment Tool (003-1433-00); 2 Retractable hook tips (013-107-06); 2 Circuit board connectors; 6 in. Dual-ring ground lead (196-3295-00); Accessory Pouch (016-0708-00) 2 6 in. Ground leads (196-3113-02); 2 6 in. Ground leads with Alligator clips (196-3305-00); 2 SMT KlipChip™ (206-0364-00); 2 Low inductance GND collars (343-1003-01); 2 Probe tip holders (352-0670-00); 2 in ground leads (195-4240-00); 2 each of black, white, silver, gray, blue, orange, red, green and yellow cable markers; Instruction manual (070-7675-00).

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

# VOLTAGE ISOLATORS

## 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  $\Omega$  or 1 M $\Omega$  Inputs
- Two Independently-Isolated Channels
- High Voltage Isolation
- UL Certified to 3000 V/Channel (6000 V Maximum Channel Differential)<sup>\*1</sup>
- DC to 20 MHz Bandwidth

#### ORDERING INFORMATION

<b>A6901</b> Ground Isolation Monitor	<b>\$1,200</b>
Includes: Operator manual (070-3618-00).	
<b>A6902B</b> Voltage Isolator (500 V Max)	<b>\$2,200</b>
Includes: Two 500 V isolation probes (010-0411-15); Right angle power cord (161-0104-00); 98 in (249 cm), 50 $\Omega$ output cables (012-0204-00); Operator manual (070-5614-00).	
<b>Opt. 02</b> <sup>*2</sup> – Add two large probes. (010-0409-01)	<b>+\$630</b>
<b>Opt. 09</b> <sup>*2</sup> – Add two large probes plus two 4 mm banana adapters	<b>+\$725</b>

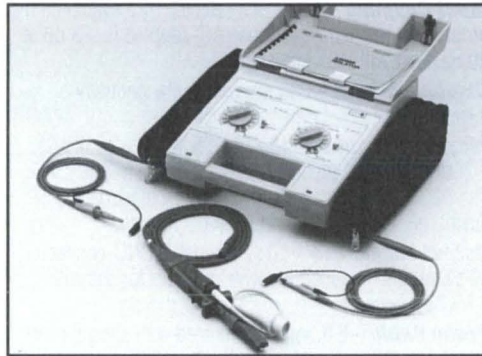
#### INTERNATIONAL POWER PLUG OPTIONS

<b>Opt. A1</b> – Universal Euro 220 V, 50 Hz.	<b>NC</b>
<b>Opt. A2</b> – UK 240 V, 50 Hz.	<b>NC</b>
<b>Opt. A3</b> – Australian 240 V, 50 Hz.	<b>NC</b>
<b>Opt. A4</b> – North American 240 V, 60 Hz.	<b>NC</b>
<b>Opt. A5</b> – Switzerland 220 V, 50 Hz.	<b>NC</b>

<sup>\*1</sup> When ordered with Option 02 or 09.

<sup>\*2</sup> 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.)



## A6902B VOLTAGE ISOLATION AMPLIFIER

The A6902B is a dual-channel, optical- and transformer-coupled voltage isolator. It 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  $\pm 500$  V (DC plus peak AC) with the small signal probes or  $\pm 3000$  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.

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 100 mV/div. Accuracy:  $\leq 5\%$  of indicated V/div switch setting.

**Frequency Response Bandwidth** – DC coupled (to  $-3$  dB point) is  $\geq 20$  MHz. AC coupled (to lower  $-3$  dB point) is  $\leq 5$  Hz to  $\geq 20$  MHz. (50 to 500 V/div not specified).

**Transient Response** – Rise time:  $\leq 17.5$  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 450 kHz. Probe Common to Earth Ground: UL 3000 V (dc + peak ac) to 250 kHz. Maximum voltage derates above 250 kHz.

**Maximum Input  $dV/dt$**  – 100 V/ns.

**Input Impedance** – Resistance: 10 M $\Omega$   $\pm 3\%$ . Capacitance:  $\approx 19$  pF with either probe.

**Output Impedance** – 50  $\Omega$   $\pm 5\%$ .

**Output Drive** – 4 V p-p into 1 M $\Omega$ .

**Common-Mode Capacitance** – 100 pF from probe common to earth ground.

**Max Common to Ground Slew Rate** – 500 V/ $\mu$ s

**Tangential Noise** –  $\leq 20$  mV.

**DC Drift with Temperature** –  $\leq 10$  mV/ $^{\circ}$ C or (0.1 div/ $^{\circ}$ 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  $\pm 3$  ns (large probe), 52 ns  $\pm 3$  ns (small probe), from probe input to instrument input. CH 1, CH 2 delay difference is  $\leq 4$  ns.

**Common Lead Signal Feedthrough** –  $-106$  dB from probe input to output BNC to 100 Hz. Derated above 100 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  $\pm 40$  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.

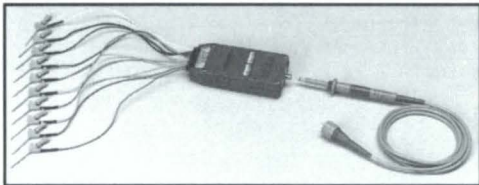
**P6407/P6408**

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 P6408 may also be used with oscilloscopes with 15-35 pF inputs when used with a P6109 probe or other probes which have a miniature size probe tip. 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 M $\Omega$  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<sub>cc</sub>

**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

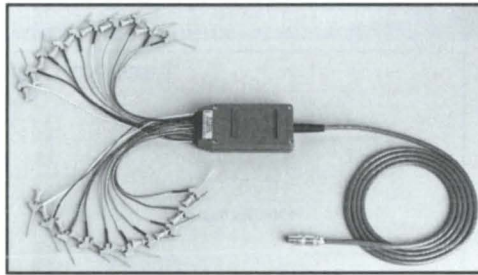
**Output Pulse Rise Time** – 10 ns max

**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  $\pm$  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  $\mu$ A

**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 **\$525**  
Includes: 2 (10 wide) Lead headers (012-0747-01); Pkg of 20 SMT KlipChip™ Adapters (SMG50); Instruction sheet (070-5582-00).

**P6408** Word Recognizer/Trigger Probe **\$375**  
Includes: 2 (10 wide) Lead headers (012-0747-01); Pkg. of 20 SMT KlipChip™ Adapters (SMG50); P6109 Probe (complete package); Instruction sheet (070-6938-00).

**OPTIONAL ACCESSORY**

**Probe Power Cable** – Order 174-1342-00 **\$54**

☎ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

## PROBE ACCESSORIES SELECTION GUIDE

### MONOLITHIC PROBE ACCESSORIES (For probes with # 6-32 Screw Tips)

Part Number	Description	Price
013-0052-00	Bayonet ground assembly.	\$12.50
013-0054-00	Probe screw tip to BNC adapter.	\$20.00
013-0056-00	Probe screw tip to BNC adapter for P6028.	\$24.00
013-0071-00	Retractable hook tip.	\$6.00
013-0071-01	Retractable hook for P6008 environmental probe.	\$5.50
134-0013-00	Banana tip (#6-32).	\$1.80
166-0428-00	Insulating ground cover for P6009.	¹
175-0124-01	5 in ground lead.	\$3.00
175-0125-01	12 in ground lead.	\$3.25
175-0263-01	3 in ground lead.	\$3.00
175-0192-00	6 in ground lead (P6015 only).	\$10.50
196-3120-00	6 in clip on ground lead.	\$3.30
196-3121-00	12 in clip on ground lead.	\$3.30
206-0015-00	Straight tip (0.055 in dia).	\$2.15
206-0060-00	Spring tip (0.08 in dia).	\$3.50
206-0061-00	Spring tip (accepts 0.065 in dia pin).	\$2.45
206-0100-00	Calibration tip (0.063 in dia).	\$13.75
206-0104-00	Long straight tip (0.032 in dia).	\$1.80
206-0105-00	Hook tip.	\$2.00
206-0116-00	Banana tip (P6015 only) #10-32.	\$3.20
206-0134-03	Pin tip (accepts 0.025 in IBM SLT pin).	\$7.50
206-0137-01	Ground lead adapter (0.025 in square pin closing).	\$4.25
206-0168-00	Spring Tip (accepts 0.068 in dia pin).	\$4.50
206-0185-00	Right angle hook tip.	\$2.00
206-0203-00	IC test tip.	\$2.15
344-0005-00	Alligator clip, # 10-32 screw thread (P6015 only).	\$5.75
344-0045-00	Alligator clip.	\$1.45
344-0046-00	Miniature alligator clip with boot.	\$2.95
352-0090-00	P600X probe holder.	\$5.50
352-0068-00	P600X probes to Scope Chassis probe holder.	\$2.55

### IC CLIPS (Not Shown)

Part Number	Description	Price
003-0709-00	16-Pin DIP, clothes pin style.	\$18.00
003-0823-00	24-pin DIP, clothes pin style.	\$37.00
003-0801-00	40-pin DIP, clothes pin style.	\$53.00

### CABLE MARKER SETS (Not Shown)

Part Number	Description	Price
016-0127-00	For 3/16 in dia. cable.	\$24.00
016-0633-00	For all modular cables (P610X/A, P612X/P613X/P6230 Families).	\$5.00

¹ Contact your local sales office.

### P6006, P6007, P6008, P6009, P6028 and P6060 Monolithic Series

#### Probe Tip System

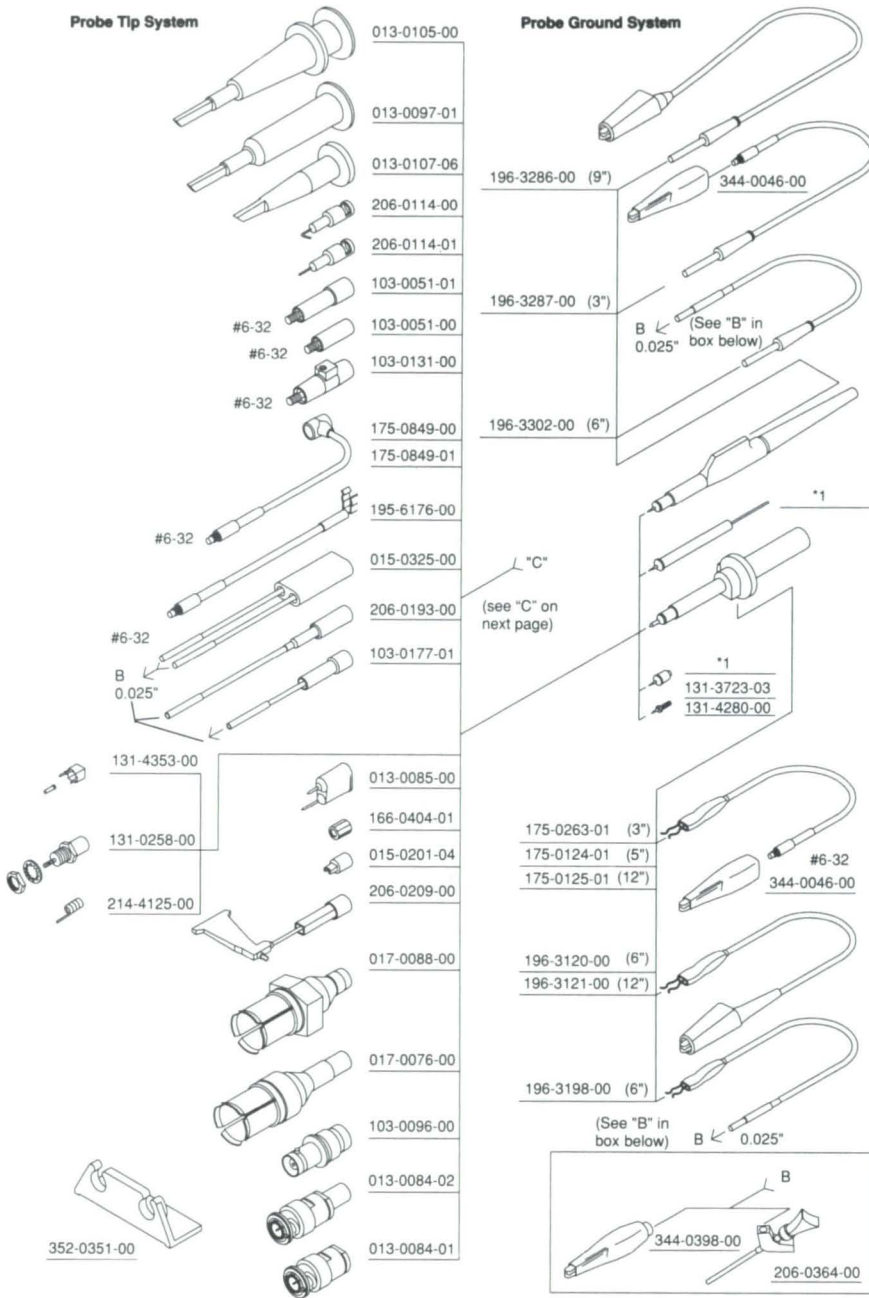
#### Probe Ground System

013-0071-00	352-0090-00 352-0068-00
013-0071-01	
206-0100-00	
206-0060-00	#6-32
206-0104-00	196-3120-00 (6") 196-3121-00 (12")
206-0105-00	
206-0185-00	
206-0015-00	176-0263-01 (3") 175-0124-01 (5") 175-0125-01 (12")
206-0203-00	
206-0137-01	#6-32
206-0168-00	344-0045-00
206-0061-00	344-0046-00
134-0013-00	
206-0134-03	
013-0052-00	P6015
166-0428-00	206-0116-00
013-0054-00	
013-0056-00	175-0192-00 (6") 344-0005-00

NOT TO SCALE

## 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, P6119, P6202A, P6203, and P6204.**



NOT TO SCALE

### MINIATURE PROBE ACCESSORIES

Part Number	Description	Price
013-0084-01	Miniature probe tip to BNC adapter.	\$11.50
013-0084-02	Miniature probe tip to BNC adapter for all except P6202A, P6420, and P6201 adapter.	\$13.00
013-0085-00	Bayonet ground assembly.	\$10.75
013-0097-01	Retractable hook tip for P6202A and P6420.	\$12.75
013-0105-00	Retractable hook tip (except P612X).	\$11.00
013-0107-06	Retractable hook tip (for all except P6202A and P6420).	\$4.25
015-0201-07	IC Test ground cover, gray. Package of 10	\$8.00
015-0201-08	Package of 100	\$21.00
015-0325-00	Dual lead adapter.	\$15.75
017-0076-00	Miniature probe tip to GR adapter.	\$95.00
017-0088-00	Miniature probe tip GR 50 Ω termination adapter.	\$90.00
103-0051-00	Screw tip (#6-32 for P6202A and P6420).	\$1
103-0051-01	Screw tip (#6-32)	\$6.00
103-0096-00	Miniature probe tip to BNC female adapter.	\$15.75
103-0131-00	Screw tip with ground connection (#6-32).	\$17.50
103-0177-01	Flexible tip.	\$8.75
131-0258-00	Chassis mount test jack.	\$3.35
131-3723-03	Replaceable tip for P6103, P6109, and P6119, Pkg. 5.	\$11.00
131-4280-00	Replaceable tip for P6203 and P6204.	\$1.00
131-4353-00	Circuit board test point, package of 25.	\$48.00
166-0404-01	Insulating ground cover. 5 in clip on ground lead.	\$1.50
175-0124-01	5 in clip on ground lead.	\$3.00
175-0125-01	12 in clip on ground lead.	\$3.25
175-0263-01	3 in clip on ground lead.	\$3.00
175-0849-00	3 in probe tip cap lead for all miniature size probe tips.	\$8.75
175-0849-01	6 in probe tip cap lead for all miniature size probe tips.	\$9.00
195-6176-00	3 in probe tip clip-on lead for all miniature size probe tips.	\$7.75
196-3120-00	6 in clip on ground lead.	\$3.30
196-3121-00	12 in clip on ground lead.	\$3.30
196-3198-00	6 in clip on ground lead (with 0.025 in pin receptacle).	\$5.25
196-3286-00	8 in ground lead.	\$8.00
196-3287-00	#6-32 thread ground lead.	\$8.25
196-3302-00	6 in slip on ground lead (with 0.025 in pin receptacle).	\$11.00
206-0114-00	Hook tip.	\$4.25
206-0114-01	Straight tip.	\$4.25
206-0193-00	Flex tip for 0.025 in square pin.	\$19.00
206-0209-00	Pin tip (accepts 0.025 in IBM SLT pin).	\$5.75
206-0364-00	SMT KlipChip™ (used with 0.025 pin receptacles).	\$4.90
SMG 50	Package of 20 each SMT KlipChip™ adapters.	\$89.00
214-4125-00	Electrical contact ground	\$2.65
344-0046-00	#6-32 Thread alligator ground clip.	\$2.95
344-0398-00	Slip on alligator ground lead (use with 0.025 pin receptacle).	\$3.50
352-0351-00	Probe holder, self-adhesive back, black.	\$2.00

\*1 Contact your local sales office.

Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

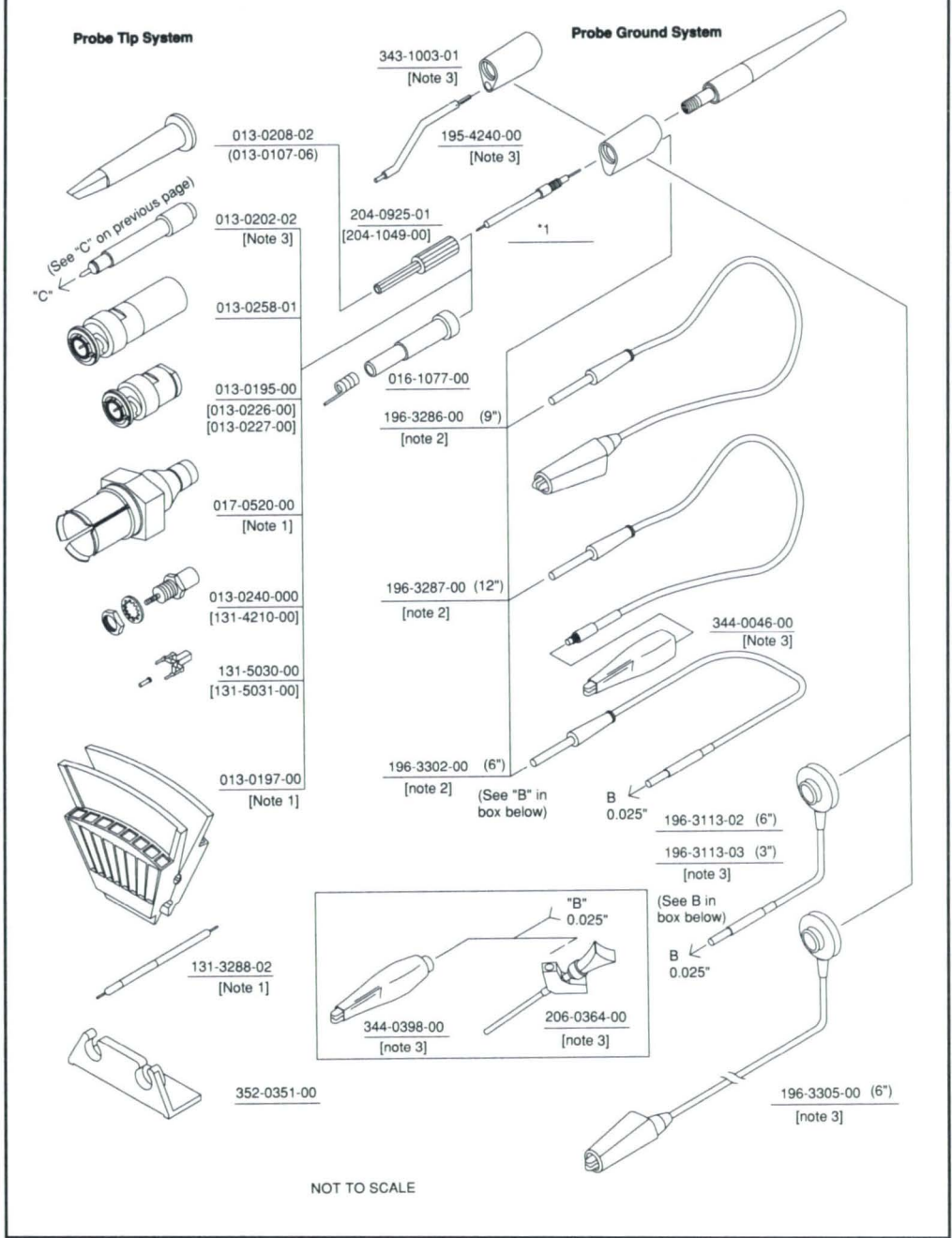
## PROBE ACCESSORIES SELECTION GUIDE

### SUBMINIATURE AND COMPACT

Part Number	Description	Price
013-0107-06	Retractable hook tip for compact tip probes.	\$4.25
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). (See note 1)	\$55.00
013-0258-01	P6562 probe tip to BNC adapter, 50 Ω terminated.	\$90.00
013-0202-02	Subminiature/Compact to-miniature probe tip adapter (allows use of miniature probe tip accessories. See page 323).	\$5.50
013-0208-02	Retractable hook tip for subminiature tip probes.	\$4.35
013-0226-00	Compact probe tip to BNC adapter.	\$10.75
013-0227-00	Compact probe tip to BNC 50 Ω termination adapter.	\$69.00
013-0237-00	Compact probe tip to SMD adapter (not shown).	\$345.00
013-0240-00	Subminiature probe tip Chassis mount test jack.	\$5.25
016-1077-00	Ground tip contact for compact tip probes. 2 ea. five different probe tip to ground contact spacings.	1
017-0520-00	Subminiature probe tip to GR 50 Ω termination adapter.	\$75.00
131-3288-02	Signal/ground pins for KLIP-KIT (013-0197-00), (includes eight pins).	\$60.00
131-4210-00	Compact probe tip chassis mount test jack.	\$5.25
131-5030-00	Subminiature probe tip circuit board test points (pkg. 25).	\$48.00
131-5031-00	Compact probe tip circuit board test points (pkg. 25).	\$48.00
195-4240-00	Low impedance ground contact.	\$2.90
196-3286-00	8 in. alligator ground lead.	\$8.00
196-3287-00	12 in. slip on ground lead.	\$8.25
196-3113-02	6 in. slip on ground lead.	\$8.50
196-3113-03	3 in. slip on ground lead.	\$8.50
196-3302-00	6 in. alligator ground lead (not compatible with P6137 or P6156).	\$11.00
196-3305-00	6 in. alligator ground lead.	\$12.00
204-0925-01	Subminiature probe tip attenuator tip cover.	\$1.20
204-1049-00	Compact probe tip attenuator tip cover.	\$1.00
206-0364-00	SMT KlipChip™ Adapter	\$4.90
343-1003-01	Ground collar.	\$3.00
344-0046-00	#6-32 thread alligator ground clip.	\$2.95
344-0398-00	Slip on alligator ground clip.	\$3.50
352-0351-00	Probe holder, self-adhesive back, black.	\$2.00

\*1 Contact your local sales office.

### SUBMINIATURE TIP (P6130/P6131/P6133/P6134/P6135/P6136/P6230/P6231) AND COMPACT TIP (P6053C, P6137, P6156, P6134C, P6135A, P6133 Opt. 25 and P6136 Opt. 25) PROBE ACCESSORIES [Bracket P/N's pertain to Compact Tip Probes only.]



NOT TO SCALE

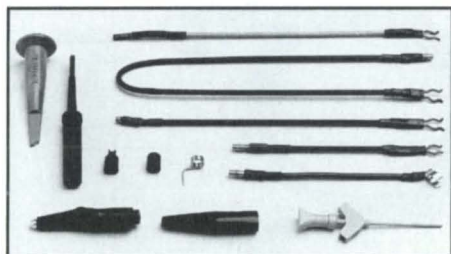
Note 1: Not compatible with Compact Tip Probes.  
 Note 2: Not compatible with P6137, P6156, P6134C, P6135A, and P6053C.

Note 3: Use same part number as subminiature probe, also see page 325 for other compatible tip accessories.

# PROBE ACCESSORY PACKS/ CONVERSION KITS

## PROBE ACCESSORY PACKS/CONVERSION KITS SELECTION GUIDE

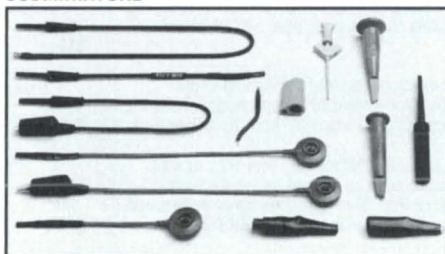
### ACCESSORY PACK/MINIATURE PROBE TIPS



Order 020-1724-00 ☎ \$35.00

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); SMT KlipChip™ (206-0364-00); Alligator clip for 0.025 in connector (344-0398-00); Alligator clip for #6-32 Thread (344-0046-00); IC Test Tip (see page 323); 3.5 in ground lead (195-6176-01); Spring ground (214-4125-01).

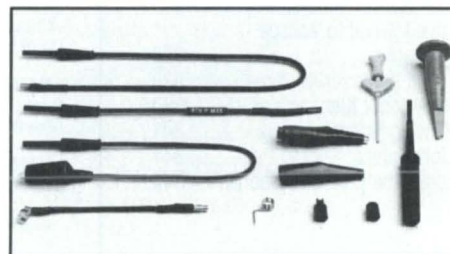
### ACCESSORY PACK/P613X COMPACT AND SUBMINIATURE



Order 020-1835-00 ☎ \$65.00

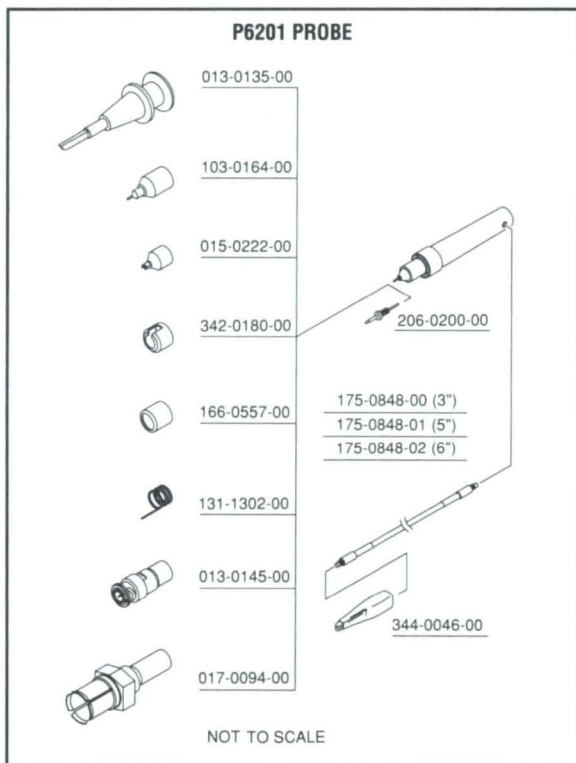
Includes: Screwdriver (003-1433-00); Retractable hook tip (013-0107-06); Retractable hook tip (013-0208-02); 2 in ground lead (195-4240-00); 3 in ground lead (196-3113-03); 6 in ground lead (196-3113-02); 12 in #6-32 stud ground lead (196-3287-00); 8 in ground lead (196-3286-00); SMT KlipChip™ (206-0364-00); Ground collar (343-1003-01); Alligator clip 0.025 in 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



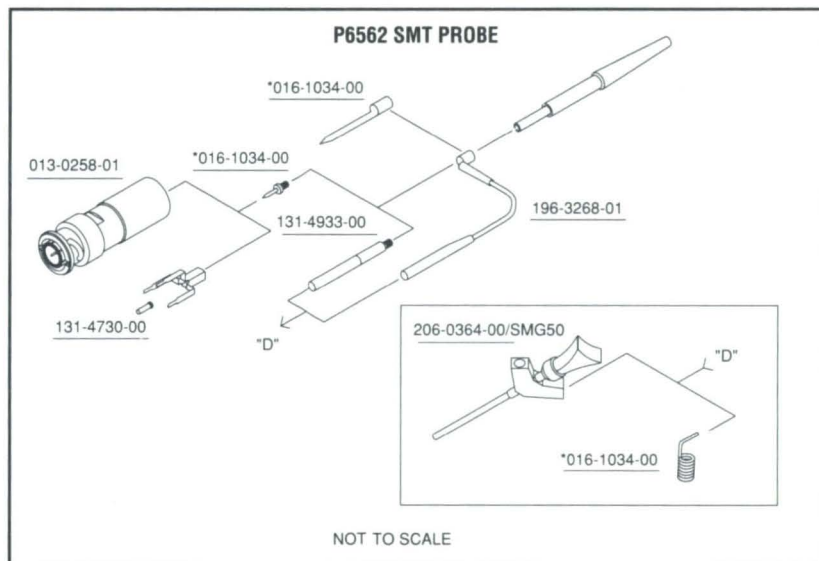
Order 020-1836-00 ☎ \$43.00

Includes: Screwdriver (003-1433-00); IC Test Tip (see page 331); Tip insulator (166-0404-01); 3.5 in ground lead (195-6176-00); 6 in ground lead (196-3302-00); 8 in ground lead (196-3286-00); 12 in ground lead (196-3287-00); Retractable hook tip (013-0107-06); Alligator clip #6-32 connector (344-0046-00); SMT KlipChip™ (206-0364-00); Spring ground (214-4125-00); Alligator clip for 0.025 in connector (344-0398-00).



#### PROBE TOOLS (NOT SHOWN)

003-0675-00	Adjustment tool P6055.	\$3.00
003-0675-01	Adjustment tool P6202A.	\$2.65
003-0825-00	Tip extractor for miniature probes (except for P610X "A" version and P612X family probes).	\$1.85
003-1433-00	Adjustment tool for P601X/A, P612X, and P613X family.	\$1.05
003-1433-01	Package of 5 each of 003-1433-00, above.	\$4.25



#### P6201 PROBE

Product Number	Description	Price
013-0135-00	Retractable hook tip.	\$8.75
013-0145-00	Probe tip to BNC adapter.	\$27.00
015-0222-00	IC Test ground cover.	\$1.00
017-0094-00	Probe tip to GR 50 Ω termination adapter.	\$100.00
103-0164-00	Probe tip to miniature probe tip adapter (See page 331 for compatible accessories).	\$13.50
131-1302-00	Ground contact.	\$1.50
166-0557-00	Insulating ground cover.	\$1.75
175-0848-00	3 in ground lead.	\$4.00
175-0848-01	5 in ground lead.	\$3.55
175-0848-02	12 in ground lead.	\$3.25
206-0200-02	Replaceable probe tip.	¹
342-0180-00	Ground contact insulator.	\$2.00
346-0046-00	#6-32 Thread alligator ground clip.	¹

#### P6562 PROBE

Product Number	Description	Price
SMG 50	Package of 20 each SMT KlipChip™ adapters	\$89.00
013-0258-01	Probe tip to BNC adapter 50 Ω terminated.	\$90.00
206-0364-00	SMT KlipChip™, 1 each.	\$4.90
131-4730-00	SMT probe tip circuit board test points, pkg of 5.	\$15.00
131-4933-00	Jack tip assembly: 0.025 in square pin socket, pkg of 5. Can be purchased as part of 016-1034-00. See below.	¹
196-3268-01	Ground lead with 0.025 in receptacle, pkg of 5.	\$40.00
016-1034-00	Adapter accessory kit: Tips, spring adapter, Jack tip assembly, low inductance ground lead.	\$35.00

¹ Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

¹ Contact your local sales office.

# OTHER ACCESSORIES

## TEST LEADS, COAXIAL CABLES, INTERFACE CABLES

### Contents

Test Leads .....	334
Coaxial Cables .....	334
Interface Cables .....	334
Adapters/Connectors .....	335
Attenuators/Terminations .....	336
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Travel Accessories .....	339
Rackmount Kits .....	340
Viewing Hoods .....	341
Light Filters .....	341
Logic Analyzers Accessories .....	342

### TEST LEADS SELECTION GUIDE

- ALM01** UL approved red and black test lead set with miniature size probe tips. Incorporates shrouded banana plugs and includes two retractable hook tips. \$18
- ALM02** Red and black test lead set with miniature 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 miniature 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



ALM01 and ALM02 (inset)

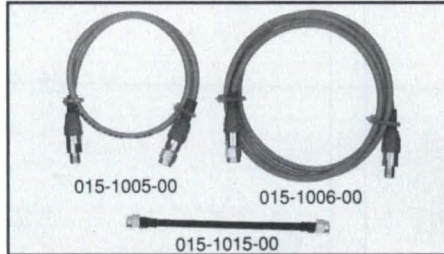
Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

### COAXIAL CABLES AND INTERFACE CABLES SELECTION GUIDE



COAXIAL BNC CABLES

<b>50 Ω</b>			
10 in., male to male	012-0208-00	\$20	
18 in., male to male	012-0076-00	\$25	
24 in., male to male	012-1342-00	\$45	
36 in., male to male	012-1341-00	\$45	
56 in., precision (1%) male to male	012-0482-00	\$35	
42 in., male to male	012-0057-01	\$25	
18 in., male to female	012-0104-00	\$30	
10 in., BNC male to BSM female	012-0128-00	\$30	
18 in., BNC male to BSM female	012-0127-00	\$40	
<b>75 Ω</b>			
24 in., male to male	012-1339-00	\$45	
36 in., male to male	012-1338-00	\$45	
42 in., male to male	012-0074-00	\$25	
60 in., male to male	012-1337-00	\$45	
<b>93 Ω</b>			
42 in., male to male	012-0075-00	\$40	



COAXIAL SMA (3mm) 50 Ω CABLES

<b>General Purpose Flexible Cables</b>			
12 in., male to male	174-1364-00	\$27	
20 in., male to male	174-1427-00	\$50	
60 in., male to male	174-1428-00	\$55	
<b>Precision, Flexible Delay Cables</b>			
1 ns., male to female	015-1019-00	\$155	
2 ns., male to female	015-1005-00	\$250	
5 ns., male to female	015-1006-00	\$210	
1 ns., male to male	015-0562-00	\$320	
2 ns., male to male	015-0560-00	\$320	
5 ns., male to male	015-0561-00	\$425	
<b>Semirigid Delay Cables</b>			
500 ps., 4.5., male to male	015-1015-00	\$35	
750 ps., male to male	015-1017-00	\$50	

#### COAXIAL GR 50 Ω CABLES (not shown)

10 ns., RG58A/U	017-0501-00	\$150	
5 ns., RG213/U	017-0502-00	\$225	
2 ns., RG58A/U	017-0505-00	\$205	
5 ns., RG58/U	017-0512-00	\$155	

#### COAXIAL N 50 Ω CABLES (not shown)

6 ft. male to male	012-0114-00	\$32	
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#### PATCH CORDS (not shown)

<b>BNC to BNC, 18 in.</b>			
Red	012-0087-00	\$16.25	
Black	012-0086-00	\$10.00	
<b>BNC to banana plug-jack, 18 in.</b>			
Red	012-0091-00	\$9.00	
Black	012-0090-00	\$9.00	
<b>Banana plug-jack to banana plug-jack, 18 in.</b>			
Red	012-0031-00	\$13.00	
Black	012-0039-00	\$13.00	
<b>Pin-jack to pin-jack, 0.08 in. dia-pin</b>			
Red, 8 in.	012-0179-00	\$5.00	
Black, 8 in.	012-0181-00	\$5.00	
Red, 18 in.	012-0180-00	\$4.55	
Black, 18 in.	012-0182-00	\$6.00	

#### INTERFACE CABLES (not shown)

<b>GPIB</b>			
1m, double-shielded	012-0991-01	\$140	
2m, double-shielded	012-0991-00	\$160	
4m, double-shielded	012-0991-02	\$235	
<b>Centronics</b>			
8 ft. Male Centronics to PC 25-pin D	012-1250-00	\$50	
9 ft. Male to Male	012-1284-00	\$33	
10 ft., 4695 to Terminal	012-0555-00	\$125	
<b>RS-232C</b>			
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	



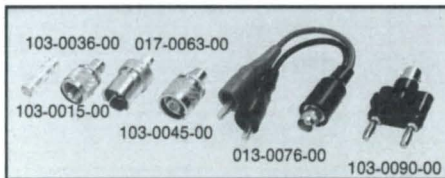
# ADAPTERS, CONNECTORS AND ADAPTER KITS

## ADAPTERS, CONNECTORS AND ADAPTER KITS SELECTION GUIDE



### BNC ADAPTERS

BNC male to UHF female	103-0032-00	\$7.00
BNC male to GR	017-0064-00	\$115.00
BNC male to N female	103-0058-00	\$14.00
BNC male to binding post	103-0033-00	\$7.00
BNC male to dual binding post	103-0035-00	\$20.00



BNC female to BSM male	103-0036-00	\$19.00
BNC female to UHF male	103-0015-00	\$6.00
BNC female to GR	017-0063-00	\$65.00
BNC female to N male	103-0045-00	\$17.00
BNC female to Clip Leads	013-0076-00	\$44.00
BNC female to EZ ball	013-0076-01	\$26.00
BNC female to dual banana	103-0090-00	\$11.00



BNC female to GR	017-0063-00	\$65.00
BNC male to GR	017-0064-00	\$115.00
BNC male to GR, 50 Ω		
ThruLine Termination	017-0083-00	\$120.00

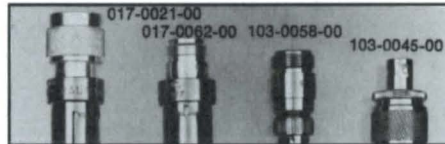
### SMA ADAPTERS (not shown)

SMA female to BNC male	015-0572-00	\$19.25
SMA male to BNC female	015-0554-00	\$33.00
SMA male to GR	015-1007-00	\$160.00
SMA female to GR	015-1008-00	\$175.00
SMA male to N-female	015-1009-00	\$47.00
Threaded female to male slip on connector	015-0553-00	\$47.00
Male to female connector saver*1	015-0549-00	\$165.00

### NEW 3.5 mm ADAPTERS (not shown)

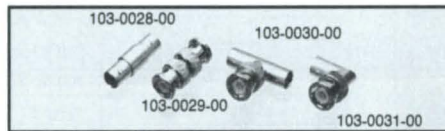
Male to male	015-0551-00	\$330
Female to female	015-0550-00	\$295
Male to female connector saver*1	015-0552-00	\$220

\*1 Used permanently installed on instrument to prolong life of instrument connector.



### N STYLE ADAPTERS

N male to GR	017-0021-00	\$90.00
N female to GR	017-0062-00	\$80.00
N female to BNC male	103-0058-00	\$14.00
N male to BNC female	103-0045-00	\$17.00



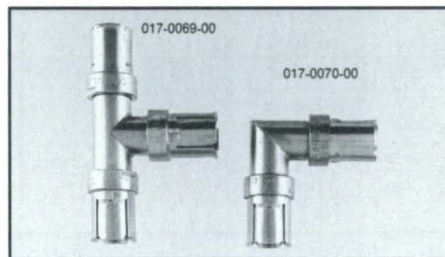
### BNC CONNECTORS

BNC female to BNC female	103-0028-00	\$12.00
BNC male to BNC male	103-0029-00	\$11.00
BNC T	103-0030-00	\$14.00
BNC elbow male to female	103-0031-00	\$12.00



### SMA CONNECTORS

SMA male to male	015-1011-00	\$28.00
SMA female to female	015-1012-00	\$20.00
SMA T	015-1016-00	\$40.00
SMA male to BNC female	015-1018-00	\$11.00



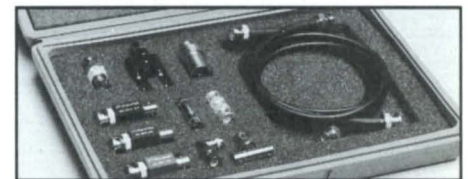
### GR CONNECTORS

GR T	017-0069-00	\$220.00
GR elbow	017-0070-00	\$165.00



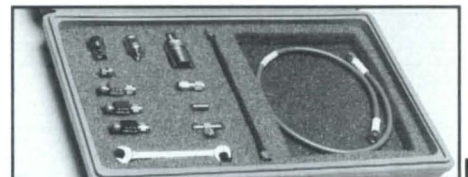
### MISC. CONNECTORS

Female to BNC male	013-0126-00	\$22.00
Male to "F" male	103-0157-00	\$8.00
Male to BNC female	103-0158-00	\$6.00
Female to "F" female	103-0159-00	\$8.00



### BNC ADAPTER KIT

**AK01 BNC Adapter Kit** \$425  
Includes: 50 ohm feed-through termination 011-0049-01; 50 ohm 10X attenuator 011-0059-02; 50 ohm, 5X attenuator 011-0060-02; 50 ohm, 6 dB attenuator 011-0069-02; 50 ohm, coax cable, 42 in. (2 each), 012-0057-01; GR to BNC female adapter 017-0063-00; BNC female to BNC female adapter 103-0028-00; BNC "T" 103-0030-00; BNC elbow male to female 103-0031-00; BNC female to dual banana 103-0090-00; BNC male to BNC male 103-0029-00.



### SMA ADAPTER KIT

**AK02 SMA Adapter Kit** \$1,050  
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.

# ATTENUATORS/TERMINATIONS

## 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	\$35
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	\$55
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	\$50
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	\$55
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	\$50
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	\$65
011-0055-01	Feed through termination	75	±1	NA	NA	NA	100 MHz	1	300	1.1-dc to 100 MHz	\$40
011-0056-01	Feed through termination	93	±1	NA	NA	NA	100 MHz	1	300	1.1-dc to 100 MHz	\$35
011-0057-01	Min. loss attenuator	50-75		2.3X	7.2	±0.5	100 MHz	.5		1.1-dc to 100 MHz	\$50
011-0058-01	Min. loss attenuator	50-93		2.3X	7.2	±0.5	100 MHz	1.2		1.1-dc to 100 MHz	\$47
011-0061-00	Attenuator	75		10X	20			.5			\$40
011-0062-00	Attenuator	93		10X	20			.5			\$40
011-0092-00	Feed through termination	600	±1	NA	NA	NA	1 MHz	1			\$40
011-0112-00	Min loss attenuator	75-50						2		(ac coupled)	\$70
011-0129-00	Feed through termination	50	±0.05	NA	NA	NA	100 kHz				\$150
011-0102-00	Coax termination	75	±0.5	NA	NA	NA		.5			\$25
011-0103-00 <sup>†</sup>	Return loss bridge	75	±0.5	NA	NA	NA					\$30

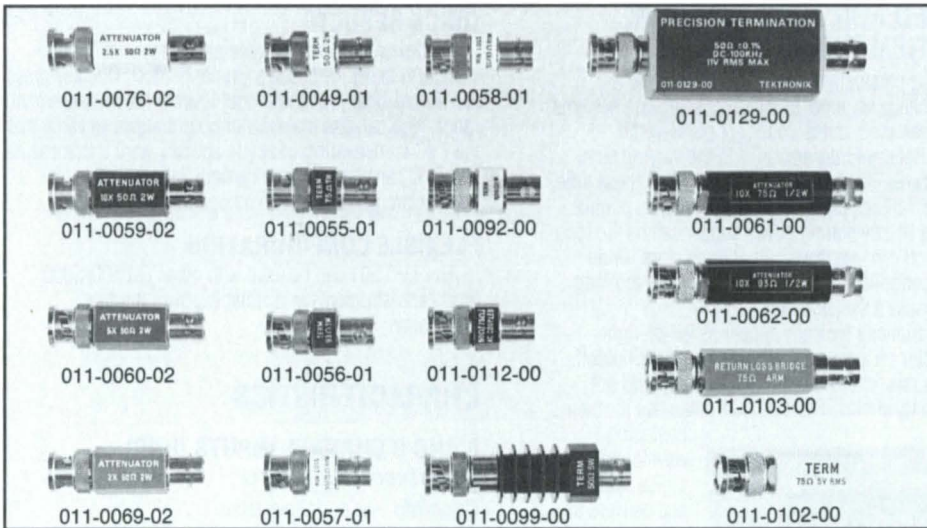
<sup>†</sup> 011-0103-00 red color body; 011-0103-01 green color body; 011-0103-02 white color body.

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	\$165
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	\$175
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		\$31
015-1022-00	termination (male)	50	±0.5	NA	NA	NA	18 GHz	0.5	100		\$41

N CONNECTOR 50 OHM (see photo on next page)

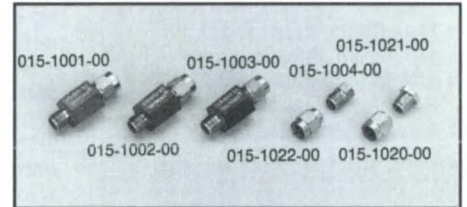
	Type	Impedance (Ohms)	Z-Tol (Ohms)	Atten.	Atten. (db)	Tol. (db)	Freq. (dc to)	Avg. Power (Watts)	Peak Power (Watts)	Max. VSWR	Price
011-0085-00	Attenuator	50		3X	10	±0.5	12.4 GHz	2	300	1.2-DC to ≥ 4 GHz 1.3-4 to ≥ 8 GHz 1.4-8 to ≥ 12.4 GHz	\$130
011-0086-00	Attenuator	50		10X	20	±1	12.4 GHz	2	300	1.4 - dc to 12.4 GHz	\$130
011-0087-00	Attenuator	50		100X	40	±1	12.4 GHz	2	300	1.4 - dc to 12.4 GHz	\$130



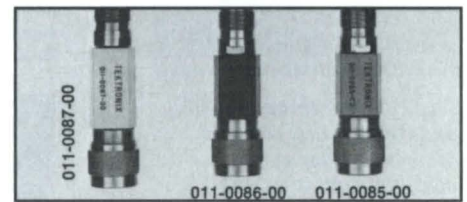
BNC



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	\$485
017-0079-00	Attenuator	50	±0.5	5X	14	Same	4 GHz	1	1000	Same	\$375
017-0080-00	Attenuator	50	±0.5	2X	6	Same	4 GHz	1	1000	Same	\$270
017-0081-00	Termination end-line	50	±0.5	NA		Same	4 GHz	1	1000	Same	\$550

### 3.5 MM TERMINATIONS (not shown)

Female 50 Ω	011-0149-00	\$900	Female short-circuit	011-0150-00	\$275
Male 50 Ω	011-0148-00	\$900	Male short-circuit	011-0151-00	\$275



50 Ω POWER DIVIDER

SMA female connector	015-0565-00	\$285
SMA male connector	015-1014-00	\$300
GR connectors	017-0082-00	\$885

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	\$70
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Accessory housing without electrical components is useful for applications requiring special circuitry.



50 Ω COUPLING CAPACITORS

Coupling Capacitor SMA	015-1013-00	\$255
Coupling Capacitor GR	017-0028-00	\$140

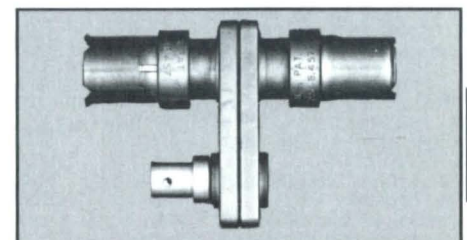
The coupling capacitor is a short length of coaxial line with a disk capacitor (4700 pF GR and 5000 pF SMA) in series with the inner conductor. High frequencies are transmitted with small reflection, but DC and low frequencies are blocked. Voltage rating is 200 V (015-1013-00), 500 V (017-0028-00).



50 Ω AIR LINE

50 Ω Air line	017-0084-00	\$260
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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	\$320
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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.

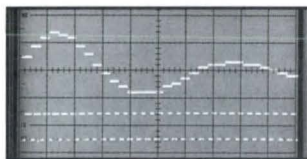
**Insertion Impedance** – With 50 Ω termination is 1 Ω shunted by 4.5 μH, 2 Ω shunted by 4.5 μH without a 50 Ω termination.

**VSWR** – <1.2 at 1.5 GHz.

**Voltage Rating** – AT 0 V dc is 25 V RMS. 1 kV pulse peak.

## A clear view into digital control systems

- Real-time Scope Display of Time-Interval Variations vs. Time
- Time Delay, Pulse Width, and Period Measurements
- >2 Million Uninterrupted Event-by-Event Measurements/second



The TVC 501 instantaneously and continuously converts consecutive timing measurements to a time-interval vs. time waveform. The top trace (TVC output) shows the pulse-to-pulse width vs. time variations of the lower stream of pulses.

### ORDERING INFORMATION

**TVC 501 Instrument Module \$2,500**  
Includes: 2 monitor cables; 1 output cable; 1 P6109 10X readout probe; operator's manual (070-7991-00); service manual (070-7992-00). Requires a TM 500/5000 Power Module. See page 241.

#### RECOMMENDED ACCESSORIES

**Monitor cable - 42 in SMB-BNC (012-0532-00) \$55**  
**Output cable - 42 in BNC-BNC (012-0057-01) \$25**  
**50Ω BNC feed through termination - (011-0049-01) \$35**  
**P6408 16-bit Word Recognizer \$375**  
Use the P6408 when time-intervals are defined by a bus address.  
**P6420 RF Probe, 10 kHz-1 GHz \$195**  
Demodulates RF bursts for pulsed RF timing measurements  
**P6009 100X Readout Probe \$250**  
Extends trigger voltage range to ±125V for high voltage pulses  
See probes section for other readout probes and input terminations.

## THE NEED FOR TIME-INTERVAL MEASUREMENTS

Measuring parameters is no longer as simple as recording voltage vs. time. In digital or switching systems, signals are sampled, pulse-coded, or pulse-width modulated. Relevant information is in the varying time intervals between the signal transitions. It is in these time intervals that failures often occur. For example, control pulse widths in a switching power supply can be too long or short which can overdrive output transistors. Or an embedded controller's interrupt latency can be too long which can cause a system crash.

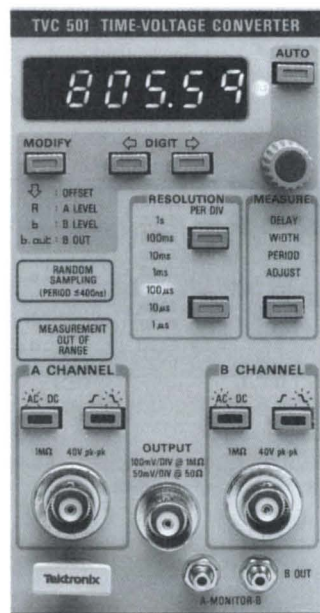
Timing variations typically appear as left-to-right motion or jitter on a scope. Timebase or trigger holdoff adjustments may improve display stability but do not show timing dynamics. The TVC 501 untangles the often

confusing waveforms in digital systems and delivers a coherent and real-time view.

## SAME SCOPE, MORE POWER

The TVC 501 adds three measurement functions to your scope's voltage vs. time capability: time-delay vs. time, pulse-width vs. time, and period vs. time.

The TVC continuously measures the timing parameter



### TVC 501

and instantaneously generates a voltage proportional to the measurement. Timing measurements are made with crystal controlled accuracy using digital counters. Conversions are performed pulse-to-pulse without averaging. The TVC output goes to any scope. The TVC 501 provides seven vertical scales from 1 μsec to 1 sec per division. Up to 30,000 divisions of offset permit small timing variations to be viewed on events with large average values.

### REAL TIME

There is no resetting or re-arming. The continuous TVC output becomes another trace on your scope that can be correlated, measured, and analyzed with waveforms on other channels. Since the TVC generates voltages proportional to time-intervals, you can set your scope to trigger on timing violations such as a time-delay that exceeds a threshold or an incorrectly narrow pulse or glitch.

### QUICK RESULTS

On power-up, the TVC generates a scale calibration waveform to set the scope's gain and offset. One key press can automatically set the trigger level or the measurement range. You can use the monitor output signal to verify that the TVC is measuring what you actually want it to measure. The TVC can also generate demonstration signals to quickly familiarize you with its operation.

### FLEXIBLE CONFIGURATION

The TVC 501 can be used with other TM 500/5000 modular instruments in a suitable power module mainframe. See page 241.

## CHARACTERISTICS

### A AND B CHANNEL INPUTS (BNC)

**Impedance** -1 MΩ, ≤50 pF.

**Coupling** - ac or dc selectable.

**Trigger Slope** - Rising or falling edge selectable.

**Trigger Level** - Adjustable in 10 mV steps in ±1.25V window, 100 mV steps in ±12.5V window when using 10X probes. Digital trigger level readout decodes Tektronix readout probes.

**Sensitivity** - ~10 nsec pulses at 250 mV.

### TIMING MEASUREMENTS

**Functions** - A-Period, A-Width, A-to-B Delay.

**Scope Viewing Range** - ±4 divisions around Conversion Offset, out-of-range LED flags conversions outside of viewing range.

**Conversion Offset** - Adjustable to 30,000 divs in 0.1 div increments.

**Conversion Scale** - 1 μsec/div to 1 sec/div in 7 decade steps.

**Best Timing Resolution** - 33 nsec at 1 μsec scale (1/30th of a division).

**Uninterrupted Rate** - Up to 2.5 MHz (400 nsec between events), random sampling LED flags missed measurements.

### MEASUREMENT OUTPUT (BNC)

**Voltage range** - ±400 mV into 1 MΩ. Corresponds to ±4 vertical scope divisions when scope set to 100 mV/div. Automatically clips outside of ±4 division range.

**Response time** - voltage settles <500 nsec after end of event.

### A AND B MONITOR OUTPUTS (SMB)

**Voltage range** - -0-500 mV into 1 MΩ. Goes high when input meets trigger slope and level criteria.

**B monitor prescaler** - Can generate one pulse every 100 or every 1000 triggers to measure high frequency oscillators (>100 MHz).

**B monitor demonstration** - Can generate 5 different digital demonstration signals.

# INSTRUMENT TRAVEL ACCESSORIES

## 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 convenient carrying strap for hands-free operation and transport.

The Travel Line Package can be ordered at the time of purchase or as a field retrofit kit (available on 2235A, 2236A, 2221, 2224, and 2232).

#### 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

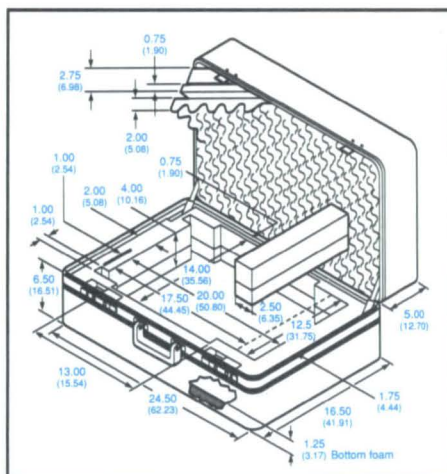
Includes: Replacement cabinet and rear cover with the rubber moldings installed.

2235A Order 040-1188-03 \$360  
2236A, 2221, 2224, 2232 Order 040-1187-03 \$200

### 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

271X Family Order 016-0792-00 \*1  
275X Family Order 016-0962-00 \$495  
2400 Series, 2200 Series, 490 Series, Order 016-0792-01 \$345  
OF150, OF235 Order 016-0658-00 \$990  
TM 503A Order 016-0565-01 \$770  
TM 504 Order 016-0608-00 \$805  
TM 515 Order 016-0643-00 \$770  
C-50 Series Order 016-0177-00 \$395

#### SOFT SIDED CASE

490 Series, OF150, OF235 Order 016-0659-00 \$155  
HC100 Order 016-0707-00 \*1

#### CARRYING STRAP

2200/2300 Series Order 346-0199-00 \$20

### 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	\$24
5000 Series	016-0544-00	\$18
2400 Series	016-0720-00	\$34
2200 Series	016-0848-00	\$18
200 Series	016-0512-00	\$25
490	016-0659-00	\$155
465/465B/475/485	016-0554-00	\$20
453A/454A/491	016-0074-01	*1
434/464/466	016-0365-00	\$37
326	016-0532-00	*1
314/335	016-0612-00	\$85
TM 504	016-0621-00	\$45
TM 503	016-0620-00	\$35



*Front Covers Only*

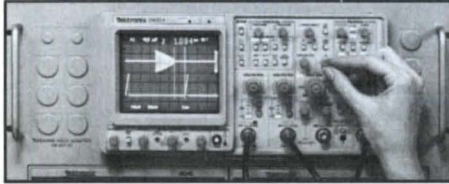
Snap-on front cover, molded of high-impact plastic, is available for most portable oscilloscopes, spectrum analyzers, and TM 500/5000 mainframes.

2400 Series	200-3199-01	\$13.25
2245A, 2246A, 2247A	200-3232-00	\$10.00
2235A, 2236A/2710	200-2520-00	\$10.00
2201, 2205, 2211, 2225	200-3397-00	\$10.00
TM 506	200-1728-00	\$21
TM 504	200-1727-00	\$20
TM 503A	200-3554-00	\$26

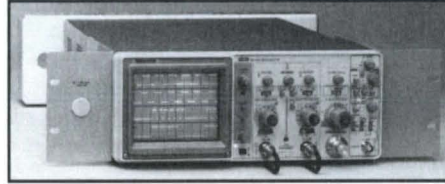
\*1 Product available within 24 hours through Tek Direct. Call 1-800-426-2200.

# RACKMOUNT KITS

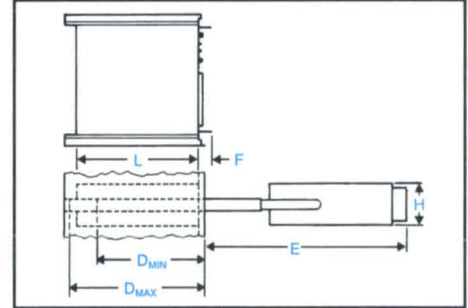
## RACKMOUNT KIT SELECTION GUIDE



Typical 2400 series rackmount kit.



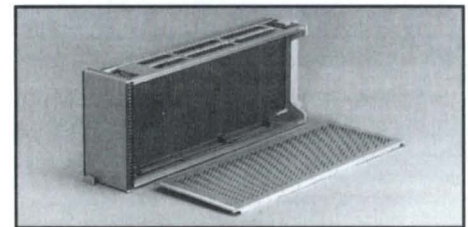
Typical 2200 series rackmount kit



### DIMENSIONS (Exclusive of Plug-in Units and Probes)

Symbol	Definition
H	Height of front panel
L	Rack front to rear most 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

Instrument	Part Number	H in. cm	L in. cm	F in. cm	E in. cm	D Min. in. cm	D Max. in. 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	— —	— —	— —	— —	— —
271X Family	016-0901-00	5.25 13.3	16.3 41.4	1.84 4.67	— —	— —	— —
271X Family	016-0897-00*1	7.0 17.8	18.4 46.7	4.67 11.9	— —	— —	— —
2400 Series (with DV or DMM Opt.)	016-0805-00	8.75 22.3	18.3 46.5	1.8 4.5	24.8 62.9	12.8 32.5	26.8 68.1
2400 Series (w/o DV or DMM Opt.)	016-0825-01	7.0 17.8	18.3 46.5	1.8 4.5	24.8 62.9	12.8 32.5	26.8 68.1
2402 TekMate™	016-0971-00	3.5 8.9	18.0 45.7	1.8 4.5	24.5 62.2	11.0 27.9	23.0 58.4
2245A, 2246A, 2247A	2240FIR	7.0 17.8	18.3 46.5	2.2 5.6	24.8 62.9	12.8 32.5	24.5 62.2
2335	016-0468-00	5.25 13.3	16.3 41.4	1.8 4.5	— —	7.5 19.1	24.5 62.2
2236, 2236A	016-0015-00	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	016-0819-02*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	1230FD5	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	— —	— —



### BLANK PLUG-IN CHASSIS

Available for all Tektronix mainframes. The 11000 Series provides a blank plug-in only. The 7000 Series includes a bare printed circuit board.

11000 Series	016-0829-00	\$145
7000 Series	040-0553-04	\$230
5000 Series	040-0818-04	\$145
TM 500 Series	040-0652-06	\$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	\$100
5000 Series	016-0452-01	\$75
TM 500/TM 5000 Series	016-0195-05	\$42

### 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	\$90
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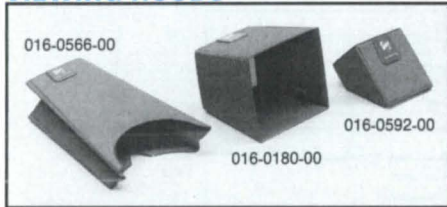
\*1 Cradle mount to rackmount a cabinetized instrument.

\*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.

# VIEWING HOODS AND LIGHT FILTERS

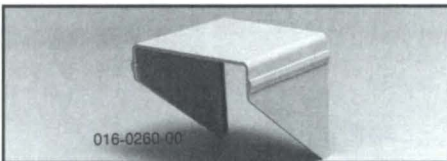
## SELECTION GUIDE

### VIEWING HOODS

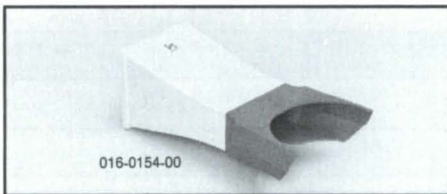


The viewing accessories normally mount on the instrument graticule cover. Some may fit camera-mounted bezels. If you intend using a camera on your instrument, check with your Tek Sales Engineer for bezel-viewer compatibility.

	Part No.	Price
<b>Folding Binocular</b> – 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	\$24
<b>Collapsible</b> – To reduce reflections and glare under high ambient light. Blue vinyl, folds flat for storage. For 2200 series, 2445A/B, 2455A, 2465A/B, 2467B, 271X Family, 432, 434, 455, 465/B, 475, 464, 466 (polarized)	016-0180-00	\$70
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	<sup>3</sup>



	Part No.	Price
<b>Folding</b> – For 576	016-0259-00	\$25
For 577, 5000, 7000, 11000 Series	016-0260-00	\$48



	Part No.	Price
<b>Non-collapsible</b> – For older Tek 5-inch oscilloscopes	016-0001-01	\$240
<b>Molded</b> – gray polystyrene with polyurethane eyepiece. For 5000 and 7000 series, 528, 577	016-0154-00	\$80
For 576	016-0153-00	\$55

### CATHODE-RAY TUBE LIGHT FILTERS

Instrument <sup>1</sup>	Color	Part Number	Price
200 Series	Blue	378-0691-00	\$4.70
324/335	Blue	378-2016-01	\$2.25
490	Amber	378-0115-01	\$3.30
	Gray	378-0115-02	\$6.00
	Blue	378-0115-00	\$3.10
434	Blue	378-0678-01	\$14.75
455/465M	Blue	337-2122-00	\$7.00
465/465B	Blue	337-1674-00	\$8.00
475	Clear	337-1674-01	\$7.25
464/466	Smoke-gray filter	337-1674-07	\$9.50
540/550	Smoke-gray <sup>2</sup>	378-0567-00	<sup>3</sup>
Series	Green	378-0568-00	\$19.00
565/575	Blue	378-0569-00	<sup>3</sup>
	Amber	378-0570-00	<sup>3</sup>
576	Blue <sup>2</sup>	378-0616-00	\$7.25
603/604	Clear (603 <sup>2</sup> )	337-1440-00	\$4.25
	Green	337-1440-01	\$4.65
	Amber	337-1440-02	\$3.50
	Blue	337-1440-03	\$6.75
	Gray	337-1440-04	\$7.75
	Graticule (8 x 10 div)	331-0303-00	15.00
605/606/607	Blue	337-1674-00	\$10.75
	Graticule	337-1674-10	\$10.00
	Clear Shield	337-1674-13	\$14.75
	Gray <sup>2</sup>	337-1674-06	\$5.00
	Graticule (8 x 10 div)	331-0391-00	\$9.00
608	Amber	378-0704-00	\$10.00
	Graticule <sup>2</sup>	337-2126-02	\$10.00
2200 Series	Blue <sup>2</sup>	337-2775-00	\$4.20
	Clear	337-2775-01	\$1.95
	Gray w/TV Graticule	035-0175-00	<sup>3</sup>
2300 Series	Blue Implosion Shield <sup>2</sup>	337-2760-00	\$2.25
	Clear Implosion Shield <sup>2</sup>	337-2781-00	\$4.40
2400 Series	Blue <sup>2</sup>	378-0199-03	\$4.05
	Clear Implosion Shield <sup>2</sup>	378-0208-00	\$2.05
271X Family	Smoke Gray	337-2775-02	\$3.00
5100 &	Clear	337-1440-00	\$4.25
5400 Series	Green	337-1440-01	\$4.65
	Amber	337-1440-02	\$3.50
(except 5441)	Blue	337-1440-03	\$6.75
	Gray	337-1440-04	\$7.75
5441	Clear <sup>2</sup>	337-1674-01	\$9.00
	Gray	337-1674-07	\$12.75
	Graticule (8 x 10 div)	331-0391-00	\$9.00
7603	Blue	378-0684-00	\$10.50
	Amber	378-0684-01	\$7.00
	Gray	378-0684-02	\$9.25
	Green	378-0684-03	\$14.25
	Spectrum Analyzer		
	Graticule	337-1439-01	\$9.75
	Blue Implosion Shield <sup>2</sup>	337-1700-01	\$8.00
	Clear Implosion Shield	337-1700-04	\$6.50
7613/7623/7623A/7633	Spectrum Analyzer		
	Graticule	378-0625-07	\$14.50
	Green (UV)	378-0625-08	\$6.00
7844/7313	Blue <sup>2</sup>	378-0625-00	\$8.50
7700 Series/7613/7623/7100 Series/7900	Amber	378-0625-01	<sup>3</sup>
	Gray	378-0625-02	\$8.75
	Green	378-0625-03	\$9.50
	Gray TV Graticule		
	NTSC	378-0625-06	\$14.50
	Clear Shield Spectrum Analyzer Graticule	337-1159-02	\$9.75

### 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 <sup>1</sup>	Part Number	Price
314/326/335	378-0063-00	\$65
432/434	378-0682-00	\$65
422/491/453A/454A/485	378-0648-00	\$70
465/465B/475/464/466/434	378-0726-01	\$100
271X Family	378-0227-01	\$95
7400/7603	378-0696-00	\$95
7100/7500/7700/7800/7900 Series/7613/7623A/7633	378-0603-00	\$110

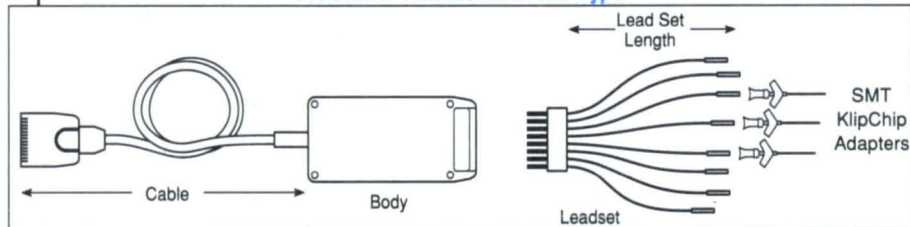
<sup>1</sup> For both cabinet and rackmount instruments unless rackmount version is listed.

<sup>2</sup> Standard filter supplied with instrument.

<sup>3</sup> Contact your local sales representative.

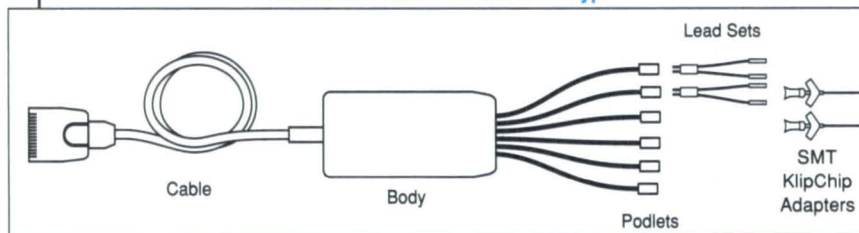
## LOGIC ANALYZER PROBES AND LEADSETS

FIGURE 1: Traditional Probe Type



Traditional Acquisition Probes	Probe Price	For Use With	INPUTS			Lead set Part Number	Available <sup>1</sup>	Leadset Length	Leadset Price	Additional Information
			Data	Clock	Qual					
P6443	\$500	1230, 1230B, 1230D 1230E1	16	4	2	174-1264-00	Standard	10"	\$33.00	Black Ends Red Ends White Ends
						174-1265-00	Standard	10"	\$30.00	
						174-1266-00	Standard	10"	\$30.00	
P6444	\$700	1230, 1230B, 1230D 1230E1	16	2	1	012-1230-01	Standard	10"	\$200.00	Black Ends Red Ends White Ends
						174-1265-00	Standard	10"	\$30.00	
						174-1266-00	Standard	10"	\$30.00	
P6460	\$750	DAS9200 92A16, 92A16E 92S16, 92SX109 DAS9100 91A24, 91AE24 1240, 1241 1240D1, 1240D2	8/9	1	1/0	012-0747-00	Standard	10"	\$40.00	
						012-0987-00	Optional	5"	\$33.00	
Traditional Pattern Generator Probe	Probe Price	For Use With	OUTPUTS			Lead set Part Number	Available <sup>1</sup>	Leadset Length	Leadset Price	Additional Information
			DNRZ	Clock	RZ/R1					
P6463A	\$1,000	DAS9200 92S16, 92S32	16/9	1		012-1236-10	Standard	12"	\$145.00	
						012-1236-20	Optional	14"	\$155.00	

FIGURE 2: Active Podlet Probe Type



Podlet Acquisition Probes	Probe Price	For Use With	INPUTS			Leadset Part Number	Available <sup>1</sup>	Leadset Length	Leadset Price	Additional Information
			Data	Clock	Qual					
P6461	\$1,600	DAS9200 92A16, 92A16E	8	1	1	196-3047-00	Standard	3"	**	Ten required per probe.
P6461E	\$1,400	DAS9200 92A16, 92A16E	8			196-3047-00	Standard	3"	**	Eight required per probe
Podlet Pattern Generator Probes	Probe Price	For Use With	OUTPUTS			Leadset Part Number	Available <sup>1</sup>	Leadset Length	Leadset Price	Additional Information
			DNRZ	Clock	RZ/R1					
P6464	\$1,400	DAS9200 92S16, 92S32 92SX109, 92SX118 DAS9100 91S16, 91S32	9	1		196-2963-00	Standard	3"	\$9.75	Twelve required per probe.
P6465	\$1,700	DAS9200 92S16, 92S32	8	1	1	196-2963-00	Standard	3"	\$9.75	Twelve required per probe

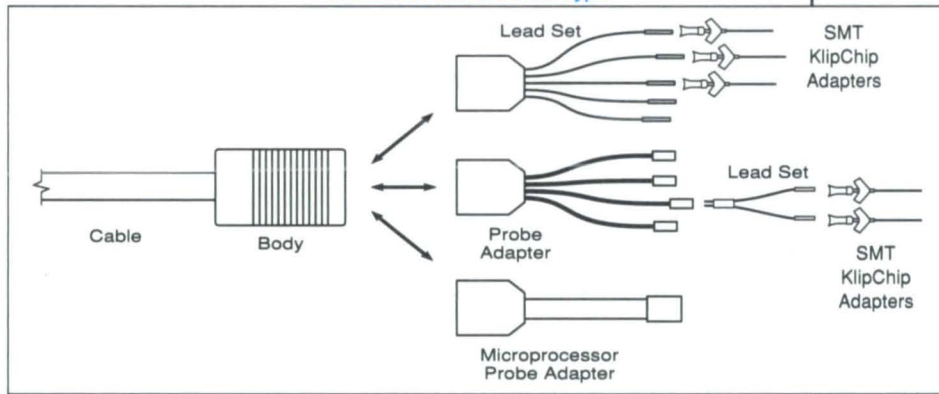
<sup>1</sup> Standard indicates that this leadset is sold as part of the product. This is the part you need to buy as a direct replacement. Optional indicates that the part can be substituted for the original part and varies in some way. i.e., longer.

<sup>2</sup> Contact your local sales office.



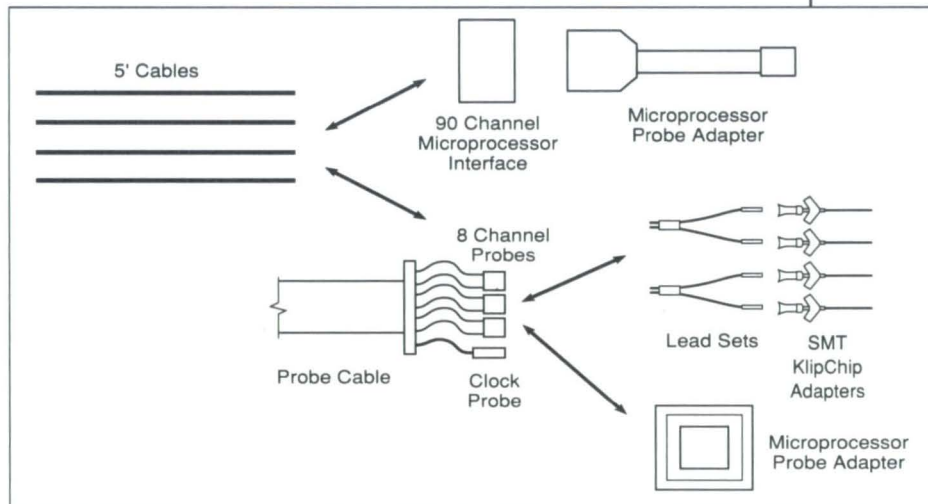
## LOGIC ANALYZER PROBES AND LEADSETS

FIGURE 3: Buffer Probe Type



Buffer Acquisition Probes	Probe Price	For Use With	INPUTS			Leadset Part Number	Available <sup>1</sup>	Leadset Length	Leadset Price	Additional Information
			Data	Clock	Qual					
P6480	\$750	PRISM 3000 30MPX 3001MPX	96	3	5	012-0747-00	Standard	10"	\$40.00	30MPX or 3001MPX State Probe
P6486	\$1,000	PRISM 3000 30MPX 3001MPX	10			012-1230-01	Standard	10"	\$200.00	30MPX or 3001MPX Timing Probe
						012-1231-01	Optional	10"	\$550.00	
P6487	\$1,100	PRISM 3000 30HSM 3001HSM	10	4	4	012-1230-01	Standard	10"	\$200.00	2 leadsets per 30HSM or 3001HSM.
			10	4	4	012-1231-01	Optional	10"	\$550.00	400 MHz Probe Adapter
			2	4	4	012-1277-01	Optional	12"	\$1,200.00	2 GHz Probe Adapter
Buffer Probe	NA	DAS9200	60	4	4	012-1165-00	Standard	10"	\$495.00	
	NA	92A60, 92A60D 92A90, 92A90D	90	4	4	012-1165-00	Standard	10"	\$495.00	

FIGURE 4: Passive Podlet Probe Type



**100 Channel Probe Set** – Order 010-0492-00  
Includes: 96 data (organized as twelve 8-channel probes) & 4 clock probes.  
Does not include leadsets or KlipChips.

**\$3,950**

**25 Channel Probe Set** – Order 010-0508-00  
Includes: 24 data (organized as three 8-channel probes) & 1 clock probe. Includes leadsets and KlipChips. See photo on following page.

**8 Channel Leadset** – Pkg. of 12  
Order 020-1919-00

**\$950**

**Single Channel Clock Leadset** – Pkg. of 12  
Order 020-1888-00.  
See photo on following page.

**\$95**

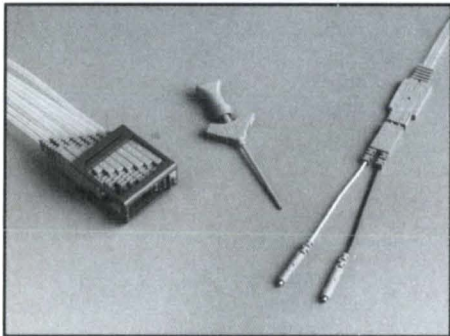
**\$600**

**Dual Lead SMT KlipChip™ Adapters** – Pkg. of 12  
Order 020-1386-01.  
See photo on following page.

**\$46**

# LOGIC ANALYZER ACCESSORIES

## ADDITIONAL ACCESSORIES



The 100-Channel and 25-Channel probe sets for the 92A96/A96D are based on multiple 8-channel probes, shown above, left. Notice the grouping clip that surrounds the individual podlets. Also shown is a SMT KlipChip™ (206-0364-00), clock probe & clock leadset (020-1888-00, pkg. 12).

### SMT KLIPCHIP™ ADAPTERS

**Double Sided** – Order 020-1386-01 **\$46**  
Package of twelve.

**Single Sided, SMT** – Order 206-1386-00 **\*\***  
Package of twelve. Also see page 317.



The 90-Channel Microprocessor Interface allows existing 92A60/A60D or 92A90/A90D microprocessor probe adapters to work with the 92A96/A96D. Order 010-0508-00.

### DAS 9200

**Circuit Board Ejector Tools** – Order 105-0985-00 **\$2.50**  
For removal of circuit boards from the DAS 9200 Mainframe (2 required).

**Deskew Adapter** – Order 010-0456-00 **\$185**  
For use with the DAS 92A60, 92A60D, 92A90, & 92A90D to deskew channel groups.

**Training Aid Board** – For use with DAS 9200, connects acquisition probe leadset to pattern generation leadset **\*\***

**Podlet Gang Connector** – Order 020-1442-00 **\$35**  
For use with P6461/P6461E, 10 wide, Pkg of 2. **NOT FOR USE WITH P6464 or P6465.**

**Retainer Clamps** – Order 020-1484-01 **\$18.50**  
Pkg of 4. For use with P6460, P6461, P6461E, P6463A, P6464, and P6465

**90-Channel Microprocessor Interface** – **\$950**  
Order 010-0508-00

### PRISM 3000

**3002P Transit Case** – Order 016-0994-00 **\$660**  
Hard case with wheels.

**3002P Carrying Case** – Order 016-0909-01 **\$120**  
Soft case with shoulder strap.

**3002 Display Filler Panel** – Order 386-5664-00 **\$21**

**3002 to Color Display Cable** – **\$90**  
Order 174-1299-00 6 foot.

**3002 to Color Flat Panel Cable** – **\$90**  
Order 174-1299-00 6 foot.

**3002 to Color Flat Panel Cable** – **\$90**  
Order 174-1299-00 10 inch.

**TekLink Cable, 4 ft.** – Order 174-1152-00 **\$240**

**TekLink Cable, 9 in.** – Order 174-1391-00 **\$200**

**Trigger In/Out Cable** – Order 012-0482-00 **\$35**  
36 in., 50 ohm, coax with 50 ohm terminator (PN: 011-0049-01)

### 1230

**Training Aid Circuit** – Order 671-0049-00 **\$140**  
A convenient tool to aid in gaining experience and confidence with the use of a logic analyzer.

**Service Maintenance Kit** – Order 020-1674-00 **\$1,500**  
Includes 1230 Service Manual, Extender Card for 1230E1 module, and cable assemblies.

### DISKETTES

**5.25" Floppy Disks** – Order 119-1583-01 **\$36**  
360k, 5.25-inch, Box of 10.

**5.25" Floppy Disks** – 1.2M, 5.25-inch, Box of 10. **\*\***

**3.5" Floppy Disk** – Order 119-3136-00 **\$6**  
720k, 3.5-inch, Each.

### RACKMOUNT KITS

These kits include all appropriate hardware for installing the listed instrument in a standard 19" rack. Please refer to page 340 for physical deminisions.

**Rackmount Kit** – For DAS 9200. Order 016-0845-00 **\$545**

**Rackmount Kit** – For 92HS8. Order 016-0884-00 **\$415**

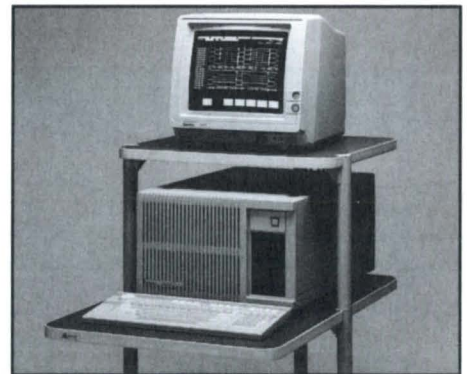
**Rackmount Kit** – For 1230. Order 1230F05 **\$450**

### CARTS

**K217 Cart** – For 1230 **\$625**

**K335BN Cart** – For PRISM 3000 **\$340**

Refer to the cart selection guide on page 306 for complete description.



**92 Cart** – For DAS9200 **\$355**

### CABLES

**RS-232 Cable** – Order 012-0911-00 **\$100**

Used with DAS 9200 mainframe to 9201T display or printerand communications interface. Male-to-female. 20 inch, wires: 1-1, 2-2, 4-4, 5-5, 6-6, 7-7, 8-8, 11-11, 12-12, 15-15, 17-17, 19-19, 20-20-, 22-22.

**Null Modem Cable** – Order 012-0530-00 **\$90**

Used with PRISM 1200C01 Serial Printer interface. 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.

**Parallel Interface Cable** – Order 012-0997-00 **\$90**

Two meter, for Centronix-type printer interface.

**GPIOB Cable** – Order 012-0630-03 **\$110**

Two meter, shielded.

**Probe Extender Cable** – Order 012-1012-01 **\$140**

Male to Female, 6 feet, 34-position double-row connectors. Compatible with P6463 & P6463A.

**Flat Cable Mounts** – Order 343-1048-00 **\$.95**

Adhesive Back for securing and organizing probes with flat ribbon cables.

\*\* Contact your local sales office for information

Tektronix Fiber Optic Cable Testers provide solutions to customer needs in the areas of telecommunications, local area networks, CATV, and other communications applications. Our newest line of high performance, user-friendly optical products include the TFS2020 FiberScout Handheld Optical Fault Finder, and the TFP2 FiberMaster Optical Time Domain Reflectometer. Also available is our OF-150 Optical Time Domain Reflectometer.



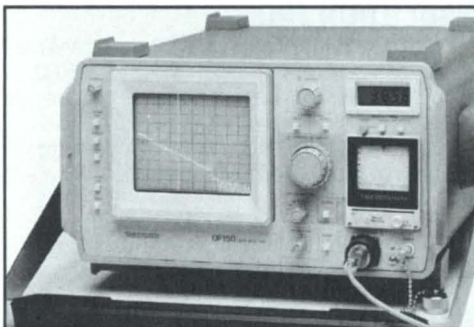
**TFS2020 FiberScout Optical Fault Finder**

TFS2020 FiberScout Optical Fault Finder is designed to locate faults or catastrophic events in optical cable systems. Weighing just 5 pounds (2.3 kg), the user-friendly FiberScout allows cable troubleshooting by practically any user, regardless of skill level. Representative users include optical telephony, LAN, and CATV restoration environments.



**TFP2 FiberMaster**

The TFP2 FiberMaster is a full feature custom configurable OTDR offering a broad range of performance in a user-friendly package. The FiberMaster is ideal for installation and maintenance of optical cable systems, as well as laboratory and manufacturing applications. Representative users include telephony, LAN, CATV,



**OF150 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.

**TFS2020 FiberScout features include:**

- Simple symbolic display
- Fast restoration capability
- Small, lightweight, easy to handle
- 4-button operation
- Low cost – high performance
- Multiple port configurations
- High distance accuracy
- User configured fault thresholds

**NEW TFP2 features include:**

- 2 plug-in module capacity allows dual wavelength operation in single mode and multimode without switching modules.
- Optics modules available combining high resolution and long range performance.
- High resolution CRT display available in color or monochrome.
- Optional high resolution, high speed internal printer
- Mass data storage options available
- MS-DOS standards compatible
- Dual trace comparison function
- Context sensitive help function
- User selectable power-up defaults
- GPIB and RS232C interfaces for remote control and peripheral access

**ORDERING INFORMATION**

<b>OF150</b> Multimode OTDR	<b>\$15,600</b>
Combines high resolution and dynamic range in an easy to operate package for LAN installers and end users.	
<b>TFS2020</b> FiberScout	*1
<b>TFP2</b> FiberMaster Color Display Mainframe	<b>\$12,600</b>
<b>Opt. 01</b> – 850 nm Multimode, 62.5 μm (FM8500)	<b>+\$7,000</b>
<b>Opt. 04</b> – 1310 nm Singlemode (FS1300)	<b>+\$15,000</b>
<b>Opt. 05</b> – 1550 nm Singlemode (FS1500)	<b>+\$17,500</b>
<b>Opt. 06</b> – 1310 nm/1550 nm Singlemode (FS1315)	<b>+\$23,000</b>

\*1 Contact your local sales office.

## 1502C/1503C 1502B/1503B

- Direct distance readout – accurate to better than 1%
- Intermittent fault monitor mode
- High resolution LCD display with zoom
- Menu-driven setup
- Help mode
- Rugged portability
- Calibrated vertical scale
- Optional serial interface
- Optional internal printer
- Noise filtering

### ORDERING INFORMATION

1503C Metallic TDR	\$4,950
1503B Metallic TDR	\$5,850
1502C Metallic TDR	\$6,700
1502B Metallic TDR	\$7,850

Each instrument includes the following accessories: AC PowerCord; 50  $\Omega$  BNC Terminator; Precision 50  $\Omega$  Cable; Female-to-female BNC Connector; Spare Fuse; Operator's Manual; Accessory Pouch; OptionPort Cover; Calculator Slide Rule.

#### OPTIONS

- Opt. 03 – Battery Pack**  
1500C Series products meet environmental requirements of MIL-STD-28800C for Type III, Class 3, Style C, and utilize a high performance internal gel-cell battery. 1500B Series products meet environmental requirements for Style A, and utilize a removable NiCad battery pack. **+\$250**
- Opt. 04 – YT1 Chart Recorder**  
Records all information displayed on LCD, including waveform and settings for a permanent record. **+\$950**
- Opt. 06 – (1503 only) Ethernet SP232 Serial Interface Module**  
Provides a serial link to a host PC for remote control, waveform storage, and automated fault finding. Includes host software for IBM-compatible PCs. **\$595**

A wide range of other options and connectors are available. Contact your local sales engineer for details.

### 1502C, 1503C, 1502B, AND 1503B

Tektronix 1500 Series cable testers use time domain reflectometry (TDR), also known as cable radar, to precisely pinpoint faults or changes in impedance in almost any dual-conductor metallic cable.

With a complete range of products and options to choose from, a 1500 Series TDR can be custom configured to meet your test needs.

### THE 1503B AND 1503C GENERAL PURPOSE CABLE TESTERS

These products generate a 1/2 sine pulse, with selectable pulse widths of 2, 10, 100, or 1000 nanoseconds. The high-resolution 2 ns pulse permits the identification of multiple faults as close together as one foot. The 1000 ns pulse gives the 1503C a range of 5,000 to 50,000 feet (depending on cable type and condition).

For most TDR applications, where determining distance to an impedance change is the key measurement, the 1503C and 1503B are the best choice.

### THE 1502C AND 1502B ULTRA-HIGH RESOLUTION TDRS

The 1502C and 1502B generate a 200 picosecond rise time step pulse and have an output impedance of 50  $\Omega$ . The fast risetime permits the identification of multiple faults as close together as 0.6 inches. In addition to direct readout of distance to the cursor, the 1502C and 1502B also offer direct readout of impedance at the cursor.

### SAMPLE APPLICATIONS

#### TELEPHONE

In addition to locating shorts, opens, splits, crosses and bridges, the 1503C and 1503B can be used to identify and locate load coils or pinpoint and map wet

sections of cable (together with the YT1 printer). Wire gauge and cable temperature won't affect the measurement either. Automated intermittent fault monitoring helps eliminate costly return calls to fix these challenging problems.

#### LOCAL AREA NETWORKS

Cable and connector problems can be the biggest headache for the LAN installer. The 1503C's high resolution 2 ns pulse will precisely identify problems in seconds. The calibrated vertical scale can help identify marginal components before they cause problems, and a return call. Use the optional YT1 chart recorder or SP232 serial interface to document the working installation for certification or future troubleshooting. The Ethernet option permits testing of an active Ethernet bus. Adapters are available for all popular LAN standards.

#### ON-BOARD SYSTEMS

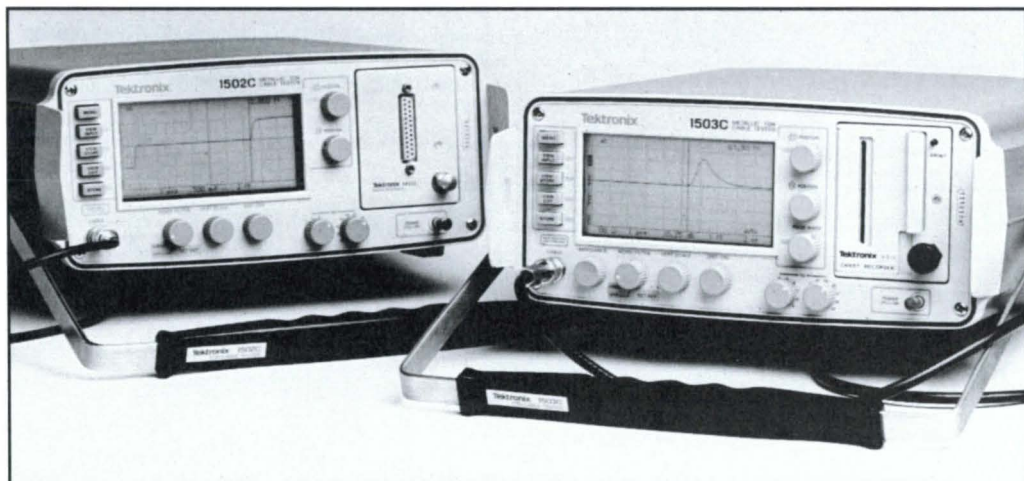
The ultra high resolution of the 1502C and 1502B are perfectly adapted for testing critical wiring on board aircraft and ships, or for analyzing cabling in ultra-high speed data links or weapons systems.

#### MANUFACTURING QUALITY CONTROL

The 1502C and 1502B combine ultra-high resolution, rugged reliability and automated operation (with the optional SP232 serial interface) into one package. Manufacturers of circuit boards or precision cabling can quickly and accurately determine or verify the impedance characteristics of their products, in a matter of seconds.

#### OTHER APPLICATIONS

For details on these and other applications, including cable TV, power transmission line testing, antenna cable testing, and general information, call 1-800-833-9200.



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.

### 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 communications 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.

#### 835 DATA COMMUNICATIONS ANALYZER

- Triggering Capability
- Data Rates up to 19.2K Baud
- Applications for a Wide Range of Protocols and Interfaces
- Upload/Download Capabilities
- Lightweight and Rugged Construction
- Library Packs with Multiple ROM Pack Applications
- Memory Packs (Removable RAM Memory)
- Three Year Warranty
- Upgradable to the 836

#### 836 DATA COMMUNICATIONS ANALYZER

- All the Capabilities of the 835
- Data Rates up to 72K Baud in All Modes and 144K Baud in Half Duplex Monitor
- Multiple Triggers
- Receiver Ready Compression (HDLC)

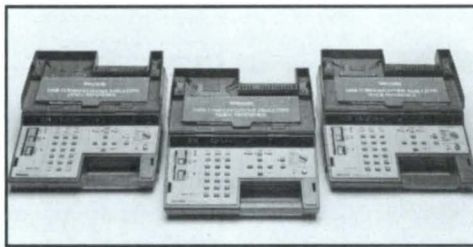
#### MODES OF OPERATION

##### 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 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 test the DCE equipment.

##### BERT Mode

The 830 Series performs bit and block error rate testing using the 511-bit CCITT Standard pseudorandom patter. Additional patterns and testing capabilities are available with 830R03 (including distortion) and 830R03B ROM packs.

#### 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 troubleshooting, preventative maintenance, engineering R&D and manufacturing quality assurance (QA).

#### SOFTWARE APPLICATION PACKS

Tektronix has developed a series of software application 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 that find problems quickly and easily.



#### 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 the specific period.

### 830 SERIES

For simulation, monitoring, and BERT Testing.

- Fully Programmable
- Lightweight, Rugged, Portable
- Three-year Warranty

#### ORDERING INFORMATION

836 Protocol Analyzer	\$4,680
835 Protocol Analyzer	\$3,680
RS232 Interface Standard	NC
<b>INTERFACE OPTIONS</b>	
Opt. 02 - Current Loop	+\$495
Opt. 03 - RS-449 (RS-422/RS-423)	+\$495
Opt. 04 - MIL-STD-188C	+\$495
Opt. 06 - V.35	+\$495
<b>TV ANALYZER</b>	
836TV Television Production Protocol Analyzer (EBU/SMPTE Bus Interface)	\$5,600
<b>ROM PACKS</b>	
830RDA ROM Development Aid	\$195
830R01 Asynchronous	\$195
834R02A Bisynchronous (EBCDIC)	\$195
830R02B Bisynchronous ROM Pack	\$195
830R03 Link Test	\$195
830R03B Link + Async	\$195
834R04 HDLC/X.25	\$195
834R05 Extended Instruction	\$95
834R06 Bisynchronous (ASCII)	\$195
830R07 PARS/IPARS	\$195
830R10 SDLC/SNA (FID2)	\$195
830R10B SNA (FID2)	\$195
834R11 Extended Monitor	\$195
830R13 SDLC/SNA (FID3)	\$195
830R31 Multipurpose	\$195
830L30 IBM Solutions	\$550

### TMA802

Affordable and easy-to-use

- Finds Cable and Connector Faults
- Monitors Ethernet and Starlan Utilization

#### ORDERING INFORMATION

TMA802 Media Analyzer	\$2,495
Includes: Selection of one network kit (Option 01, 02, or 03). Additional network kits available at additional charge.	
<b>INTERNATIONAL BATTERY CHARGERS</b>	
Opt. 1C - Univer. Euro, 220 V, 50 Hz	NC
Opt. 2C - UK 240 V, 50 Hz	NC
Opt. 3C - Canada 115 V, 60 Hz	NC
<b>NETWORK KITS</b>	
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

### TMA802 MEDIA ANALYZER

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 connect the cable, select the network type from the menu and press the "test" button. The TMA802 reports test results in plain English on its 16-character LCD. For example:

"OK to 500M" "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.

## VM 700A

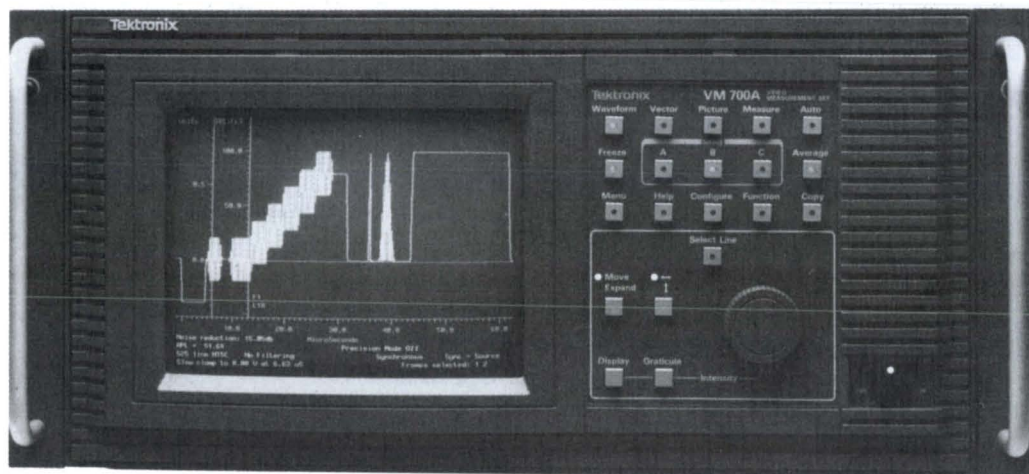
- **Many Capabilities in One Instrument**
  - Digital Waveform Monitor
  - Digital Vectorscope
  - Group Delay and Frequency Response
  - Noise Measurement Set
  - Automatic Measurement Set
- **Auto Mode**
  - Unattended Monitoring of NTSC or PAL Video Signals from Studios, STLs, Earth Stations, and Transmitters
  - User-Specified Limits
- **Measure Mode Provides Graphic Display of Measurements**
  - K Factor
  - Differential Gain and Phase
  - Chrominance to Luminance Delay
  - Noise Spectrum
  - Group Delay with  $(\sin x)/x$
  - Color Bars
  - Relative to Reference on Most Measurements
- **Three Input Channels**
- **Averaging on Most Measurement Modes**
- **Picture Mode for Source ID**
- **Hardcopy for Analysis and Documentation**
- **Remote Control Operation**
- **Automatic Measurement of Short Duration Audio Test Sequence**
- **Measure Frequency Response, Distortion, Phase, Crosstalk, and Other Important Audio Parameters**

## NEW ASG-100

- **Short Duration Audio Test Sequence for Rapid Automatic Checkout of Audio Lines**
- **Connects in-line for easy test signal insertion**
- **Dual channel for stereo applications**
- **Quick identification of insertion point with voice ID**

### ORDERING INFORMATION

VM 700A Video Measurement Set	\$15,000
Opt. 01 - NTSC Measurements	+\$4,500
Opt. 11 - PAL Measurements	+\$4,500
Opt. 40 - Audio Measurements	+\$4,000
Opt. 1C - Cabinet Version	NC
Opt. 1P - Printer Version (110V only)	+\$875
ASG-100 - Audio Signal Generator	\$1,800



Emmy Award Winning VM 700A Video Measurement Set

The VM 700A is a complete video monitoring and measuring instrument which can be used for automatic and 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 VM 700A Auto Mode makes standard video measurements automatically, including those specified in RS-250B/EIA-250C, NTC-7, and RS-170A/for NTSC measurements, or CCIR Rep. 624-1, Rec. 567, and Rec. 569/for PAL measurements. These measurements can be compared with user-defined limits.

With the VM 700A, a caution or alarm message is generated when these limits are violated. Reports can be made and printed automatically at operator scheduled times.

The VM 700A Option 40 Audio Measurement Set expands the power of the VM 700A Option 01 NTSC or Option 11 PAL Video Measurement Set to include comprehensive audio measurement capabilities. This option incorporates both automated and manual audio measurements, audio spectral analysis, and stereo audio monitoring into the VM 700A's full set of video measurements.

The VM 700A Option 30 and the VM 700A Option 20 expand the power even further by adding component measurement capabilities and teletext measurement capabilities respectively.



ASG-100 Audio Signal Generator

The ASG 100 Audio Signal Generator supplies test tone sequences used to perform automated measurements with the VM 700A Option 40 Audio Measurement Set. In approximately 30 seconds, these two products can totally characterize the audio performance of studios, STLs, transmitters and satellite uplinks. Its small size and quick line-up tone selection make it well suited for verifying microwave links from EFP/ENG vans.

Installing the ASG 100 in-line near the program source eliminates the need to change cables every time you perform a test. A fail-safe feature prevents interruption of audio service due to loss of power or instrument malfunction. The tone sequence can be initiated by front panel controls or rear panel contact closure. After insertion of a tone sequence is completed, the ASG 100 returns to a bypass mode.



## 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



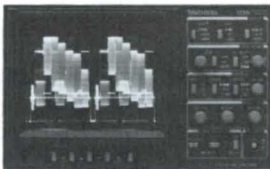
## 1710/11B Waveform Monitors

- Easy operation/cost effective
- Burst phase indicator
- Dual filter display
- Bright CRT display
- Available in NTSC or PAL standards



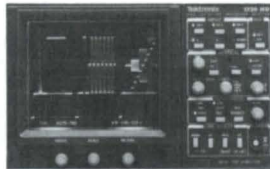
## 1720/21/NEW 1725 Vectorscopes

- Performance and economy
- Simultaneous channel A & B display
- Stereo audio phase measurement
- R-Y output for differential phase measurement
- Available in NTSC, PAL or dual standard



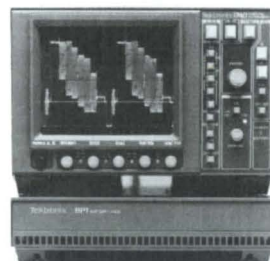
## 1730/31/35 and 1730/31D2 Waveform Monitors

- Performance and economy
- Complete line select
- Simultaneous channel A & B display
- Differential gain measurement
- One button front panel recall
- Dual filter display
- VTR servo rates
- Available in NTSC, PAL or dual standard
- Digital composite input available



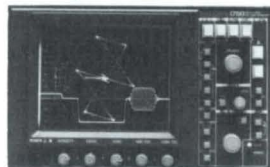
## 1730HD Waveform Monitor

- HDTV sweep speeds
- Full 30 MHz bandwidth
- Six video input channels
- Parade and overlay displays
- Complete line select
- Accepts most HDTV formats



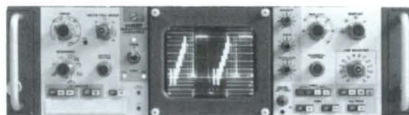
## 1740/41/42 Waveform/Vector Monitors

- Two instruments in one
- R-Y (V axis) mode
- Available in NTSC, PAL and PAL-M
- DC option available



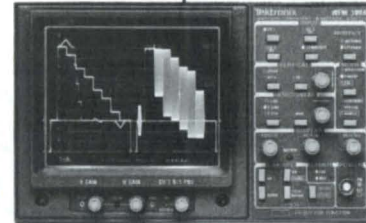
## 1750/51 Waveform/Vector/SCH Phase Monitors

- 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 Video Measurement Set	\$9,900
1780F02 Portable Cabinet for 1780/81R	\$275
1710/11B Waveform/Burst Phase Monitor	\$1,745
1720/21 Vector Monitor	\$2,250
1725 PAL/NTSC Vector Monitor	\$3,200
1730/31 Waveform Monitor	\$2,250
1735 PAL/NTSC Waveform Monitor	\$2,450
1730/31D2 Waveform Monitor	\$2,950
1730HD HDTV Waveform Monitor	\$5,900
1740/41 Waveform/Vector Monitor	\$3,970
Opt. 05 - Internal Waveform, External Vector Graticules	+\$60
1742 PAL-M 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/SCH Monitor	\$5,900
1700F00 Plain Cabinet	\$60
1700F02 Portable Cabinet	\$95
1700F05 Dual Rack Adaptor	\$220
1700F06 Blank Panel	\$60
1700F10 12 VDC Kit for 1710/20/30 and 1705 series	\$200
1480C/R NTSC Waveform Monitor	\$8,300/\$7,900
1481C/R PAL Waveform Monitor	\$8,300/\$7,900
1482R PAL-M Waveform Monitor	\$8,500
1485C/R PAL/NTSC Waveform Monitor	\$8,300/\$7,900
1480 Series Options	
Opt. 01 - Probe Input	+\$400
WFM300A Component/Composite Waveform Monitor	\$3,900
Opt. 05 - Delete Color Shutter	-\$180
Opt. 10 - NTSC/BETA CAM Transcoder	NC
Opt. 14 - NTSC/MII Transcoder	NC
Opt. 74 - P-4 White Phosphor Available on 1700 Series Products	**

\*\* Contact your local sales office

**NEW TSG-1001****TSG-1050****TSG-1125****TSG-1250****NEW SPG-1000****NEW TSG-130/  
TSG-131****NEW TSG-120/  
TSG-121****TSG-100****ORDERING INFORMATION**

<b>TSG-1001</b> Programmable TV Generator	<b>\$18,000</b>
<b>TSG-1050</b> HDTV Generator	<b>\$14,500</b>
<b>TSG-1125</b> HDTV Generator	<b>\$14,500</b>
<b>TSG-1250</b> HDTV Generator	<b>\$14,500</b>
<b>TSG-1050/1125/1250</b> Options	
Opt. 06 - User PROM board	<b>+\$4,500</b>
Opt. 07 - User RAM board	<b>+\$3,500</b>
Opt. 11 - GBR Test Pattern	<b>+\$4,500</b>
Opt. 12 - Y, P <sub>B</sub> , P <sub>R</sub> Test Pattern	<b>+\$4,500</b>
Opt. 21 - Zone Plate Generator	<b>+\$2,000</b>
<b>SPG-1000</b> HDTV Sync Generator	<b>\$5,000</b>
<b>TSG-130</b> Multiformat Generator (NTSC)	<b>\$2,500</b>
<b>TSG-131</b> Multiformat Generator (PAL)	<sup>*1</sup>
<b>TSG-120</b> YC/NTSC Generator	<b>\$1,750</b>
<b>TSG-121</b> SVHS/PAL Generator	<sup>*1</sup>
<b>TSG-100</b> NTSC Test Signal Generator	<b>\$1,250</b>

<sup>\*1</sup> Contact your local sales office

**TSG-1001 Programmable TV Generator**

- Programmable test signal generator
- Programmable zone plate generator
- SDP 1000 Signal Development Package
  - PC based software program
  - Waveform editing and creation
  - PC to generator test signal downloads
  - HDTV, SMPTE/EBU, Betacam®, MII, and NTSC test signal libraries
- Internal or external clock operation
- 10 bit signal generation
- 30 MHz bandwidth
- Analog and parallel digital test signal outputs
- Battery backup for signal memory
- Programmable trigger function for waveform analysis

**TSG-1000 HD Television Generator Family**

- Supports proposed HDTV production standards
- Comprehensive test signal complement
- GBR and Y, P<sub>B</sub>, P<sub>R</sub> formats
- 30 MHz bandwidth
- 10 bit signal generation
- Analog and parallel digital test signal outputs
- Battery backup for signal memory
- Options
  - User PROM board
  - User RAM board
  - Picture monitor test pattern
  - Zone plate generator

**SPG 1000 HDTV Sync Generator**

- Master sync generator for high definition television systems
- Genlocks to HDTV, NTSC, and PAL
- Supports proposed HDTV production standards
- Color bars and monitor setup test signals
- Provides genlock function for TSG 1000 Series Generators

**TSG-130/TSG-131 Multiformat Generators**

- Low cost test signal generator
- NTSC or PAL; Y, B-Y, R-Y; Y, C and Y/C; CTDM outputs
- Betacam® or MII levels
- Stereo audio outputs
- Ideal for equipment maintenance

**TSG-120 YC/NTSC and TSG-121 SVHS/PAL Signal Generators**

- Low cost test signal generator
- NTSC or PAL; Y,C and Y/C outputs
- Stereo audio outputs
- Ideal for equipment maintenance

**TSG-100 NTSC Signal Generator**

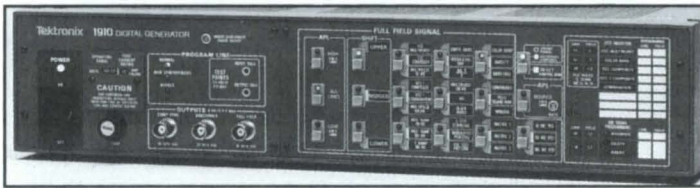
- Studio and transmission test signal sets
- 8 bit digital generation
- Conforms to RS-170A timing specifications
- 1 kHz audio tone
- H or V rate scope trigger signal
- DC power option
- Compact and lightweight





**TSG-273 PAL Composite Digital Signal Generator**

- Analog and parallel digital test signal outputs
- Serial and parallel digital audio outputs
- PAL test signals
- PAL sync generator with genlock
- Full field character identification
- Tape leader countdown



**1910 NTSC Digital Generator/Inserter**

- Studio, transmitter, and transmission test signals
- 10 bit signal generation
- User friendly RS-232C control port for added versatility
- Four external VITS inputs
- Non-volatile memory to maintain selected VITS and full field signal configuration after power interruption
- Ghost Canceller Reference (GCR) signal available



**TSG-170A NTSC Television Generator**

- Simple, effective test signal complement
- Correctly SCH phased sync pulse generator with digital genlock
- Separate SMPTE bars with programmable D (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-300 Component Television Generator**

- Multiple Formats and Standards
  - Y, B-Y, R-Y (Y, B, R; SMPTE/EBU)
  - GBR
  - Betacam®
- MII
- 525/60 and 625/50
- 10 Bit Digital Signal Generation

**NEW TSG-273**

**1910  
TSG-170A/TSG-170D  
TSG-271  
TSG-300**

**ORDERING INFORMATION**

TSG-273 PAL D2 Signal Generator	\$6,700
1910 NTSC Digital Generator/Inserter	\$7,500
Opt. 01 – GCR signal and 0% setup test signals	NC
Opt. 02 – GCR signal and 7.5% setup test signals	NC
Opt. 03 – CBC test signals	NC
Opt. 04 – GCR signal and CBC test signal set (Opt. 03)	NC
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
TS6-300	\$6,500

**TSG-370/TSG371**  
**VITS 201**  
**TPG-625**  
**TSG-422**  
**NEW VS-211**  
**110-S/118-AS**

## ORDERING INFORMATION

<b>TSG-370</b> Component/NTSC Television Generator	<b>\$4,800</b>
<b>Opt. 01</b> – MII/NTSC	<b>NC</b>
<b>TSG-371</b> Component/PAL Television Generator	<b>\$4,800</b>
<b>VITS 201</b> Inserter	<b>\$4,000</b>
<b>TPG-625</b> Pattern Generator	<b>\$5,500</b>
<b>TSG-422</b> Generator	<b>\$5,500</b>
<b>VS 211</b> PAL Video Synchronizer	<b>\$7,500</b>
<b>110-S</b> Video Synchronizer	<b>\$14,975</b>
<b>Opt. 10</b> – Four-field Memory	<b>+\$1,500</b>
<b>Opt. 20</b> – Adds Time Base Correction for Heterodyne Color VTRs	<b>+\$2,000</b>
<b>118-AS</b> Audio Synchronizer	<b>\$5,500</b>

**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

**VITS 201 PAL Inserter Generator**

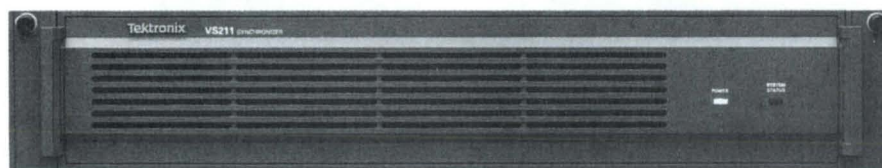
- CCIR, EBU, UK National ITS
- Operates in the presence of sound in syncs
- Four external ITS inputs
- Comp Sync output
- Source identification
- All user program settings saved in non-volatile storage
- User programs for:
  - Insertion of internal, external, and source identification signals
  - Loss of program input modes
  - Text insertion

**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)

**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

**VS 211 PAL Video Synchronizer**

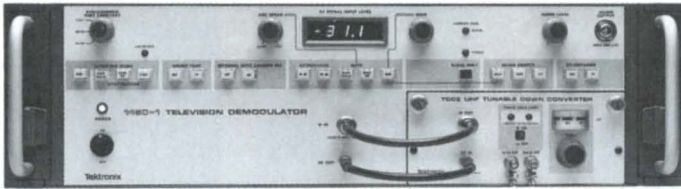
- 10 bit digitizing
- 8 field memory
- Sync and burst insertion
- Processing amplifier functions
- Composite digital input and output
- Audio delay control signal output
- Remote control

**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



## 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



## TDC Television Down Converter

- Any single VHF or UHF channel



## 751 BTSC Monitor

- Precision modulation monitor for entire BTSC sound channel
- Simultaneously displays all components necessary to ensure modulation remains within legal limits
- Bars feature peak indicators with timed peak hold and easily set peak limits
- 4.5 MHz demodulator input available

The 751 BTSC aural modulation monitor/decoder provides accurate modulation monitoring and measurement of the BTSC encoded TV sound channel.

## PC 751 Remote Display Software

- Remote display of 751 Screens over RS-232 on a PC
- Real-time display of peak modulation and processed audio screens
- Data logging of the held peak data

## 1450-1 ONLY

- Wideband audio output for BTSC multi-channel sound applications
- Wideband audio output compatible with Japanese stereo sound with FAX channel

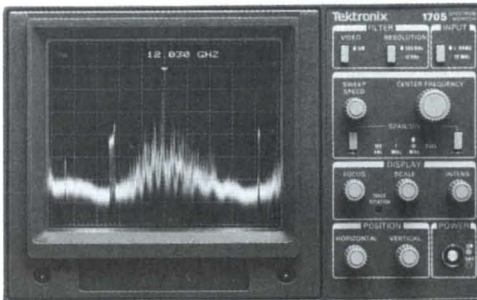
## 1450-3A ONLY

- NICAM intercarrier output compatible with 728D NICAM Decoder input



## TDC1 VHF and TDC2 UHF Tunable Down Converters

- Easy selection of any channel in the VHF (TDC1) or UHF (TDC2) bands



## 1705 Spectrum Monitor

- Designed for satellite news gathering
- Easy, reliable operation
- Cost effective
- On-screen Ku-band or C-band frequency readout
- On-screen setup menu
- L-band and 70 MHz IF inputs
- Selectable 2 dB/div or 10 B/div sensitivity
- Resolution switchable to 10 kHz or 300 kHz
- Span range and video filter selection
- Center frequency control
- Bright clear display
- DC operation available

**TDC1/TDC2**  
**1450-1/1450-2**  
**1450-3A**  
**751/PC751**  
**1705**

## ORDERING INFORMATION

<b>1450-1</b> Demodulator (System M)	<b>\$14,900</b>
<b>Opt.01</b> - 37%MHz Vision IF	<b>NC</b>
<b>Opt.02</b> - 38%MHz Vision IF	<b>NC</b>
<b>Opt.03</b> - 45.75%MHz Vision IF	<b>NC</b>
<b>1450-2</b> Demodulator (System B/G)	<b>\$13,145</b>
<b>1450-3A</b> Demodulator (System I)	<b>\$13,145</b>
<b>751</b> BTSC Aural Modulation Monitor/Decoder	<b>\$12,000</b>
<b>Opt.01</b> - 4.5 MHz demodulator board	<b>\$2,000</b>
<b>1705</b> Spectrum Monitor	<b>\$3,850</b>
<b>TDC1</b> VHF Tunable Down Converters	<b>\$7,660</b>
<b>TDC2</b> UHF Tunable Down Converters	<b>\$7,660</b>

## 2721/2722 Non-Interfering CATV/Broadband Sweep

- Non-interfering
- Full 5-600 MHz range
- Full Alpha Keyboard for data entry
- LCD Display visible even in bright sunlight
- Lightweight, compact Receiver
- Frequency-agile Telemetry
- 50-waveform NVRAM storage
- RS-232C downloads stored waveforms to Serial Printer or PC

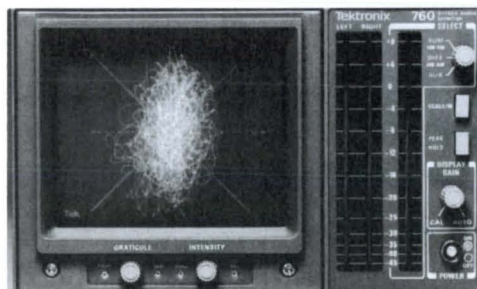
For ordering information, see page 184.

# TELEVISION PRODUCTS

## 760/760N/760D 728D/728E AVC-20

### ORDERING INFORMATION

760 Series Audio Monitors	\$2,500
728D NICAM Decoder	\$3,200
Opt. 01 – System I (6.552 MHz)	NC
Opt. 02 – System B/G (5.85MHz)	NC
728E NICAM Encoder	\$8,000
Opt. 01 – Delete modulator	-\$2,500
Opt. 03 – Mixer/combiner board	+\$1,200
AVC-20 Audio Vector Conv.	\$495



### 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

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



760N



760D

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).



### 728D NICAM Decoder

- Numeric Eye Height/Parity Display
- Monitoring Outputs
- Digital Bitstream Connection

The Tektronix 728D NICAM Decoder demodulates the NICAM-728 carrier and decodes the left and right analog audio channels and a monaural channel derived from them as well as providing access to the user data bits and 728 kB/s data stream. It also monitors the performance of the digital bitstream and provides indications for service type, loss of carrier, and errors.



### 728E NICAM Encoder

- Multi Systems (I and B/G)
- Analog Audio Inputs
- Digital Data Input
- Digital Data Outputs
- I.F. Mixer/Combiner Option
- Built-In Test Signals

The Tektronix 728E NICAM Encoder has been designed as a cost-effective solution to a broadcaster's requirements for NICAM-728 encoding and modulation.

### 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

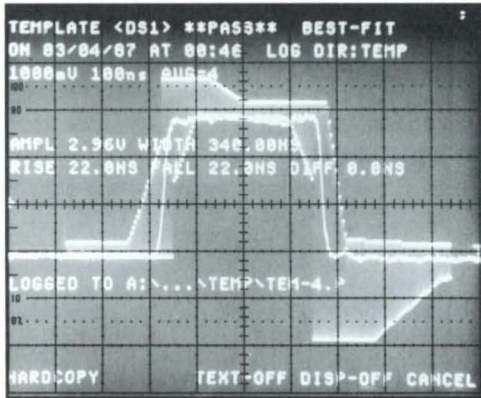
The AVC-20 provides stereo audio monitoring capability when installed with an NTSC Vectorscope. Complete audio monitoring can be added to VTR bridges, master control consoles and other locations requiring stereo audio monitoring without modifying the vectorscope and without using front panel space.



## 2410 DIGITAL INTERFACE TEST 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). 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. CCITT 2 Mb, 8 Mb or 34 Mb don't require the T-Carrier Trigger unit.

### PULSE SYMMETRY (BALANCE) TESTING

Power imbalance is tested to within 0.5 dB, as required by ANSI. For CCITT, the 2410 tests amplitude and width ratios of the positive and negative pulses.

### PULSE SPECTRAL POWER TESTING

The 2410 selects five sequential pulses, then compares power in the second harmonic against power in the fundamental.

### ZERO LEVEL TEST

Test the zero level before and after the pulse in accordance with the CCITT Red Book. The value of a "zero" cannot exceed 10% of the nominal pulse amplitude.

### 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 91. 2402A TekMate has a 1-year warranty, with *Warranty-Plus* available. See 2402A Ordering Information, page 93.

Software: 90-day warranty covering software media (floppy disks) for materials and defects. Software operation carries no warranty.

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 Tests:
  - Pulse Shape
  - Pulse Balance
  - Pulse Spectral Power
- CCITT tests:
  - Pulse Shape
  - Pulse Symmetry
  - Zero Level Test
- Portable, Rugged System

## ORDERING INFORMATION

<b>2410 Digital Interface Test System for ANSI T-Carrier tests</b>	<b>\$19,020</b>	<b>Opt. 41 - DSO Program Development System</b>	<b>+\$995</b>
Includes: T-Carrier Trigger, software for ANSI tests and all ANSI test templates, TGEN template generation software, 2440 Opt. 11 Digital Oscilloscope, 2402A TekMate.		See TekMate Option 41, page 92.	
<b>HARDWARE OPTIONS</b>			
<b>Opt. 30 - Substitute 2430A Opt. 11 Oscilloscope</b>	<b>-\$4,165</b>	<b>INTERNATIONAL POWER PLUG OPTIONS</b>	
<b>Opt. 32 - Substitute 2432A Opt. 11 Oscilloscope</b>	<b>-\$2,000</b>	<b>Opt. A1 - Universal Euro 220 V, 50 Hz</b>	<b>NC</b>
<b>Opt. 03 - Word Recognizer Option for oscilloscope</b>	<b>+\$495</b>	<b>Opt. A2 - UK 240 V, 50 Hz</b>	<b>NC</b>
<b>Opt. 05 - Video Trigger Option for oscilloscope</b>	<b>+\$1,295</b>	<b>Opt. A3 - Australian 240 V, 50 Hz</b>	<b>NC</b>
<b>Opt. 1R - Rackmount</b>	<b>+\$535</b>	<b>Opt. A4 - North American 240 V, 50 Hz</b>	<b>NC</b>
<b>Opt. 1C - Transit Cart (016-1013-00)</b>	<b>+\$115</b>	<b>Opt. A5 - Switzerland 220 V, 50 Hz</b>	<b>NC</b>
<b>Opt. 1T - Transit Case (202-0302-00)</b>	<b>+\$465</b>	<b>SOFTWARE PRODUCTS</b>	
<b>Opt. 1P - HC100 Color Plotter with GPIB cable (U.S. power)</b>	<b>+\$1,020</b>	<b>S37J101 - CCITT Test Software</b>	
<b>Opt. 2P - HC100 Color Plotter with GPIB cable (Euro power)</b>	<b>+\$1,020</b>	Includes: all CCITT templates.	<b>\$2,590</b>
<b>SOFTWARE OPTIONS</b>			
<b>Opt. 4B - Add CCITT Software</b>	<b>+\$650</b>	<b>S37J102 - T-Carrier Trigger, ANSI Test Software</b>	
<b>Opt. 4C - Replace ANSI with CCITT Software. Deletes T-Carrier Trigger and Option 11 from oscilloscope.</b>	<b>-\$1,480</b>	Includes: all ANSI test templates.	<b>\$3,835</b>
<b>Opt. 4X - Delete MS-DOS</b>	<b>-\$25</b>	<b>S37J103 - T-Carrier Trigger, ANSI and CCITT Test Software</b>	
<b>Opt. 2B - 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.</b>	<b>+\$240</b>	Includes: all ANSI and CCITT test templates.	<b>\$4,455</b>
<b>SOFTWARE PRODUCT OPTIONS</b>			
<b>Opt. 2B - 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.</b>			
			<b>+\$235</b>
<b>Opt. 41 - DSO Program Development System</b>			
		See TekMate Option 41, page 92.	<b>+\$1,295</b>

# CSA 907 BIT ERROR RATE TESTER

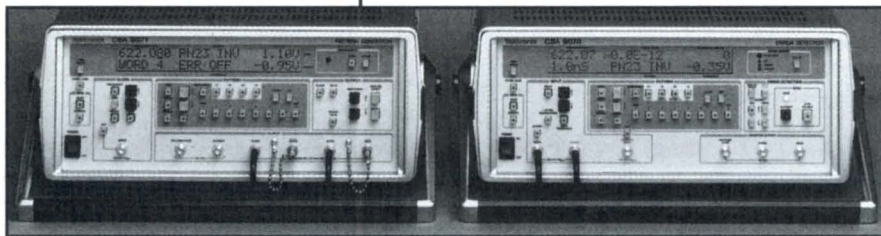
- Up to 700 MHz PLL Internal Clock Source
- PRBS Patterns  $2^n-1$ , where  $n=7, 15, 17, 20, \text{ or } 23$
- Up to 32 K Bit Programmable WORD
- SONET/FDDI Pattern Generation
- Auto Search Synchronization
- Versatile Bit Error Rate Measurements
- Error Injection; Single or Rate
- External Reference Data Input for User Generated Patterns GPIB
- GPIB/RS-232-C and Printer Interface IEEE 488.2

## CSA 907 BIT ERROR RATE TESTER

The CSA 907 Bit Error Rate Tester is a stimulus-response system that features a high-speed serial pattern generator, the CSA 907T, and a companion error detector, the CSA 907R. Each unit is portable, to be used in either benchtop, on-site, or field environment to evaluate the quality of transmission in high-speed digital communications and fiber optic devices, subsystems, and links. The CSA 907 Bit Error Rate Tester can be used for FDDI/SONET testing, SATCOM transmission system analysis, High Speed Digital Device Design, GaAs/ECL Device Characterization, and Manufacturing Systems Test.

## BUILT-IN PHASE-LOCKED-LOOP CLOCK SOURCE

The CSA 907 has a built-in Phase-Locked-Loop Clock Source that transmits patterns at a speed of 1 MHz to 700 MHz, thereby eliminating the need for an external clock synthesizer. However, for applications where the test is to be performed using a known reference clock, the CSA 907 has the capability to accept an external clock



**GPIB\***  
IEEE-488

input. The CSA 907T standard clock source has a resolution of 100 kHz but 1 kHz resolution and 10 ppm stability can be obtained through an option. This extra resolution is useful for applications such as SONET where frequencies are allocated in increments of 10 kHz or testing a clock recovery circuit where the user wants to sweep across the bandpass of the PLL to check lock in and hold ranges. User can store/recall 10 different frequencies for repeatability and testing against standards.

## PSEUDO RANDOM PATTERNS

Testing communication devices, subsystems and links with Pseudo Random Bit Sequence (PRBS) is important in order to make statistical measurements, such as jitter and noise and simulating real-life data. The CSA 907 has the capability to generate five PRBS patterns having periods of  $2^n-1$ ; where  $n=7, 15, 17, 20, \text{ or } 23$ .

## LONG (32 K RAM) PROGRAMMABLE WORD

In addition to the PRBS patterns, the CSA 907 features ten 16 bit programmable words with an optional 32 K RAM word for application specific or user-defined pattern testing. This makes the CSA 907 suitable for testing and evaluation of digital transmission systems and high-speed logic devices under a variety of conditions. Access to the memory is both by remote and front panel control.

## SONET/FDDI PATTERN GENERATION

The 32 K RAM word allows the testing of an FDDI system by simulating 2 kilobit long FDDI packets or SONET testing where the signal needs to look like a SONET frame. FDDI/SONET frame pattern can also be "built-in" by installing a ROM option. If the 32 K ROM option is installed, then each time a memory associated with a ROM coded word is recalled, the associated FDDI/SONET word is loaded into the working memory from the ROM.

## AUTO SET & SYNC

The CSA 907 "auto-set" synchronization feature allows effortless system setup and operation. The "auto-set and sync" feature eliminates the time and frustration associated with adjusting a multiple of input parameters by providing automatic compensation for data/clock timing skew (phase), selection of data pattern and polarity, bit synchronization to data pattern and data input threshold adjust. These four powerful automatic synchronization features allow the user to immediately perform a wide range of tests on systems and components with great ease.

## VERSATILE BIT ERROR RATE MEASUREMENTS

The CSA 907 allows a wide range of Bit Error Rate Measurements for fully characterizing and testing communication devices, subsystems, and links. The Error Detector measures totalized, overtime, and over bits Error Rates concurrently. Injection of Errors in the transmitted data stream for system evaluation is also possible with the CSA 907.

## EXTERNAL REFERENCE DATA

The External Reference Data mode in the CSA 907 allows the user to measure and analyze transmission errors for virtually any user generated data pattern. It is useful when evaluating the performance of a component or system against a user supplied reference data. Delay compensation up to 500 ps, data threshold adjust and input termination voltage selection is also possible with the External Reference Data input.

\*The CSA 907 Bit Error Rate Tester complies with the IEEE Standard 488.2 and Tektronix Standard Codes and Formats.

## OPERATIONAL SUPPORT

The CSA 907 support both the IEEE-488.2 GPIB with Tek Standard Codes & Formats and the RS-232-C interfaces for remote control, allowing test repeatability and reading instrument status and memory contents. The battery backed-up non-volatile RAM memory provides storage of 10 words patterns, 10 clock frequencies, error measurements and unit setup for future recall. The front panels provide outputs for viewing eye diagrams and waveshape analysis on the CSA 803 and CSA 404 signal analyzers. The rear panel allows specialized I/O that allows custom data generation and BER measurements.

## CHARACTERISTICS

### CSA 907T PATTERN GENERATOR

**Frequency Range** – 1 MHz to 700 MHz (Mbit/s) with Internal or External Clock.

**Resolution** – 100 kHz (1 kHz optional).

**Stability** – 30 ppm (10 ppm optional).

**Memory** – 10 frequencies.

**Ext Clock In** – 0.5 - 1.5 V p-p, 50  $\Omega$ , ac coupled.

**Data Out Formats** – NRZ-L, Normal and Complement; PRBS patterns or programmable WORD.

**PRBS Pattern** –  $2^n - 1$ , where n=7, 15, 17, 20, or 23.

**WORD Length max** – 16 bits (32 K pattern memory optional).

**WORD Memories** – 10 x 16 bits (10 x 32 kilobits optional).

**Data and Clock Outputs** – 50  $\Omega$  True and Complement (Differential).

**Amplitude** – 700 mV p-p to 2 V p-p into 50  $\Omega$ .

**Baseline Offset** – -2.0 V to 0.0 V.

**Rise/Fall Times** – 200 ps, typical @ 1 V p-p.

**Error Injection** – Single, or  $10^{-n}$ , where n = 3, 4, 5, 6, or 7.

**External** – 1 error injected for each rising edge, ECL.

**Auxiliary Outputs** – Clock/4 and Pattern Sync. (ECL levels).

### CSA 907R ERROR DETECTOR

**Frequency Range** – 1 MHz to 700 MHz, Clock Input. 1 Mbit/s to 700 Mbit/s, Data Inputs.

Memory: 10 frequencies.

**Auto Set & Sync** – Search and lock to: clock input frequency, data synchronization pattern selection and polarity, bit position in data pattern, data/clock timing skew, and input threshold.

BER Measurements: BER over time of test, BER over  $10^6$  to  $10^{16}$  bits, selectable.

Total Errors: Zero to 99,999,999.

Data and Ref. Data Inputs: NRZ-L, RZ, True (or Inverted, Data only).

Input Threshold: Variable -1.5 V to +1 V.

Input Level: 0.5 - 1.5 V p-p.

Impedance: 50  $\Omega$ , GND or -2.0 V Termination.

Delay Range: 0 - 4 ns, variable.

Clock Input: 0.5 - 1.5 V p-p, Sine or Square Wave, 50  $\Omega$ , ac coupled.

Monitor Outputs: Pattern Sync, Clock, Data, and Error (ECL levels).

### CSA 907T/CSA 907R GENERAL SPECIFICATIONS

**Front Panel Connectors** – SMA female.

**Power Requirements** – 90-132 VAC, or 180-264 VAC, 47-63 Hz. 100 VA max.

**Operating Temperature** – 0 to 50°C.

## ORDERING INFORMATION

<b>CSA 907T</b> Pattern Generator Includes: User Reference Manual (070-8026-00)	<b>\$21,995</b>
<b>CSA 907R</b> Error Detector Includes: User Reference Manual (070-8026-00)	<b>\$20,995</b>
<b>CSA 907</b> Bit Error Rate Tester (CSA 907T/CSA 907R) Includes: User Reference Manual (070-8026-00)	<b>\$34,995</b>

### INSTRUMENT OPTIONS

<b>Opt. 1R</b> – Rackmount	<b>+\$295</b>
<b>Opt. 1T</b> – High Resolution Clock (CSA 907T)	<b>+\$995</b>
<b>Opt. 2D</b> – Extended Pattern Memory 32K RAM	<b>+\$4,995</b>
<b>Opt. 3D</b> – Extended Pattern Memory 32K ROM	<b>+\$995</b>
<b>Opt. 4D</b> – Differential Inputs (CSA 907R)	<b>**</b>
<b>Opt. 5D</b> – 75 $\Omega$ termination (CSA 907T/R)	<b>+\$995</b>
	<b>+\$1,990</b>

### INTERNATIONAL POWER PLUG OPTIONS

<b>Opt. A1-A5</b> – Available	<b>NC</b>
-------------------------------	-----------

See page 374 for description.

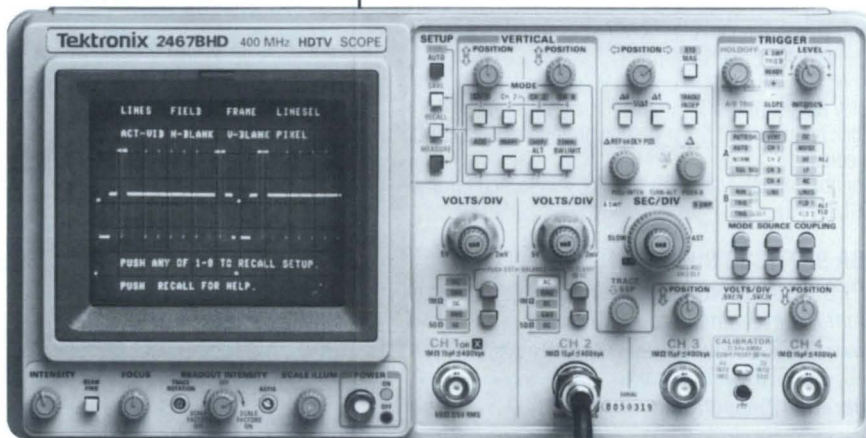
### PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width	366	14.4
Height	152	6
Depth	340	13.4
<b>Weight</b> =	<b>kg</b>	<b>lb</b>
Net	10	22

\*\* Contact your local sales office.

The most accurate, display – for HDTV now or in the future.

- Automatic Pushbutton Setup on Video Signals
- Standard Presets for Quick Recall
- Bi-level and Tri-level Sync Separation
- Brightly displays single lines and pixel detail on video signals



## 2467 HDTV OSCILLOSCOPE

Tek lets you trigger on tri-level synchronization pulses with performance never before possible in high-definition video.

The HDTV Scope answers a pressing need of component video design and troubleshooting for an oscilloscope able to capture, measure and display high-definition TV signals with excellent fidelity.

Many designers of composite video systems are already familiar with the Tek 2467 Oscilloscope, whose microchannel-plate (MCP) crt amplifies the intensity of low-repetition rate signals by several orders of magni-

tude, while limiting the intensity of high-rep signals, so metastability can be easily seen.

Built on the 2467 foundation, the HDTV Scope applies MCP technology and other key features, specifically to the needs of high-definition component video signals. The HDTV Scope can automatically recognize and separate tri-level sync pulses on any of the proposed HDTV standards, without making you resort to external triggers or other makeshift techniques.

To make vital timing measurements as accurately as possible, the HDTV Scope features a built-in counter/timer/trigger and enables channel-to-channel timing correction of any two channels to 50 ps.

View any field or line or pixel-sized detail. The  $\geq 4$  cm/ns visual writing speed of Tek's MCP technology makes possible a bright display of extremely fast and infrequent events, while reducing the intensity of accompanying high-rep rate signals.

The HDTV Scope is compatible with the three major high-definition TV standards – 1250/50, 1125/60 and 1050/60 – as well as NTSC, PAL, SECAM and component systems. The instrument automatically senses the standard used and autosets itself accordingly.

Autosetup saves time and effort by automatically scaling, positioning and triggering waveforms for you, instantly. Autoset to the lines mode and quickly toggle between line and field modes.

Eight common front-panel setups are predefined; after autosetting to the signal, they adopt themselves to the appropriate standard. You can store an additional 22 front-panel setups for easy recall later.

The scope automatically sets the line count for the video format being used – up to 1280 lines.

The 2467BHD's 400 MHz bandwidth spec includes a frequency response flatness of  $\pm 2\%$  to 30 MHz, virtually eliminating the scope as a source of waveform distortion when making the precise evaluations required by HDTV technology. Or, use the 50 MHz filter to reduce noise or clock frequency interference.

The scope's backporch clamp stabilizes the display independent of APL.

Active video mode allows the user to select predefined start and stop lines to eliminate undesired parts of the signal.

## CHARACTERISTICS

### Frequency Response ( $-3$ dB Bandwidth) – 400 MHz.

500 kHz – 10 MHz	$\pm 1\%$
10 MHz – 20 MHz	$+1\% - 2\%$
20 MHz – 30 MHz	$\pm 2\%$

### Step Response – $< 875$ ps.

### Squarewave Flatness – $\pm 1\%$ p-p

**Deflection Range** – CH 1 & CH 2: 2 mV/div to 5 V/div in a 1-2-5 sequence. CH 3 & CH 4: 100 mV/div and 500 mV/div.

**Channel 2 to Channel 1 delay** – adjust range  $\pm 500$  psec.

**Input Characteristics** –  $1 \text{ M}\Omega \pm 5\%$ , 15 pF.  $50 \Omega \pm 1\%$ .

**Bandwidth Limit** –  $-3$  dB at 50 MHz.

**Timebase Range** – A sweep: 500 ps/div to 500 ms/div in a 1-2-5 sequence. B sweep: 500 ps/div to 50 ms/div, in a 1-2-5 sequence.

**Variable Timing Control** – Continuously variable and calibrated between sec/div settings.

**Cursor Measurements** – Volt, Time, 1/Time, %, Ratio, Phase.

**Sync Separation** – Stable sync separation from Tri-level and Bi-level sync-positive or sync-negative composite or component video on systems with 525 to 1280 lines per frame, 50 Hz or 60 Hz field rate, interlaced or non-interlaced.

**Trigger Modes** – LINES, FLD 1, FLD 2, ALT (FLD 1/FLD 2), Active Video Mode.

**BackPorch Clamp** – Within 1.0 div of ground reference.

**Line Counter** – Automatically sets to formats up to 1280 lines.

**Environmental** – MIL-T-28800C for Type III, Class 3, Style C.

**Temperature** – Operating:  $-15^\circ\text{C}$  to  $+55^\circ\text{C}$ , Nonoperating:  $-62^\circ\text{C}$  to  $+85^\circ\text{C}$ .

**Autoset** – Autosets to major TV standards such as 1250/50, 1125/60, 1050/60, NTSC, PAL, SECAM and component systems. Will also set on any bi-level or tri-level sync.

**Save/Recall** – 22 user-definable setups.

**Visual Writing Rate** – 4 cm/ns.

**Standard TV Presets** – Lines, Fields, Frame, Line select, Active video, horizontal blanking, Vertical blanking, Pixel, TSG triggering.

**Built-in Counter/Timer/Trigger (CTT)** – Frequency, Period, Delay Time, Totalize, Delay-By-Events.

## ORDERING INFORMATION

2467BHD High-Definition Television Oscilloscope **\$14,950**

### OPTIONS

Opt B1 – 2465B/2467B Service Manual **+\$55**  
Opt B2 – 24X5B/2467B Options/2467BHD Service Manual **+\$30**

### WARRANTY-PLUS SERVICE OPTIONS

Opt M2 – 5-Year Repair **+\$450**  
Opt M8 – 4 Calibrations over 5 yrs **+\$595**



# ANTHRO TECHNOLOGY FURNITURE®

## 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.

There are three members of the AnthroCart® family: the AnthroCart® Original, the MidSize and the KingSize.

### THE ORIGINAL

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.

### 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.



*GT KingSize AnthroCart® shown with Extension Shelf Kit and Side Rack.*



*The Original PC Compact Cart (Bone Color) shown with Extension Shelf Kit, Paper Feed and Catch, Document Holder, Slide Out Shelf, Wire Base Shelf and Bookends.*



*PC MidSize Cart with Document Holder, Drawer, Cable Alley, Side Rack and Scooter.*

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.

### 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.

## 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

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 TECHNOLOGY FURNITURE®

## AnthroArm® PC

- Holds up to 30 lbs.
- Easily Adjusts Up and Down
- Safely Tilts and Swivels
- Easy to Attach
- Made in the U.S.A.

## AnthroArm® GT

- Holds up to 200 lbs.
- Rotates 360°
- 5 Year Warranty
- Made in the U.S.A.

## 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  
AnthroArm® and Technology Furniture®  
are registered trademarks of Anthro.



## ANTHROARM® PC

### HOLDS UP TO 30 LBS.

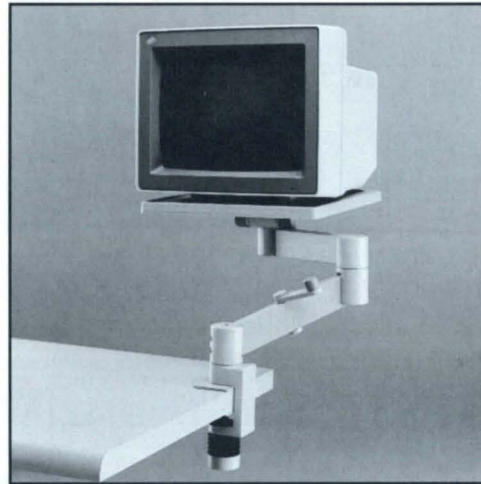
AnthroArm® PC...strong, adjustable, well-designed. Put your monitor exactly where you want it. Have room to spread out and be comfortable.

The AnthroArm® PC easily holds your monitor weight up to 30 lbs.\*<sup>1</sup> 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 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.

\*<sup>1</sup> For more weight capacity, see the AnthroArm® GT



AnthroArm® PC

## 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®: makes your space fit your work style.

## 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.

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.

AnthroArm® GT: the Arm strong enough to hold your heaviest equipment. Look for our name.



AnthroArm® GT



The perfect CAD/CAM workstation: AnthroBench® with Arm, Task light, HarterAnthro Chair and Printer Stand.

## VISUAL SYSTEMS SOLUTIONS

The Visual Systems Group brings its expertise in color, graphics, video, and X Window implementation to a wide range of powerful devices – X Terminals, netstations, and graphics terminals. Add quality color output with our family of advanced color printing solutions – from low-cost ink-jet printers to thermal wax – for a superior color-matched solution. Tek printers can be added to any network made up of PCs, Macs, or workstations.

## NETWORK DISPLAYS

In today's growing multi-vendor environments there's no problem finding compute power – the challenge is finding efficient ways to distribute it. And Tek X Terminals and Netstations are the solution. From the monochrome XP21 to the high-resolution color XP29, our family of X Terminals provides outstanding performance for the price.

They're compatible with a wide range of workstations and computers. They support Ethernet LAN, TCP/IP, DECnet, NFS and more. And they run Tek's powerful implementation of the X Window System in monochrome, grayscale or color.

Tek Netstations are configurable as graphics terminals on minis or mainframe hosts, or as nodes attached to workstations. You'll find outstanding graphics speed, color and features in every model, whether it's the economical 4211 or high-performance 3D 4235.

Tek Netstations also give you access to a tremendous selection of software, ethernet connections, plus RS-232-C and optional coax connections on selected models.

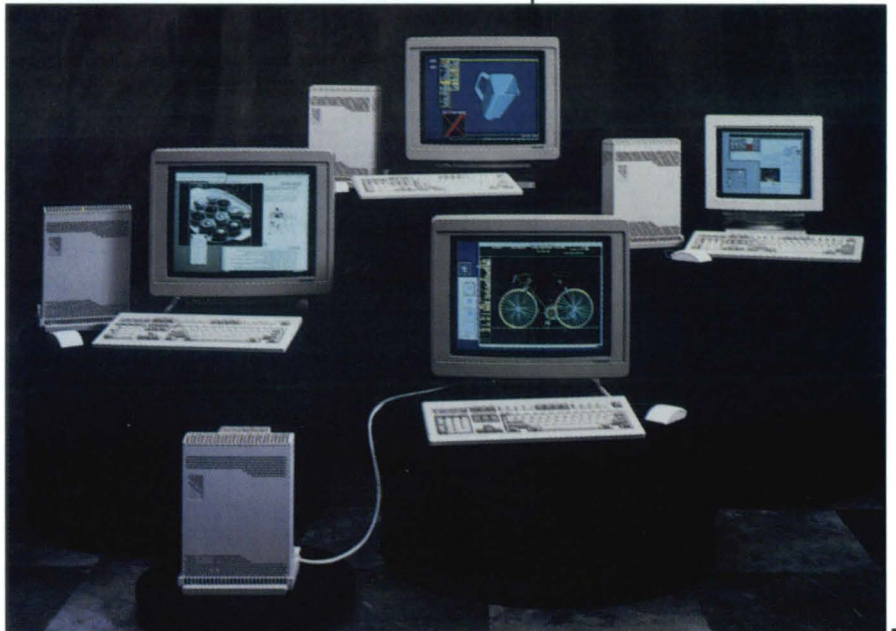
## GRAPHICS TERMINALS

For over 20 years, the most popular way to get connected has been with Tek graphics terminals. And today, Tek 4200 Series Intelligent Graphics Terminals continue to provide cost-effective solutions in a wide range of graphics environments.

From the low-cost 4205 to the large-screen 4209, Tek terminals bring exceptional color and clarity to applications such as CAD/CAM, architectural and engineering design, mapping, manufacturing, and process control.

Tek terminals let you access graphics applications running on workstations, minicomputers, or mainframes with outstanding graphics performance and full functionality. Which means you can access compute power throughout your organization at the lowest possible cost.

Tek terminals are supported by thousands of software packages. And they support a wide array of output devices from a variety of manufacturers, including Tek's own color printers.



*The TekXpress Family offers the easiest interface to color X, the highest X performance, the most comfortable ergonomic design, and the lowest cost of ownership.*

## FEATURES

- Dual Processing Architecture
- Powerful Straightforward Setup Menus
- Complete Color Management System
- Innovative Modular Design

## BENEFITS

- High-Performance X Window
- Easy-to-use interfaces for quick setup and simplified color selection
- Small footprint for minimal impact on desk space
- Substantial range of application software

## INTRODUCING THE TEKXPRESS FAMILY

The TekXpress Family includes five high performing, easy-to-use X terminals.

Superior support of the X Window System ensures compatibility with all X graphical user interfaces. Also supported are hundreds of applications compatible with X, including those for CAD, CAE, CAM, CIM, process control, mapping, publishing, CASE, data analysis and presentation graphics, among others. You can access these applications through both TCP/IP and DECnet, and run them simultaneously in multiple on-screen windows.

The XP25, XP27 and XP29 feature easy color selection and screen-to-printer color matching (WYSIWYG) through Tek's Color Management System – TekColor™. This interface improves productivity by letting you quickly select and edit colors from an on-screen menu.

With the X server supported by both the Motorola MC68030 and the Texas Instrument TMS34020 processors, TekXpress uses parallel X server processing for industry leading X performance. This dual processor architecture also allows general network I/O and graphics tasks to be separated and processed in parallel. And the Tek-developed X server is optimized for the TekXpress architecture.

The silent, compact logic module can go just about anywhere, freeing up valuable desk space. You can place it on a bookshelf above the monitor, on your desk in the unused space behind the monitor, or even on the floor completely out of sight.



*The XP27 sets the new price/performance standard for color X Terminals.*

You'll also find that every TekXpress X Terminal is built to the highest standards of quality and reliability – Tek's. A fact that lets us offer you a standard three-year warranty, worldwide.

## TEKXPRESS SELECTION GUIDE

Characteristics	XP21	XP23	XP25	XP27	XP29
Screen Size	17" (44 cm)	19" (48 cm)	14" (36 cm)	19" (48 cm)	19" (48 cm)
Resolution	1152 x 900	1280 x 1024	1152 x 900	1152 x 900	1280 x 1024
Refresh Rate	72 Hz	72 Hz	60 Hz	72 Hz	72 Hz
Colors	Monochrome	16 shades of gray	256 colors from 16.7 million		
Environment	X Window System, Version 11, Release 4				
Processors	Motorola 68030 and Texas Instruments 34020				
Memory	4 MB standard, 2 MB optional				
Compute Side	4 MB standard, 2 MB optional				
Graphics Side	1 MB standard, 2 MB, 4 MB, or 8 MB optional				
Number of Fonts	13				
Standard	13				
Optional	400				
Keyboards	IBM 101 (PS/2 compatible), or IBM 102 International versions				
Standard	IBM 101 (PS/2 compatible), or IBM 102 International versions				
Optional	VT200				
Network Interface	Ethernet				
Network Protocol	TCP/IP with Telnet, TFTP, NFS				
Standard	TCP/IP with Telnet, TFTP, NFS				
Optional	DECnet with DAP and MOP				

# GRAPHICS NETSTATIONS & TERMINALS

4200 SERIES

## NETSTATIONS FOR 2D AND 3D NEEDS

Tek netstations also provide high-performance displays in networked environments, linked to mainframes, minicomputers or workstations. Our complete netstation family offers a range of price/performance alternatives, and RS-232-C, and LAN allow connection to a wide variety of host environments running the Tek graphics model.

The 4230 Series of 3D Color Netstations is fully compatible with Tek's terminals and provides a logical upgrade path to increased performance. 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.

Tek's 4211 and 4220 Series of Color Netstations provides 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.

## WORLDWIDE SERVICE AND SUPPORT

Tek provides you with worldwide service and support to complement your new product purchase. Visual Systems Group products are paired with world-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. To order service plans to suit your needs, call our toll free number: 1-800-547-8949.

## 4200 SERIES GRAPHICS TERMINALS

Tektronix color graphics terminals provide advanced features at affordable prices, with a wide range of compatible products. The 4205 is the entry member. The 4207 adds more advanced features like a two-port peripheral interface and extended memory. For even more memory and RGB-out, choose the 4209 with a 19-inch screen.

Special options for the 4200 Series include sealed keyboards for harsh environments, bar code readers and rackmount capability. In fact, the SF4208 is constructed to withstand the rigors of factory floor environments.

All 4200 Series Terminals are compatible with thousands of applications on hosts and deliver excellent reliability for maximum productivity.

All of Tek's terminals, X terminals, and netstations\* are designed for export to all destinations without U.S. Government Individual licenses. These products qualify to General License G-DEST.

\* Except the 4237 Netstation.

## ORDERING INFORMATION

TekXpress X Terminals	from \$2995
4200 Netstations	from \$2800
4200 Terminals	from \$2500

All products are available with International keyboards & power plug options.



**With COLOR you can**

- Give a Competitive Edge to Your Presentations.
- 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**

4696 Color Ink-Jet Printer Order 4696	\$1,795
ColorQuick™ Ink-Jet Printer Order 4697	\$2,495
Phaser™ II SX Color Printer Order 4694SX	\$4,995
Phaser™ II PX Color Printer Order 4694PX	\$7,995
Phaser™ II DX Color Printer Order 4694DX	\$8,995
Phaser™ CQS Color PrintStation Order 4597PS	\$6,995
RGB II Color Screen Printer (The RGB II must be ordered with a video adapter with prices starting at \$1,200.)	\$6,500
469CART Printer Cart	\$395

**OPTIONS**

Contact your local Tektronix Sales Representative or authorized dealer.

**WARRANTY-PLUS SERVICE OPTIONS**

See Service Support on page 376.

**GRAPHIC SUPPLIES  
DIRECT ORDER DESK**

Toll Free 1 800-835-6100  
6:00 a.m. to 5:00 p.m. Pacific Time.  
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 Phaser II PX Color Printer.

**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.

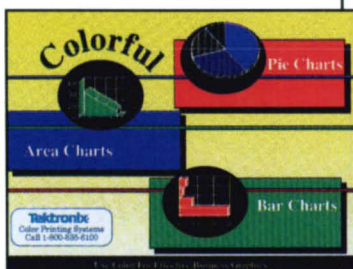
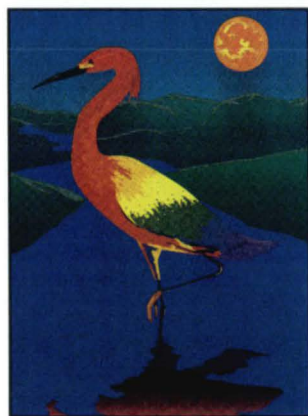
**TEKTRONIX OFFERS BRILLIANT  
COLOR OUTPUT FROM THE  
PLATFORM OF YOUR CHOICE**

With a full range of ink-jet and thermal wax transfer printers, Tektronix has a color printer for most application requirements. Compatible with PCs, Macintosh computers, and most leading graphics terminals and workstations, Tektronix color printers let you connect to one or more computing environments with minimal effort.

**NEW PHASER II PX COLOR PRINTER**

This thermal wax 300 dpi color printer was designed for departmental color printing from one or more type of computers. It can handle simultaneous input from IBM PCs, PS/2s or compatibles as well as Macintosh computers and most technical workstations. Compatible with both PostScript® and HP-GL, the Phaser II PX works with almost any color graphics application. Capable of

producing brilliant color overhead transparencies, the Phaser II PX is an excellent choice for business presentation graphics. For the graphic arts professional, it provides PANTONE® color simulations and compatibility with downloadable fonts from Adobe, Bitstream and others.



Professional-quality thermal-wax and ink-jet color output.

**NEW PHASER II SX COLOR PRINTER**

The Phaser II SX offers laser quality color printing at an unprecedented price. Designed for use by individuals or small departments, it connects to both IBM PCs, PS/2s and compatibles as well as Apple Macintosh computers. Drivers for Microsoft Windows 3.0, Apple Macintosh, Truevision TARGA systems and PostScript file printing are available separately. The Phaser II SX features a modular design so you can upgrade to the full capabilities of the Phaser II PX, should your color printing requirements grow.

**NEW PHASER II DX COLOR PRINTER**

The Phaser DX is an intelligent, raster-based color printer designed for fast processing and printing of color raster data. It is ideal as a shared color screen copying device for a variety of graphics terminals and workstations including Sun, Silicon Graphics, HP/Apollo and others. The Phaser II DX is fully plug-compatible with both the popular 4693DX color image printer and the new Phaser II SX.

**COLOR QUICK INK-JET PRINTER**

A 216 dpi drop-on-demand ink-jet printer. Handles plain bond paper or the recommended special paper in many sizes up to 12"x18". Now available with drivers for MicroSoft Windows 3.0, Apple Macintosh, TARGA, and many others. Connects to PCs and Macintoshes or selected Tektronix terminals. A good entry level printer for presentation graphics or graphic arts applications.

**4696 COLOR INK-JET PRINTER**

A 120 x 240 dpi low cost ink-jet printer. Compatible with most Tektronix color terminals as a screen copying printer. Connects to PCs, PS/2s and compatibles as well. Individually replaceable ink cartridges offer economical operation.

**PHASER CQS COLOR PRINTSTATION**

Combines the ColorQuick ink-jet printer with a PostScript compatible network interface for AppleTalk networks. Has built in hardware spooling and font storage. Ideal for graphic arts applications such as comps, package designs, and page design.

**RGB II COLOR SCREEN PRINTER**

A 300 dpi thermal wax printing system designed to capture the contents of your color display and produce a hardcopy in less than 50 seconds with no software drivers or other system overhead. Connects with an intelligent video interface which automatically calibrates itself for use with a broad range of high-end color displays from workstations, terminals, and advanced personal computers. Ideal for working screen copies from CAD, mapping or process control systems.

**NETWORKED CONFIGURATIONS AVAILABLE**

Tektronix offers special network interfaces which allow you to connect selected color printers directly to Ethernet or IBM networks. This network connection reduces network traffic and lets you locate your printer independent of existing servers or workstations. These interfaces support TCP/IP protocol on Ethernet as well as IPDS data streams in most IBM mainframe networks.

# STEREOSCOPIC 3-DIMENSIONAL GRAPHIC MONITORS, SYSTEMS AND KITS

SGS SERIES

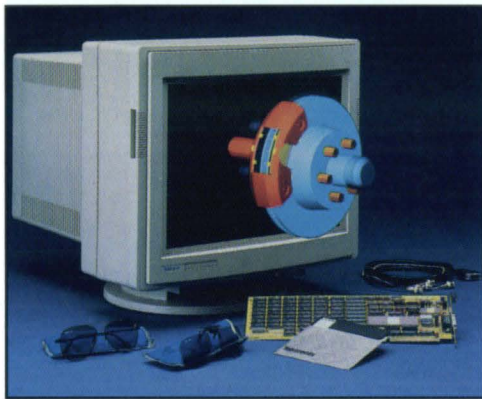
NEW

## STEREOSCOPIC 3-DIMENSIONAL COLOR DISPLAYS

Tektronix SGS Series Stereoscopic-3D Color Monitors and Display Systems enable users with 3D databases and stereo software to easily add stereoscopic viewing to their systems. Our stereo-3D products incorporate the latest advancements in liquid crystal shutter research and development to assure the best possible image quality, including higher light transmission and a reduction in front surface reflections by up to 80%. The SGS Series products are also designed to be used in both 2D monoscopic and 3D stereoscopic modes, featuring an easy-to-remove stereoscopic modulator assembly.

## INTEGRATED MONITORS

The SGS 421 and SGS 620 single-mode monitors are completely packaged units featuring large area 16-inch and 19-inch diagonal color CRT displays, removable liquid crystal stereoscopic-3D modulators, and simple polarizing glasses and clip-ons. The display monitor automatically switches from 2D monoscopic @ 60 Hz to 3D stereoscopic @ 120 Hz by sensing the vertical sync.



New SGS 630

## WORKSTATION-COMPATIBLE MONITORS

The 16" SGS 425 and 19" SGS 625 include all the features of the SGS 431 and SGS 620, and are designed as multi-mode displays 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 classifications and are certified by UL, CSA and TUV.

## STEREO-3D SYSTEMS FOR THE IBM PC/AT

The 16" SGS 431, 19" SGS 630 and new 19" multi-mode (workstation-compatible) SGS 635 Stereoscopic-3D Graphics Systems feature an IBM PC/AT Stereo Graphics Adapter (SGA) card, allowing users to display high quality stereo 3D images from applications software. The SGA card, which off-loads low level graphic functions from the host, supports all common 2D primitives such as Move, Line, Polygon, Circle, etc.

The complete system also includes the *Graphics Subroutine Library (GSL)*, which supports all 3D primitives, as well as 2D primitives, such as Window, View, Viewport, Color Map, to name a few.

## STEREOSCOPIC 3D KITS

Stereo kits are offered for developers interested in designing 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.

## STEREOSCOPIC 3D APPLICATIONS

Typical stereoscopic-3D applications include: mechanical CAD, molecular modeling, remote sensing, robotics, remote vision, non-destructive testing, cartography and photogrammetry.

## CHARACTERISTICS/SELECTION GUIDE

Feature	SGS 421 / SGS 431	SGS 620 / SGS 630	SGS 425 / SGS 625 / SGS 635
Display Size (diagonal-measure)	16-in	19-in	19-in, 16-in (SGS 425)
Stereo Display Area	9.76 x13.0 in	10.8 x13.5	10.8 x13.5, 9.76 x13.0 in (SGS 425)
Display Resolution (all)	--- 1280 pixels x 512 lines (120 Hz) or 1280 pixels x 1024 lines (60 Hz) ---		
Aperture grill pitch	0.26 mm	0.31 mm	0.31 mm/.26mm
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	+10° C to +40° C	+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.
Includes SGS100 SGA Card Set		SGS 630	SGS 425/SGS 635

## SGS 421/620 Single-Mode Monitors

## NEW SGS 425/625 Multi-Mode Monitors

## SGS 431/NEW 630/NEW 635 Stereo Systems for the IBM PC/AT

## SGS 310/410/610 Stereo Shutter Kits

## ORDERING INFORMATION

### STEREOSCOPIC KITS AND SOFTWARE

SGS 310 12-in. Kit <sup>1</sup>	\$3,800
SGS 410 16-in. Kit <sup>1</sup>	\$5,250
SGS 610 19-in. Kit <sup>1</sup>	\$6,700
SGS 9000 Graphics Subroutine Library	\$100

<sup>1</sup> Specify Option 10 on order

### STEREOSCOPIC 3D MONITORS

Includes: Stereo-Ready Monitor, Liquid Crystal Modulator and Bezel Assembly, Four Pairs of Glasses/Clip-ons, Users Manual, and Power Cords.

SGS 421, Opt. 30 (16-in. Single-mode Monitor)	\$7,500
SGS 620, Opt. 30 (19-in. Single-mode Monitor)	\$11,000
SGS 425, Opt. 30 (16-in. Multi-mode Monitor)	\$8,000
SGS 625, Opt. 30 (19-in. Multi-mode Monitor)	\$11,500

### MONITOR OPTIONS

SGS 100 Stereoscopic Graphics Adapter (SGA Card) for IBM PC/AT. Includes Graphics Subroutine Library Storage Rack for Modulator and Glasses, Opt. 40	\$2,500
Additional Glasses or Clip-ons	\$60 ea

### STEREOSCOPIC 3D SYSTEMS for the IBM PC/AT™

Includes: RGB Color Monitor, Liquid Crystal Modulator, Stereo Modulator Driver Unit, Connecting Cable, Four Pairs Glasses/Clip-ons, Stereoscopic Graphics Adapter (SGA) Card and Graphics Subroutine Library (GSL)

SGS 431 (16-in. System)	\$9,800
SGS 630 (19-in. System)	\$13,300
SGS 635 (19-in. System with Multi-mode Monitor)	\$13,800

For further information, contact:  
Tektronix Display Products  
P.O. Box 500, M.S. 46-943  
Beaverton, Oregon 97077  
Phone: (800) 835-9433, ext. 2002  
(503) 627-5000  
FAX: 503-627-1070

## GMA 201

## APPLICATIONS

- Architectural CAD
- Picture Archiving
- Reconnaissance

GMA 202/  
NEW GMA 212

## APPLICATIONS

- Document Retrieval
- Electronic Publishing
- Medical Imaging

## NEW GMA 213T

## APPLICATIONS

- Air Traffic Control
- Remote Sensing
- Government Information Systems

GMA 213C/  
GMA 213S

## APPLICATIONS

- Remote Sensing
- Non-Destructive Testing
- Photogrammetry

## ORDERING INFORMATION

**GMA 201** Monochrome Raster Monitor (19" D, 2048 x 1536 Pixels, 30 fL with 62% Filter, Landscape Mode) **\$4,505**

**GMA 202** Monochrome Raster Monitor (19" D, 1536 x 2048 Pixels, 30 fL with 62% Filter, Portrait Mode) **\$5,175**

**GMA 212** Monochrome Raster Monitor (19" D, 1536 x 2048 Pixels, 50 fL with 62% Filter, Portrait Mode) **\$6,625**

**GMA 213C** Bi-Primary Color Raster Monitor (19" D, 1024 x 1024 Pixels, 80 FL, Landscape Mode) **\*1**

**GMA 213S** Monochrome Stereo-3D Display (19" D, 1024 x 1024 Pixels, 40 fL Each Eye, Landscape Mode) **\$19,500**

**GMA 213T, OPT. 23** Monochrome Raster Monitor (19" D, 1280 x 1024 Pixels, 165 fL, 30% Filter, Landscape Mode) **\$9,970**

For further information, contact:  
Tektronix Display Products  
P.O. Box 500, M.S. 46-943,  
Beaverton, Oregon 97077  
Phone: (800) 835-9433, ext. 2002  
(503) 627-5000  
FAX: 503-627-1070

\*1 Contact your local sales office.

COLOR, MONOCHROME AND  
STEREOSCOPIC 3-D DISPLAYS

The GMA Series Displays consist of three major product types – color, monochrome and stereoscopic 3-D. These displays, which are based on Tek's own state-of-the-art cathode-ray-tube technology, offer extremely high image resolution that is also matched to the display's addressability. Our displays are complete with all necessary internal shielding, and meet regulatory requirements.

EXCELLENT PICTURE QUALITY & IMAGE  
UNIFORMITY

All GMA 200 Series Displays feature digital dynamic focus and astigmatism. These electronic features, which control CRT spot size and shape, assure a uniform image across the entire screen and offer the highest performance in corner to corner resolution. Such quality and consistency is absolutely necessary for high resolution applications that require "picture perfect" images.

HIGH BRIGHTNESS AND 256 GRAY SCALE  
LEVELS FOR GREATER INFORMATION  
CONTENT AND BETTER VIEWABILITY

Brighter displays enable more bits of information to be presented to the viewer. Our new portrait mode GMA 212, which uses a Tek-designed and built ultra-high resolution (UHR) CRT, provides up to 50 footlamberts of luminance, allowing better viewability even in high ambient light. Each of our GMA Series Displays also provide gray scale capability up to 256 levels, enabling true differentiation of features for many image processing applications.

## COLOR AND STEREOSCOPIC-3D OPTIONS

The use of color in your application can help you target or enhance key items on your display. In addition, stereoscopic-3D capability adds a new third dimension in the presentation of critical information. Combining our high resolution monochrome displays with the latest in liquid crystal shutter technology (which is also provided by Tektronix) allows you to have either a high resolution bi-primary color display (GMA 213C) or a high-resolution monochrome stereo-3D display (GMA 213S).

CUSTOM FEATURES TO MEET YOUR  
SPECIFIC NEEDS

Choosing a GMA 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 Series models feature bright, flicker-free images that are distortion-free. In addition as mentioned above, the GMA 213S offers our stereo-3D viewing capability (using passive glasses).



New GMA 213C

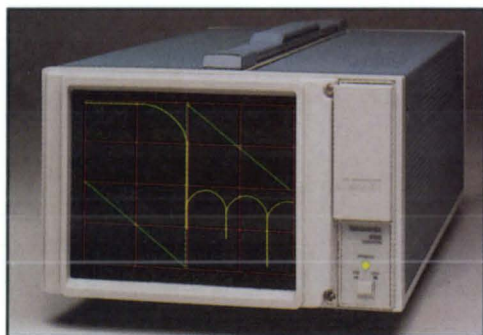


New GMA 212



GMA 213S/GMA 263S





608 (with Color Option)

## 608 (608 COLOR) HIGH BRIGHTNESS X-Y DISPLAY

### TYPICAL APPLICATIONS

- *Ultrasound Imaging*
- *Test and Measurement*
- *Simulation (608 with Color Option)*

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. The high brightness (70 fL), 10-mil spot size and large screen (9.8 x 12.2 cm) allow high quality photography. The 608 with color option display incorporates a liquid crystal shutter to produce a bi-primary color palette.



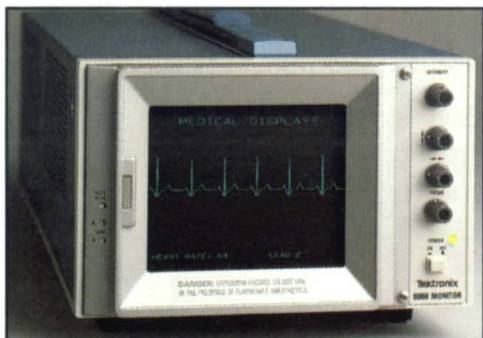
634

## 634 HIGH RESOLUTION VIDEO DISPLAY

### TYPICAL APPLICATIONS

- *Film Recording*
- *Reconnaissance and Surveillance*
- *Automated Testing*

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.



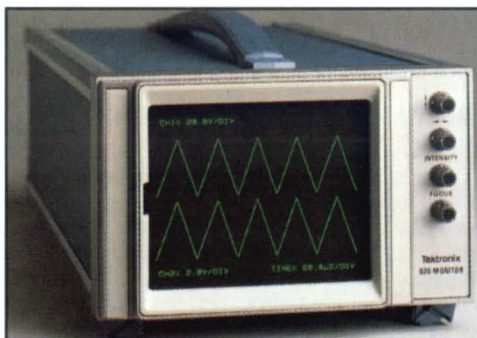
606B

## 606B VERY HIGH RESOLUTION X-Y DISPLAY

### TYPICAL APPLICATIONS

- *Gamma Camera Recording*
- *Scan-Conversion Imaging*
- *Scanning Electron Microscopy*

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.



620

## 620 MECHANICALLY RUGGED X-Y DISPLAY

### TYPICAL APPLICATIONS

- *Electronic Equipment Testing*
- *Network Analysis*
- *Non-Destructive Testing*

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.

## NEW 608 (608 with Color Option)

### FEATURES/BENEFITS

- *High Brightness*
- *High Resolution*
- *Excellent Gray Scale*
- *High Ambient Viewing*
- *Photographic Quality Images*
- *Bi-Primary Color-Enhanced Images (608 with color option)*

## 606B

### FEATURES/BENEFITS

- *Very High Resolution*
- *Uniform Brightness*
- *Multi-Imaging Capability*
- *Ultra Sharp Images*
- *Image Stability*

## 620

### FEATURES/BENEFITS

- *Mechanically Rugged*
- *Versatile Modular Packaging*
- *Low Power Consumption*
- *Economical Display*
- *High Reliability*

## 634

### FEATURES/BENEFITS

- *Superior Resolution*
- *Gray Scale Fidelity*
- *Uniform Full-Screen Brightness*
- *Picture Perfect Images*
- *Low Distortion Images*

## ORDERING INFORMATION

606B Monitor	\$4,995
608 Monitor	\$3,190
608 w/Color Monitor	\$4,900
620 Monitor	\$1,875
634 Monitor	\$3,750

### RECOMMENDED CAMERAS

See Cameras pages 298-305

For further information, contact:  
Tektronix Display Products  
P.O. Box 500, M.S. 46-943,  
Beaverton, Oregon 97077  
Phone: (800) 835-9433, ext. 2002  
(503) 627-5000  
FAX: 503-627-1070

**NEW RP88B16**  
**RP88B20**  
**RP88B25**  
**NEW RP88B33**

**FEATURES**

- Up to 28 MIPS and 9 MFLOPS Performance (with RP88B33)
- 16-33 MHz Operation (33 MHz Operation with RP88B33)
- Motorola 88100 RISC CPU
- Up to 3 Motorola 88200 CMMUs
- Up to 32 MBytes of DRAM with Burst Mode Cache Line Fill
- Up to 48 kBytes Cache
- Full Master/Slave NuBus Interface

**TYPICAL APPLICATIONS**

- Engineering CAD
- Photorealistic Imaging
- Manufacturing Robotics and Machine Vision
- Finite Element Analysis
- Image Processing
- Scientific Visualization
- Molecular Modeling
- Electronic Prepress

**BENEFITS**

- Increased Processing Power for Mac II (up to 50 times)
- C and Fortran Programmer's Tool Kits for Fast Applications Development
- Full Access to Mac II Tool Box (New Applications can run From Mac II Operating System)
- Easy Installation with Complete Use Documentation Provided



RP88 Coprocessor Package

**INCREASED MAC II PROCESSING POWER**

The Tektronix RP88 Series Coprocessors are single Macintosh<sup>®</sup> II Series-compatible boards that offer significant performance advantages for applications configured for the boards. Based on Motorola's 88000 RISC chip set, the new 33 MHz RP88B33 Coprocessor increases the processing power of the Mac<sup>®</sup> II by up to 50 times, delivering up to 28 MIPS and 9 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<sup>™</sup>), 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 RP88 Series Coprocessors 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**

RP88 Series Coprocessors are easily installed into any Mac II series expansion slot, and complete user documentation is provided. RP88 Coprocessors are fully serviced and supported by Tektronix.

**CONTACT INFORMATION**

Tektronix Advance Technologies  
 P.O. Box 500, M.S. 50-380  
 Beaverton, Oregon 97077  
 (800) 835-9433, ext. 8800  
 FAX: 503-627-5502

**ORDERING INFORMATION**

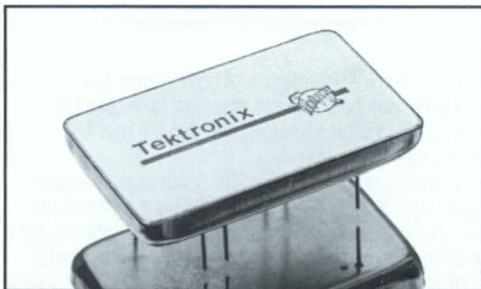
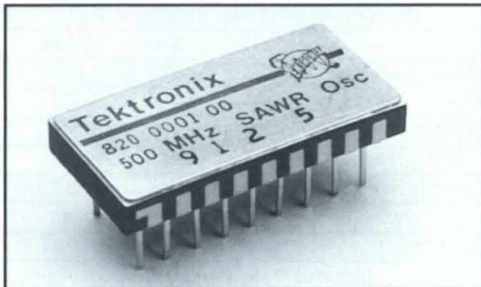
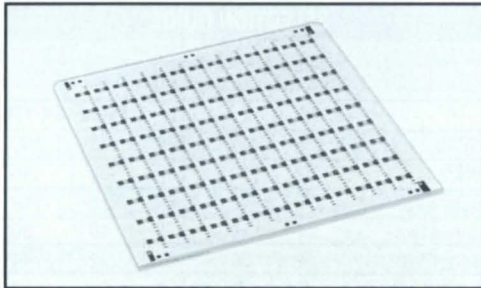
COPROCESSOR BOARDS	RP88B16 (16 MHz)	RP88B20 (20 MHz)	RP88B25 (25 MHz)	RP88B33 (33 MHz)
Includes: 2 MBytes DRAM; 32 K Cache Memory; Sample Programs; User Documentation.	\$4,495	\$5,495	\$6,495	\$7,745
Opt. 01 - Adds 6 MBytes of DRAM (8 MBytes Total)	+\$250	+\$250	+\$250	+\$250
Opt. 02 - Adds 16 KBytes of Cache Memory (48 KBytes Total)	+\$150	+\$250	+\$250	+\$300
Opt. 03 - Adds 30 MBytes of DRAM (32 MBytes Total)	+\$1,995	+\$1,995	+\$2,250	+\$2,250
<b>PROGRAMMER'S TOOL KITS:</b>				
<b>RP88KC Base C Kit</b> Includes: C Compiler; Assembler, Symbolic Debugger and Libraries.			\$995	
<b>RP88KF Fortran Kit</b> (Requires Base C Kit.) Includes Fortran Compiler and Libraries		\$1,995		
<b>RP88P25 COMPLETE DEVELOPMENT PACKAGE</b> Includes Coprocessor Board with Options 01 and 02, and RP88KC Base C Kit	RP88P16 \$5,690	RP88P20 \$6,740	RP88P25 \$7,740	RP88P33 \$8,990
Opt. 04 - Adds 24 MBytes of DRAM (32 MBytes Total)	+\$1,745	+\$1,745	+\$2,000	+\$2,000

## 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.

## Surface Acoustic Wave (SAW) Products



### 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\*<sup>1</sup>

### SAWR OSCILLATORS (SAWROs)

- 1 GHz SAWRO
- 500 MHz SAWRO
- 400 MHz SAWRO
- Any Custom SAWRO and Tunable Voltage Controlled SAWR Oscillator from 100 MHz to 1 GHz\*<sup>1</sup>

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\*<sup>1</sup>
  - Wide range of bandwidths: 500 kHz to 250 MHz\*<sup>2</sup>
  - 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:  $\pm 2^\circ / \pm 10$  ns

### CUSTOM SAW SUBSYSTEMS

- With Hybrids, Switches and Multiple Type Packages
- Phase Lock Loops
- Filter Banks

\*<sup>1</sup> Negotiable to 2 GHz

\*<sup>2</sup> Negotiable depending on center frequency

## Contents

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## SAW Products

- Trade-offs Exist Between Parameters
- Tek can Tailor Product Characteristics to Your Needs
- Any Subsystems Including Various Combinations Shown on the Left

## ORDERING INFORMATION

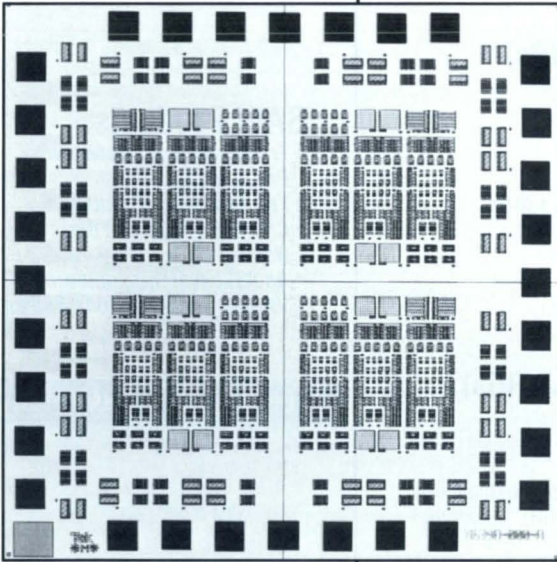
Tektronix, Inc.  
SAW Technology  
P.O. Box 500, M.S. 50-240  
Beaverton, OR 97077  
Phone: (503) 627-6171  
FAX: (503) 627-5502

# INTEGRATED CIRCUITS OPERATION

## IC Design and Fabrication Capabilities for Those Who Have High Performance IC Requirements.

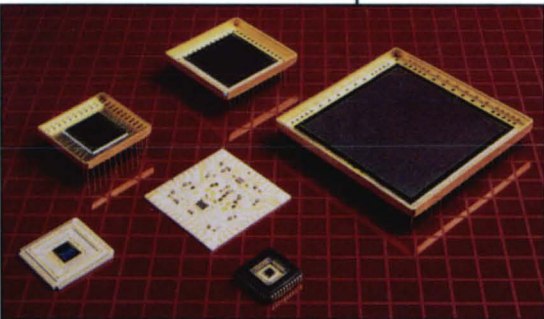
### BIPOLAR FOUNDRY SERVICES

- Semi Custom ICs
- Full Custom ICs
- State-of-the-Art Design Tools
- 6.5 GHz and 8.5 GHz Analog Processes



### CHARGE COUPLED DEVICE FOUNDRY SERVICE

- Scientific Imagers in a Large Area Format
- High Frame Rate Imagers for Fast Read Out
- Custom Design
- Sub Micron Sizes



### CONTACT INFORMATION

Integrated Circuits Operation  
P.O. Box 500, M.S. 59-420  
Beaverton, OR 97077  
Phone: (503) 627-2515  
FAX: (503) 627-5560  
General Information: 1-800-835-9433,  
Ext. 2515

## BIPOLAR ANALOG ICs

### QUICKCUSTOM™

A semi-custom design approach, QuickCustom™ consists of a series of QuickChip™ design formats (see picture) and easy to understand, time saving design tools. QuickChips have a basic "core" array of transistors, capacitors, and resistors, optimally configured for interconnection. The designer adds custom single or dual level metallization for those circuit elements required. In addition to the implanted resistors, laser trimmable nichrome resistors may be added. Once final designs are determined and approved, finished wafers can be delivered (typically) within four weeks or less.

### QUICKTILE™

The QuickTile design method uses standard blocks of tiles that are placed by the designer to suit the desired circuit function. While this method requires mask generation for all layers (like full custom), the pre-designed tiles are "snapped" together on a grid that eliminates the risk of violating layout rules.

### FULL CUSTOM

ICO also offers a total custom design approach. An experienced

Tektronix applications engineer is assigned to work with the designer throughout the entire project. Tektronix developed CAD/CAE software is used to provide circuit analysis, simulation and layout, greatly improving the

probability of meeting design specifications the first time. Typical delivery of finished wafers is less than ten weeks from approval of design layout.

### DESIGN TOOLS

The "tools" provided include a design guide and a library of SPICE models for the "core" IC that will predict the performance of your design.

Also included is 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.

### SELECTION GUIDE

QuickChip™ 2 Family (6.5 GHz, Analog Cells)					
	2S	2	2L	2K-30	2K-130
NPNs	150	214	524	78	280
PNPs	82	110	240	38	146
Resistors	602	946	2064	258	1118
Capacitors	24	20	72	10	30
Bond Pads	24	36	70	22	44
Schottky Diode	0	0	0	64	182

QuickChip™ 6 Family (8.5 GHz, Analog Cells, Density 3X QC2)			
	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

### QuickTile™ and Custom Arrays

CUSTOMER DESIGNED

## CHARGE COUPLED DEVICES

Tektronix CCD imagers perform efficiently at low light levels from UV to near infrared wavelengths.

The scientific imager family offers low noise, wide dynamic range, high QE (quantum efficiency), and high sensitivity. This family consists of the TK512, TK1024, and TK2048.

Applications include astronomy, machine vision, medical and scientific imaging.

The high frame rate imager family (TK064) offers smaller area arrays that run from 100 to 10,000 frames per second image rates, maintaining comparatively low noise and wide dynamic range. High speed signal processing applications include transversal filters, tapped analog delay lines, high speed samplers, and memory buffers.

Back illuminated versions of both imager types are available, with backside enhancement for higher QE through the visible and extending into the near UV wavelength.

A development board (TK1DEV) will operate imagers up to 3072 X 3072 pixel array size. This board provides for immediate imaging using Tektronix scientific imagers, with only the addition of power supplies and a monitor.

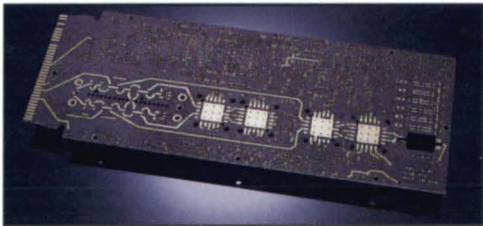
ICO also offers Prototype Services using our 2, 3, or 4 phase processes and your custom design.

### SELECTION GUIDE

Type	Array Size
<b>High Frame Rate Imager</b>	
TK064, Serial Output	64 x 64 pixels
TK064, Parallel Output	64 x 128 pixels
<b>Scientific Imagers</b>	
TK512	512 x 512 pixels
TK1024	1024 x 1024 pixels
TK2048B	2048 x 2048 pixels

## 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

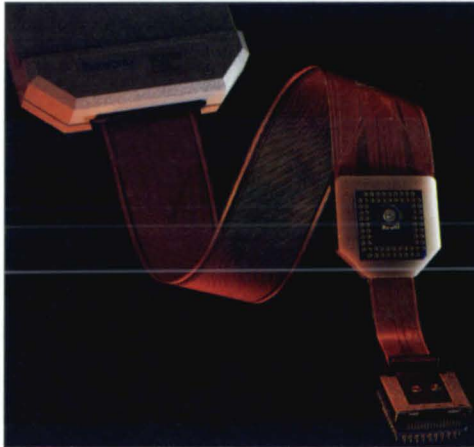
Hybrid to Circuit Board Elastomer Connector is used for analog or digital applications where a reliable and/or easily assemblable connector is needed. The patented Hypcon™ connector is unique for second level interconnections. The gold-on-gold pressure contact is virtually transparent at frequencies > 0.5 GHz.



Plating

## PHOTOCHEMICAL MACHINED PARTS

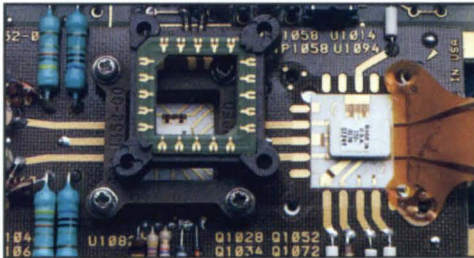
Photochemical Machined Parts provide a cost effective alternative to die blanking for tight tolerance, low volume applications. Simple, low cost phototooling means quick turn time for prototype and easy tooling modification for redesign. Burr free parts can be produced on most white and yellow metals 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  
General Information: 1-800-835-9433,  
Ext. 2000

# GENERAL TERMS OF SALE, LEASING, AND RENTAL PROGRAM

**C**heck 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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## 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

Flexible Leasing Alternatives are available for VSG products. Our specialized lease programs answer customers needs. Affordable monthly rates, maintenance, product upgrades and purchase credits are all key leasing features.

Call your local Tektronix Field Office for more leasing information.

## 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

Tektronix Authorized Rental Companies provide the widest selection of well-maintained Tek instruments, with flexible and attractive terms. For short term rentals, lease purchase options or used test equipment, Tek Authorized Rental Companies provide the right terms, the right instruments, the right options so you can make the right choice.

Our Authorized Rental Companies can provide you a solution when you need to demo new equipment before you purchase equipment for short-term projects, specific instruments for an immediate requirement, or if you are in the market for used test equipment. They will provide you the best answers for managing your test equipment inventory, whether you rent it for a month or lease it for a year.

When you need Tektronix products, you will **not** need to look further than our list of Authorized Rental Companies. Trust your rental requirements to the very best, Tektronix and . . .

Continental Resources, Inc.	1-800-343-4688
Electro Rent Corporation	1-818-787-2100
G. E. Rental/Lease	1-800-GE-RENTS
Genstar Rental Electronics, Inc.	1-800-225-2422
Leasametric, Inc.	1-800-553-2255
McGrath RentCorp	1-800-352-2900
Telogy, Inc.	1-800-TELOGY-1
U.S. Instrument Rentals, Inc.	1-800-USIR-123

## 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.

# 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.

## 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 inter-face 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.

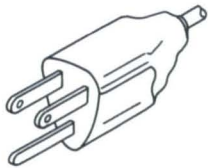
Many Tektronix instruments are designed to operate from a power source that will not apply more than 250 Volts RMS between the supply conductors or between either supply conductor and ground.

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.

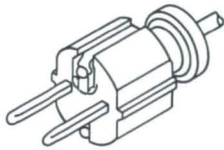
Except for some double-insulated instruments, most Tektronix instruments are equipped with either a three conductor attached power cord or a three-terminal power-cord receptacle. The third wire or terminal is connected directly to the instruments chassis to protect operating personnel.

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



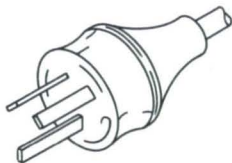
Standard  
North American  
120 V Plug



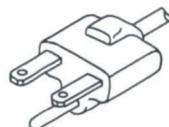
Option A1  
Universal Euro  
220 V Plug



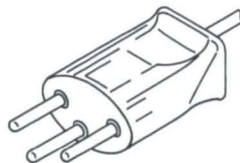
Option A2  
UK  
240 V Plug



Option A3  
Australian  
240 V Plug



Option A4  
North American  
240 V Plug



Option A5  
Switzerland  
220 V Plug



## 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 POSSIBILITY OF SUCH DAMAGES.**

PRODUCT CATEGORIES	WARRANTY PERIOD	SERVICE LOCATION
Oscilloscopes: Including 2205 (except all other 2200, 2300, 2400 Series); TM 500/TM 5000 Series; Communications Network Analyzers (except 834, 835, 836); Logic Analyzers; Spectrum Analyzers (except 3052); Television Products (except 1780R Series); Waveform Digitizers; Curve Tracers; Photometers/Radiometers; Cameras; Carts (except K217S, K318); Probes; CRTs; Isolators; Test System Interface Series; Display Stations XN10, XN11; XPTA Graphics Tablet; 4694 Series Color Printer; TestLabs; Fourier Analyzer; Tekmate; CSA 9XX; Signal Analyzer; Pulse Generator	1 year from date of shipment	Service Center designated by Tektronix
Oscilloscopes: 2200 (except 2205), 2300, 2400 Series; Communications Network Analyzers: 834, 835, 836; Television Products: 1780R Series; Terminals: XP Series X-Stations	3 years from date of shipment	Service Center designated by Tektronix
Monitors: 606B, 608, 608YX, 620, 634, 0A70, GMA 201, GMA 202, GMA 212, GMA 213C, GMA 213S	3 months, except 1 year from date of shipment for CRT	Service Center designated by Tektronix
4000 Series: Color Graphics Terminals (except those listed below), Color Graphics Output Systems, Graphics Tablets; Microprocessor Development Products (except V-Systems, MV Systems); Digital Analysis Systems: 9200 Series; LV500 Series; 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; 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 LCS: SGS 4XX, SGS 6XX; CACHE: CAXX, CAXXX, CGXX, RP88XX .	3 months from date of shipment	Service Center designated by Tektronix
Service	3 months from date of shipment or date of completion if performed on-site	Location where original service was performed

## SOFTWARE WARRANTY SUMMARY

Tektronix warrants that its software products will conform to the specifications in the documentation provided with the product, when used properly in the specified operating environment, for a period of three (3) months. The warranty period begins on the date of shipment, except that if the program is installed by Tektronix, the warranty period begins on the date of installation or one month after the date of shipment, whichever is earlier. If the software product does not conform as warranted, Tektronix will provide the remedial services as described in the documentation provided with the product.

For products offered without documentation, Tektronix warrants that the media on which the software product is furnished and the encoding of the programs on the media will be free from defects in materials and workmanship for a period of three (3) months from the date of shipment. If any such medium or encoding proves defective during the warranty period, Tektronix will provide a replacement in exchange for the defective medium. Except as to the media on which the software product is furnished, the software product is provided "as is" without warranty of any kind, either express or implied.

Tektronix does not warrant that the functions contained in any software product will meet Customer's requirements or that the operation of the programs will be uninterrupted or error-free.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and, for warranted products, make suitable arrangements for such service in accordance with the instructions received from Tektronix. If Tektronix is

unable, within a reasonable time after receipt of such notice, to provide remedial service for warranted products or, for "as-is" products, to provide a replacement that is free from defects in materials and workmanship, Customer may terminate the license for the software product and return the software product and any associated materials for credit or refund.

The above warranties shall not apply to any software product that has been modified or altered by Customer. Tektronix shall not be obligated to furnish service under this warranty with respect to any software product a) that is used in an operating environment other than that specified or in a manner inconsistent with the User's Manual and documentation; or b) when the software product has been integrated with other software if the result of such integration increases the time or difficulty of analyzing or servicing the software product or the problems ascribed to the software product.

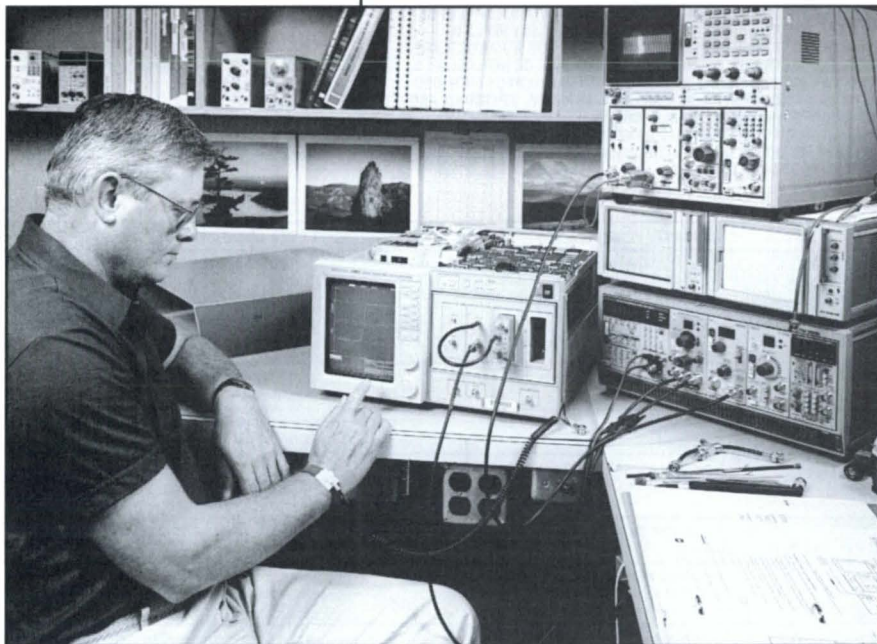
**THE ABOVE WARRANTIES ARE GIVEN BY TEKTRONIX WITH RESPECT TO THE LISTED PRODUCTS IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO PROVIDE REMEDIAL SERVICE WHEN SPECIFIED, REPLACE DEFECTIVE MEDIA, OR REFUND CUSTOMER'S PAYMENT, AS APPLICABLE, IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO CUSTOMER FOR BREACH OF EITHER WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.**

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**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



**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

through long-term product support. Our sales and service personnel work closely to help you make the best selections for your applications. Then we help you maximize your investment by ensuring optimum product performance. All this is accomplished through customer support programs ranging from training to product installations and a variety of maintenance plans.

It all begins by contacting a customer service representative (CSR) located in your nearest Tektronix sales and service office. Our U.S. and international office locations are listed at the back of this catalog. The CSR will give you information on products and the names of sales engineers assigned to serve your product interests.



### 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.

### OPERATIONAL AND APPLICATIONS 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. 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!

### WARRANTY COVERAGE

All Tektronix products are warranted to be free from defects in materials and workmanship during the applicable warranty period. See page 375.

### SERVICE OFFERINGS

Service programs include *Warranty-Plus* service plans, Maintenance Agreements, and Per-Incident service.

### CUSTOMER-SITE INSTALLATIONS

Tektronix provides on-site installations for most visual systems and Tek-configured systems for computer graphics, 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 sales and service office for more information.

**P**roviding You With Worldwide Service and Support to Complement Your New Product Purchase

### ORDERING INFORMATION

Contact your local Tektronix sales and service office or Tektronix subsidiary or call our toll-free numbers in the U.S.:

Test and Measurement:	1-800-547-5000
Visual Systems:	1-800-628-5470
General Customer Information:	1-800-835-9433



**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:
<b>M1</b> plus  =		DEPOT REPAIRS CAL	DEPOT REPAIRS CAL			Extends warranty coverage through the third year of product ownership and provides two calibrations: one each in years two and three of product ownership.
<b>M2</b> plus  =		DEPOT REPAIRS	DEPOT REPAIRS	DEPOT REPAIRS	DEPOT REPAIRS	Extends warranty coverage through the first five years of product ownership.
<b>M3</b> plus  =		DEPOT REPAIRS CAL	DEPOT REPAIRS CAL	DEPOT REPAIRS CAL	DEPOT REPAIRS CAL	Extends warranty coverage through the first five years of product ownership and provides four calibrations: one each in years two, three, four, and five of product ownership.
<b>M4</b> plus  =	 CAL	DEPOT REPAIRS CAL	DEPOT REPAIRS CAL			Extends warranty 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 of product ownership.
<b>M5</b> plus  =	 CAL	DEPOT REPAIRS CAL	DEPOT REPAIRS CAL	DEPOT REPAIRS CAL	DEPOT REPAIRS CAL	Extends warranty 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 of product ownership.
<b>M6</b> plus  =		DEPOT REPAIRS CAL				Extends warranty coverage through the second year of product ownership and provides one calibration in year two of product ownership.
<b>M7</b> plus  =		CAL	CAL			Provides two calibrations: one each in years two and three of product ownership.
<b>M8</b> plus  =		CAL	CAL	CAL	CAL	Provides four calibrations: one each in years two, three, four, and five of product ownership.
<b>M9</b> plus  =		DEPOT REPAIRS	DEPOT REPAIRS			Extends warranty 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 are serviced at Tektronix service depots or on-site at your facility. Types of services cover a broad range of calibrations, performance tests, preventive maintenance, repairs, combination services, and much more. Whatever your need, Tektronix can provide fast, flexible service that keeps your products operating at peak performance. Contact your local Tektronix service representative and ask for a free *Calibration and Repair Services Guide*. The guide will give you detailed information on service offerings for Tektronix Test and Measurement 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 Tektronix 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 Tektronix sales representative.



**ORDERING INFORMATION**

Contact your local Tektronix sales and service office or Tektronix subsidiary or call our toll-free number in the U.S.:  
Test & Measurement Service: 1-800-547-5000

## 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 needed when service is required.
- No investment required for training, spares or documentation.
- Provides priority service over customers without service agreements.
- 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 coverage as well as calibration services for up to five years. All services are performed at Tektronix service depots. Your local Tektronix sales 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 Tektronix sales 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. 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 to meet your specific, individual needs.



## 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:
<b>M2 plus</b>  = 						Extends warranty coverage through the first five years of product ownership.
<b>M3 plus</b>  = 		 	 	 	 	Extends warranty coverage through the first five years of product ownership and provides four calibrations: one each in years two, three, four, and five of product ownership.
<b>M4 plus</b>  = 	 	 	 			Provides five calibrations: one in year one, and two each in years two and three of product ownership.
<b>M5 plus</b>  = 	 	 	 	 	 	Extends warranty 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 of product ownership.
<b>M7 plus</b>  = 		 	 			Provides two calibrations: one each in years two and three of product ownership.
<b>M8 plus</b>  = 		 	 			Provides four calibrations: one each in years two, three, four, and five of product ownership.

## ORDERING INFORMATION

Contact your local Tektronix sales and service office or Tektronix subsidiary or call our toll-free number in the U.S.:  
Test & Measurement  
Service: 1-800-547-5000



**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:
<b>Q0</b> plus  =						Provides on-site installation and product verification.
<b>Q1</b> plus  =			 			Provides on-site warranty hardware coverage and one scheduled on-site calibration, performance test, or preventive maintenance call during the first year of product ownership.
<b>Q2</b> plus  =			 	 		Provides on-site warranty hardware coverage and two scheduled on-site calibrations, performance tests, or preventive maintenance calls (one per year) during the first two years of product ownership.
<b>Q3</b> plus  =			 	 	 	Provides on-site warranty hardware coverage and three scheduled on-site calibrations, performance tests, or preventive maintenance calls (one per year) during the first three years of product ownership.
<b>Q4</b> plus  =						Provides on-site warranty hardware coverage through the first year of product ownership.
<b>Q5</b> plus  =						Provides on-site warranty hardware coverage through the first two years of product ownership.
<b>Q6</b> plus  =						Provides on-site warranty hardware coverage through the first three years of product ownership.
<b>Q9</b> plus  =						Provides one year of Software Subscription Service.

**ORDERING INFORMATION**

Contact your local Tektronix sales and service office or Tektronix subsidiary or call our toll-free number in the U.S.:  
 Test & Measurement Service: 1-800-547-5000



**WARRANTY-PLUS Q-OPTIONS**

*Warranty-Plus* Q-Options differ from M-Options by providing on-site service at the customer's facility. Instead of servicing your product at 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 services are applicable to your product).

Q-Options extend warranty 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.

**WARRANTY-PLUS 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.

**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.

**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. A Maintenance Agreement provides a planned maintenance program with priority service over Per-Incident customers. It can also add the convenience of multi-year coverage to minimize your paperwork and maintain tighter controls over your ownership costs. But most important, it helps you get maximum performance from your investment with increased uptime.

Maintenance Agreements 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 covered under any kind of service agreement are serviced on a Per-Incident basis. Per-Incident services include calibration and repair services requested on an as-needed basis. There are two ways to charge for Per-Incident services: Standard Price and Time and Material.

#### Standard Price

Current Tektronix products have published standard prices for calibration services, repair services, and combined services of calibration and repair. These published Standard 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 under Time and Material charges with hourly labor rates and parts usage prices applied.

#### 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:
<b>Q0</b> plus  =					Provides on-site installation and product verification.
<b>Q1</b> plus  =		  			Provides on-site warranty hardware coverage and one scheduled on-site calibration, performance test, or preventive maintenance call during the first year of product ownership.
<b>Q2</b> plus  =		  	 		Provides on-site warranty hardware coverage and two scheduled on-site calibrations, performance tests or preventive maintenance calls (one per year) during the first two years of product ownership.
<b>Q3</b> plus  =		  	 	 	Provides on-site warranty hardware coverage and three scheduled on-site calibrations, performance tests or preventive maintenance calls (one per year) during the first three years of product ownership.
<b>Q4</b> plus  =		 			Provides on-site warranty hardware coverage through the first year of product ownership.
<b>Q5</b> plus  =		 			Provides on-site warranty hardware coverage through the first two years of product ownership.
<b>Q6</b> plus  =		 			Provides on-site warranty hardware coverage through the first three years of product ownership.
<b>Q9</b> plus  =		 			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 Tektronix sales and service office or Tektronix subsidiary or call our toll-free number in the U.S.:  
Test & Measurement  
Service: 1-800-547-5000

**ORDERING INFORMATION**

Contact your local Tektronix sales and service office or Tektronix subsidiary or call our toll-free number in the U.S.:  
 Test & Measurement Service: 1-800-547-5000

**WARRANTY-PLUS W-OPTIONS**

The third family of *Warranty-Plus* options are Comprehensive W-Options designed for systems products. They provide choices between depot or on-site service. In

addition, software subscription and telephone hotline services are bundled with extended warranty coverage or can be selected alone as Option W9. 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:
<b>W1</b> plus  =					Provides on-site warranty hardware coverage, Software Subscription Service, and telephone Hotline support through the first year of product ownership.
<b>W2</b> plus  =					Provides on-site warranty hardware coverage, Software Subscription Service, and telephone Hotline support through the first two years of product ownership.
<b>W3</b> plus  =					Provides on-site warranty hardware coverage, Software Subscription Service, and telephone Hotline support through the first three years of product ownership.
<b>W4</b> plus  =					Provides depot warranty hardware coverage, Software Subscription Service, and telephone Hotline support through the first two years of product ownership.
<b>W5</b> plus  =					Provides depot warranty hardware coverage, Software Subscription Service, and telephone Hotline support through the first three years of product ownership.
<b>W9</b> plus  =					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.

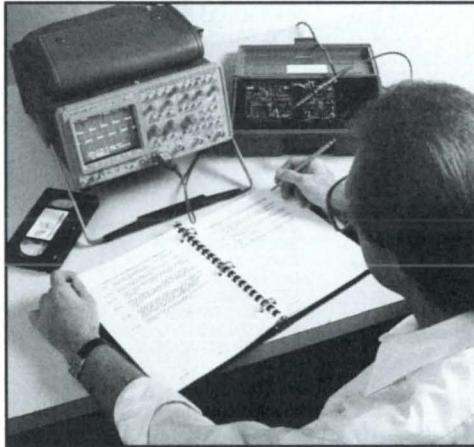
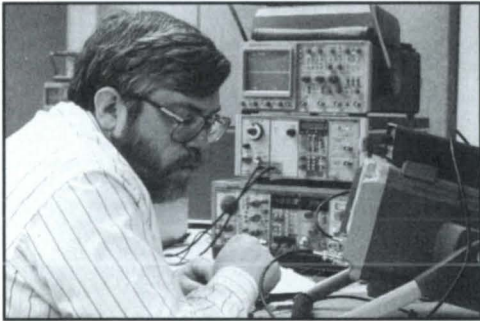


**TEKTRONIX WARRANTY-PLUS W-OPTIONS**

For products with a **1-YEAR** product warranty

W-OPTIONS AND PRODUCT WARRANTY	YEAR 1	YEAR 2	YEAR 3	WARRANTY-PLUS W-OPTION DESCRIPTIONS:
<b>W1</b> plus  =				Provides on-site warranty hardware coverage, Software Subscription Service, and telephone Hotline support through the first year of product ownership.
<b>W2</b> plus  =				Provides on-site warranty hardware coverage, Software Subscription Service, and telephone Hotline support through the first two years of product ownership.
<b>W3</b> plus  =				Provides on-site warranty hardware coverage, Software Subscription Service, and telephone Hotline support through the first three years of product ownership.
<b>W4</b> plus  =				Provides depot warranty hardware coverage, Software Subscription Service, and telephone Hotline support through the first two years of product ownership.
<b>W5</b> plus  =				Provides depot warranty hardware coverage, Software Subscription Service, and telephone Hotline support through the first three years of product ownership.
<b>W9</b> plus  =				Provides Software Subscription Service and telephone Hotline support during the first year of product ownership.





### 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.

## Test and Measurement (T&M) Customer

- *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 contact:  
 Tektronix, Inc.  
 Walker Road Industrial Park  
 Attention: T&M Training Registrar  
 P.O. Box 4600, M/S 94-925  
 Beaverton, OR 97076  
 Phone:  
 1 (800) 835-9433 ext. WR1407

# 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 M/S 50-439  
Beaverton, OR 97077 USA  
Phone: 1-800-835-9433 x1916  
Telex: 192825 TEKTRONIX  
Fax: (503) 627-6905

## ALGERIA

(Service Except VSG)  
**Entreprise Nationale Des Industries Electroniques MCE 1**

Unité de Maintenance et Calibration des Equipements Electroniques  
MCE 1, BP 121

Route de Mascara Zone - Industrielle  
Sidi Bel-Abbes  
Phone: 213 (7) 242269  
Telex: (936) 16021 MCE1 DZ

## MCE 2

Lotissement El-Idrissi  
Alger  
Phone: 213 (2) 782074/782076  
Telex: (936) 66108 DELNA DZ

## (VSG Service)

Société ASTEIN  
Résidence SERAPI  
rue Kious Mohamed  
16330 Birkhadem - Alger  
Phone: 213 (2) 56-77-40  
Fax: 213 (2) 56-94-73

## (Sales Office)

**Tektronix, S.A.**  
Algeria Sales  
ZA de Courtaboeuf, Av du Canada,  
BP 13  
91941 Les Ulis Cédex  
France  
Phone: 33 (1) 69 86 81 81  
FAX: 33 (1) 69-07-09-37  
Telex: (842) 604332 TEKOR A

## (Product Information)

**Tektronix, Bureau de Liaison-  
Algerie**  
Bureau N9, Niveau C  
Hôtel El-Aurassi  
Bd Frantz-Fanon  
Alger 2  
Phone: 213 (2) 63 07 47  
Telex: (936) 67043 TEK DZ

## ARGENTINA

**Coasin S.A.**  
**Buenos Aires**  
Virrey del Pino 4071  
1430 Buenos Aires  
Phone: 54 (1) 552-5248/-3485/-3185  
FAX: 54 (1) 11-1427  
Telex: (390) 122284 COASIN AR

**Cordoba**  
25 de Mayo No. 1930  
5000 Cordoba  
Phone: 54 (51) 3037

## AUSTRALIA

**Tektronix Australia Pty. Limited**  
**Sydney Office**  
80 Waterloo Road  
North Ryde, N.S.W. 2113  
Phone: 61 (2) 888-7066  
FAX: 61 (2) 888-0125  
Telex: (790) 24269 TEKTRNX AA

**Adelaide**  
128 Gilles Street  
Adelaide, South Australia 5000  
Phone: 61 (8) 223-2811  
FAX: 61 (8) 223-7890

**Brisbane**  
737 Logan Road  
Greenstopes Brisbane  
Queensland 4120  
Phone: 61 (7) 394-1155  
Fax: 61 (7) 397-8679

**Canberra**  
Unit 14  
Trevor Percy House  
Fern Hill  
Bruce, Austr. Capital Terr. 2617  
Phone: 61 (62) 516-111  
FAX: 61 (62) 514-509

**Perth**  
The Garden Office Park  
345 Harborne Street  
Hertsman, West Australia 6017  
Phone: 61 (9) 242-4688  
Fax: 61 (9) 242-4707

**Victoria Branch Office**  
259-263 Whitehorse Rd.  
Balwyn, Victoria 3103  
Phone: 61 (3) 836-3355  
FAX: 61 (3) 836-6592  
Telex: (790) 35680 TEKME LA

## AUSTRIA

**Tektronix Ges.m.b.H.**  
Doerenkampgasse 7  
A-1100 Vienna  
Phone: 43 (222) 68-66-02-0  
FAX: 43 (222) 68-66-00  
Telex: (847) 111481 TEK A

## BAHRAIN

**International Agencies Co Ltd.**  
(Intercol)  
P.O. Box 5841  
Manama  
Phone: 973 (\*) 727 177  
FAX: 971 (\*) 727 509  
Telex: (490) 8661 INTCOL BN

## BANGLADESH

**A. Q. Chowdhury & Co.**  
KJH Mansion  
Spectachrome Floor  
83 Laboratory Road  
Dhaka - 1205  
Phone: 880 (2) 861910, 861911, 500721  
FAX: 880 (2) 863475  
Telex: (950) 671259 AQC BJ

## BELGIUM

**Tektronix nv/sa**  
Brussels Office  
Bedrijfspark Keiberg  
Zoning Keiberg  
Excelsiorlaan, 3  
1930 Zaventem  
Phone: 32 (2) 720-80-20  
FAX: 32 (2) 720-80-25  
Telex: (846) 26713 TEKBEL B

## BOLIVIA

**Coasin Bolivia S.R.L.**  
Calle Gabriel Gozalvez 221  
PO Box 7295  
La Paz  
Phone: 591 (2) 340962, 363365  
FAX: 591 (2) 35 9268  
Telex: (336) 3233 COALAP BV

## BRAZIL

**Tektronix Industria e Comercio Ltda.**

**São Paulo Office**  
Av. Vereador José Diniz, 3530  
CEP 04604-Campo Belo  
São Paulo, SP  
Phone: 55 (11) 543-1911  
FAX: 55 (11) 542-0696  
Telex: (391) 1154068 TEKX BR

**Rio de Janeiro Office**  
Av. Marechal Câmara, 160, Gr. 605  
CEP 20020  
Rio de Janeiro, RJ  
Phone: 55 (21) 240-7370  
Telex: (391) 2130120 TEKX BR

(Color Printers Only)  
**Cit do Brasil Computacao Grafic Ltd.**

Av. Paulista, 1159-17º Andar  
CEP 01311 - São Paulo SP  
Phone: 55 (11) 251-3431, 287-6011  
FAX: 55 (11) 289-1721

## BULGARIA

**Tektronix Representation Office Sofia**  
VMEI "LENIN" BL.2  
Room 2325a  
BG-1156 Sofia  
Phone: (\*) 66 53 46  
FAX: (\*) 68 71 10  
Telex: (865) 22958 SVCE BG

## CANADA

**Tektronix Canada Inc.**  
Barrie  
50 Alliance Blvd.  
Mail: P.O. Box 6500,  
Barrie, Ontario L4M 4V3  
Phone: (705) 737-2700  
FAX: (705) 737-5588  
Telex: (389) 06875672 TEKTRONIX BAR

## Calgary

Suite 106  
3016, 19th Street NE  
Calgary, Alberta T2E 6Y9  
Phone: (403) 250-7583  
FAX: (403) 291-9840

## Montreal

900 Selkirk Street  
Pointe Claire, Quebec H9R 3S3  
Phone: (514) 697-5340  
FAX: (514) 697-5205

## Ottawa

1642 Woodward Drive  
Ottawa, Ontario K2C 3R8  
Phone: (613) 225-2850  
FAX: (613) 225-9719

## Toronto

1200 Courtney Park Dr.  
Mississauga, Ontario L5T 1S2  
Phone: (416) 670-3423  
FAX: (416) 670-4229

## Vancouver

4175 Dawson Street  
Burnaby, B.C. V5C 4B3  
Phone: (604) 291-1222  
FAX: (604) 291-1624

## CHILE

**Equipos Industriales S.A.C.I.**

Moneda 812, Of. 905  
Santiago  
Phone: 56 (2) 6990506  
FAX: 56 (2) 334539  
Telex: (359) 340987 FLOBRA CK  
(359) 341177 FLOBRA CK

## Ingenac S.A.

Av. Pedro de Valdivia 800  
Providencia  
Santiago  
Phone: 56 (2) 231995, 740973, 381422  
Fax: 56 (2) 2341107  
Telex: (359) 240285

## CHINA, PEOPLE'S REPUBLIC OF

**Tektronix China Ltd**  
**Beijing Office**  
Xiyuan Hotel, Building #1, Room 5102  
Erigou, Western Suburb  
Beijing, P.R.C.  
Phone: 86 (1) 8021657, 8021502  
FAX: 86 (1) 802-1502  
Telex: (716) 22831 XYH CN,  
"ATTN: Tektronix, Rm 5102"

## Shanghai Office

Room 614/616, Shanghai Convention Centre  
500 Zhao Jia Bang Road  
Shanghai P.R.C.  
Phone: 86 (21) 471 0281, 471 0282  
FAX: 86 (21) 471 0282

## Hong Kong

402 Citicorp Centre  
18 Whitfield Road  
Causeway Bay, Hong Kong  
Phone: 852 (\*) 570 6928  
FAX: 852 (\*) 8072144  
Telex: (780) 77708 DCBIA HX

## U.S. Office

P.O. Box 500, M/S 50-438  
Beaverton, Oregon 97077  
U.S.A.  
Phone: (503) 627-6546  
FAX: (503) 627-6905  
Telex 192825 TEKTRONIX

## COLOMBIA

**Selectronica, Ltda.**

Carrera 71 #55-98  
Mail: Apartado Aereo 25124  
Bogota D.E.  
Phone: 57 (1) 263-1220, 295-3215  
FAX: 57 (1) 263-2874  
Cable: SELECTRONICA

## COSTA RICA

**Electroimpex, S.A.**

200 Metros oeste de Pops La Sabana  
Carretera a Escazu  
Mail: Apartado 620-1000  
San Jose  
Phone: 506 (\*) 31-5701/3426  
FAX: 506 (\*) 31-6531  
Telex: (375) 2645 ELEPEX CR

## CYPRUS

**Chris Radiovision Ltd**

P.O. Box 1989  
Nicosia  
Phone: 357 (2) 466121  
FAX: 357 (2) 365177  
Telex: (826) 605 2395

## CZECHOSLOVAKIA

**Seminar & Training Center**

Bartolomejska 13  
CS-11000 Praha 1  
Phone: 42 (22) 22 32 63

## Zenit

Radlicka 138  
CS-15000 Praha 5  
Phone: 42 (2) 53 69 21  
FAX: 42 (2) 53 62 93  
Telex: (849) 121801

## DENMARK

**Tektronix A/S**

Literbuen 7  
2740 Skovlunde  
Phone: 45 (44) 53 54 55  
FAX: 45 (44) 53 07 55

## ECUADOR

**Proteco Coasin Cia Ltda.**

**Quito**  
12 de Octubre 2449 y Orellana  
Casilla 228 A  
Quito  
Phone: 593 (2) 52-6759/-9684  
FAX: 593 (2) 56-1980  
Telex: (393) 22865 PROTEC ED  
22085 ESAND ED

## Guayaquil

Miraflores Av. Principal 204  
y Calle Segunda  
Guayaquil  
Phone: 593 (4) 201529

## EGYPT

### Giza Systems Engineering Co.

2, El Mesaha Sq.  
DOKKI, A.R.E.  
P.O. Box 1913  
CAIRO 11511  
Phone: 20 (2) 3490140  
FAX: 20 (2) 3609932  
Telex: 93644 ALKAN

## FINLAND

### Tektronix Oy

Larin Kyöstin tie 4,  
SF-00650 Helsinki 65  
Phone: 358 (0) 7282 400  
FAX: 358 (0) 7520033

## FRANCE

### Tektronix S.A.

**Orsay**  
ZAC Courtaboeuf, 4 Av. du Canada  
B.P. 13  
91941 Les Ulis Cédex  
Phone: 33 (1) 69 86 81 81  
FAX: 33 (1) 69 07 09 37  
Telex: (842) 604332 TEKOR A

### After Sales Service—France

ZAC Courtaboeuf, 4 Av. du Canada  
B.P. 13  
91941 Les Ulis Cédex  
Phone: 33 (1) 69 86 81 81  
FAX: 33 (1) 69 86 11 44  
Telex: (842) 601012 TEKSAV

### After Sales Service—Paris West

39, Bd. des Bouvets  
92000 Nanterre C  
Phone: 33 (1) 47 76 13 53  
FAX: 33 (1) 47 76 33 11  
Telex: (842) 613737 TEKNANT

### Aix-en-Provence Region Center

Immeuble Tertia 1-ZI d'Aix  
13763 Les-Milles Cédex  
Phone: 33 (16) 42 24 45 03  
FAX: 33 (16) 42 24 41 20  
Telex: (842) 440045

### Bordeaux Region Center

Avenue J.F. Kennedy  
Parc Club Cadera BT T  
33700 Merignac  
Phone: 33 (16) 56 34 27 03  
FAX: 33 (16) 56 55 90 29  
Telex: (842) 570247

### Lyon Region Center

Les Jardins d'Entreprise  
213 rue de Gerland, bât. F  
69007 LYON  
Phone: 33 (16) 78 58 15 38  
FAX: 33 (16) 78 69 52 55  
Telex: (842) 300150 TEKLYON

### Rennes Region Center

ZAC de la Rigaudière  
35510 Cesson Sévigné  
Phone: 33 (16) 99 83 40 40  
FAX: 33 (16) 99 83 36 23  
Telex: (842) 740829 TEKREN

## Strasbourg Region Center

Parc d'Activités des Tanneries  
2a, Route de la Rivière  
67380 Lingolsheim  
Phone: 33 (16) 88 76 15 45  
FAX: 33 (16) 88 76 09 89  
Telex: (842) 890470

## Toulouse Region Center

Peri-Sud 2, Z.I. du Palays  
13 Rue Villet Bat. 1  
31400 Toulouse  
Phone: 33 (16) 61 80 25 69  
FAX: 33 (16) 61 34 84 52  
Telex: (842) 530243 TEKTOUL F

## GERMANY, FEDERAL REPUBLIC OF

### Tektronix GmbH

**Cologne**  
Sedanstrasse 13-17  
Mail: P.O. Box 101544  
D-5000 Cologne 1  
Phone: 49 (221) 77220  
FAX: 49 (221) 7722-362  
Telex: (841) 8885417 ATEK D

### Berlin

Ernst-Reuter-Platz 3-5  
D-1000 Berlin 10  
Phone: 49 (30) 317701  
FAX: 49 (30) 313 31 32  
Telex: (841) 185804 TEKB D

### Cologne Service Center

Schoenhauser Strasse 64  
D-5000 Cologne 51  
Phone: 49 (221) 3798-0  
FAX: 49 (221) 379 85 00  
Telex: (841) 8885541 TEKC D

### Frankfurt

Lyoner Strasse 14  
6000 Frankfurt 71  
Phone: 49 (69) 6690-020  
FAX: 49 (69) 666 40 93  
Telex: (841) 4170788

### Hamburg

Kieler Strasse 407  
D-2000 Hamburg 54  
Phone: 49 (40) 54830  
FAX: 49 (40) 548 31 59  
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Kansas City, MO  
(816) 931-0250

**ISL Corporation**

St. Louis, MO  
(314) 423-3141

### New Mexico

**Electronic Parts Co.**

Albuquerque, NM  
(505) 293-6161

### New York

**Transcat**

Rochester, NY  
(716) 458-4801  
(800) 828-1470 (outside New York)

### Pennsylvania

**Sunshine Scientific Instruments, Inc.**

Philadelphia, PA  
(215) 673-5600

### South Carolina

**Dixie Electronics**

Columbia, SC  
(803) 779-5332

### Texas

**INOTEK**

Dallas, TX  
(214) 243-7000

**ENEST**

Dallas, TX  
(214) 980-9876

### Utah

**Standard Supply Company**

Salt Lake City, UT  
(801) 486-3371

### Washington

**Radar Electric**

Seattle, WA  
(206) 282-2511

## OPTICAL/METALLIC TDR's

**Fibertron**

La Habra, CA  
(213) 690-0670

**Grass Valley Group**

Grass Valley, CA  
(916) 478-3000

**Optical Networks Int'l**

Englewood, CO  
(800) 342-3763

**Anixter Bros., Inc.**

Skokie, IL  
(800) 221-5217

**North Supply Company**

Industrial Airport, KS  
(713) 791-7000

**BEC, Inc.**

Horsham, PA  
(800) 523-3808

**TeleNetworks, Inc.**

Hato Rey, PR  
(809) 766-2829

**Radar Electric Company**

Seattle, WA  
(206) 282-2511

## LAN/DATACOM REPS

**Jordan Electronics**

Anaheim, CA  
(714) 939-9329

**Barnhill Associates**

Englewood, CO  
(303) 792-9500

**ICS Associates**

Westford, MA  
(508) 692-3545

**Dataport Technologies**

Maryland Heights, MO  
(314) 739-0665

**Peter Polus Company**

Herkimer, NY  
(315) 866-0310

**Mecom, Inc.**

Risingsun, OH  
(419) 457-3231

## TELECOM REPS

**Barnhill Associates**

Englewood, CO  
(303) 792-9500

**Southeast Datacom**

Roswell, GA  
(404) 998-5083

**EnMark Telecom Sales**

Hastings, MN  
(612) 438-2981

**Colcom, Inc.**

Austin, TX  
(512) 244-6689

## EDUCATIONAL REPS

### Alabama

**Technical Training Aids**

Birmingham, AL  
(205) 822-1326

### California

**Raneco, Inc.**

San Juan Capistrano, CA  
(714) 978-9452

### Idaho

**Idaho Instruments**

Twin Falls, ID  
(208) 733-5636

### Massachusetts

**Technical Education Products**

Hampden, MA  
(413) 516-3209

### New York

**Vowell Associates, Inc.**

Pittsford, NY  
(716) 248-9130

### Pennsylvania

**Arthur B. Williams & Associates**

Hummelstown, PA  
(717) 566-6767

### Virginia

**Ronald A. Williams, Ltd.**

Richmond, VA  
(804) 282-8239

## RENTAL COMPANIES

**Continental Resources, Inc.**

Bedford, MA  
(617) 275-0850  
(800) 343-4688

**Electro Rent Corporation**

Van Nuys, CA  
(818) 787-2100  
(800) 444-5174

**G.E. Rents**

Norcross, GA  
(404) 246-6200  
(800) GE-RENTS

**Genstar Rental Electronics, Inc.**

Palo Alto, CA  
(415) 856-7600  
(800) 225-2422

**Leasametric, Inc.**

Foster City, CA  
(415) 574-4441  
(800) 553-2255

**McGrath Rentcorp**

San Lorenzo, CA  
(415) 276-2626  
(800) 352-2900

**Telogy, Inc.**

Redwood City, CA  
(415) 594-1700  
(800) TELEGY-1

**U.S. Instrument Rentals, Inc.**

Dallas, TX  
(214) 456-4600  
(800) USIR-123

Only corporate offices are shown. If your area is not listed above, please check your local telephone directory or call the listed number for other authorized sales offices for these companies.

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Title \_\_\_\_\_  
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City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Also, please:

- Add me to your mail list.
- Send me the 1991 Catalog of all Tektronix products.
- Send me the 1990/1991 Television Products Catalog.
- Send me the latest Tek Direct Catalog.



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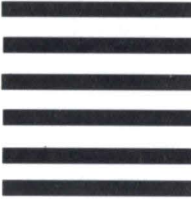
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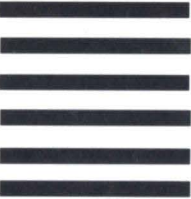
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