

11403A

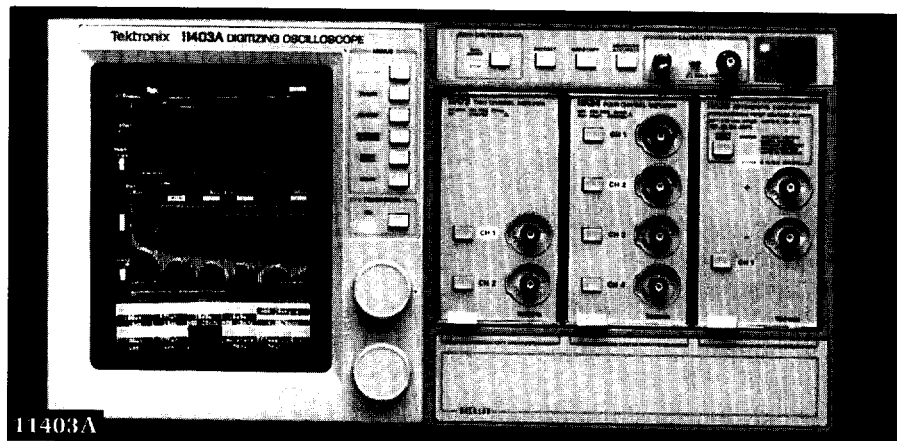
Digitizing Oscilloscopes

3 GHz

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

11403A

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



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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.

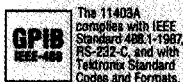
Select a trace, a trigger, a measurement or other function by just touching the appropriate area of the screen or by selecting from the menus. As your selection changes, the functions of the two front-panel knobs change accordingly – to let you set time per division, set record lengths, or zoom and pan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

Product(s) available through your local Tektronix representative (listed in the back of this catalog) or call 1-800-426-2200.



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



Tektronix Measurement products are manufactured in ISO registered facilities.

11403A APPLICATIONS

Device Characterization With precision equivalent-time sampling of repetitive signals and unsurpassed accuracy and repeatability, these oscilloscopes are ideal tools for the component engineer and device designer.

Power Supply Design With AC coupling, fast overdrive recovery, high vertical resolution, and one-touch measurements, these oscilloscopes are an excellent choice for power supply design. 11000 Series plug-in amplifiers have a wide range of calibrated offset and can recover quickly from up to 8000 divisions of overdrive. The new 11A16 Current Amplifier plug-in gives direct reading of current, and its deskew capabilities allow high-accuracy instantaneous power calculations using the waveform processing capabilities of the 11403A.

Production Testing High accuracy, full programmability, the flexibility and performance of 11000 Series plug-ins, and fast ATE throughput give the production test user significant cost savings. Speed manual adjustment of circuit performance with the Pass/Fail testing feature. Coupled with the multiple waveform measurement capabilities, the Pass/Fail testing feature makes the 11400 a standalone testing system.

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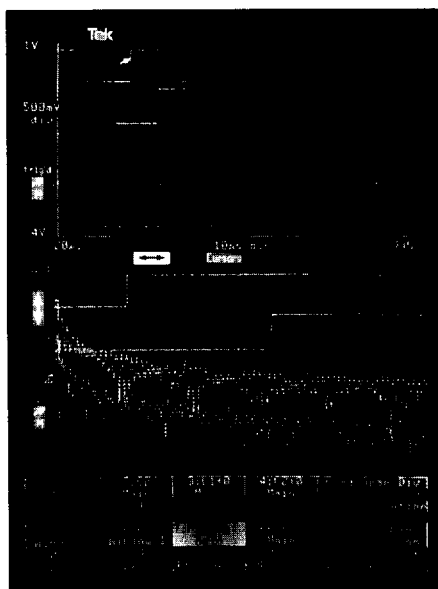


Figure 1. FFT display and measurements in the 11403A offer additional analysis power to the engineer or scientist.

Acquisition and Analysis Power

From the engineering bench to the production line, the 11403A gives 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.

Equipped with three plug-in compartments and dual time bases, the 11403A can continuously acquire and display eight 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 incorporates extensive triggering capabilities including selectable AC or DC coupling and AC or DC noise reject, as well as high and low frequency reject. Pre-trigger or post-trigger details can be viewed on the main trace. 2 GHz trigger bandwidth (11A81) lets you trigger on extremely fast transitions.

THE USER INTERFACE

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

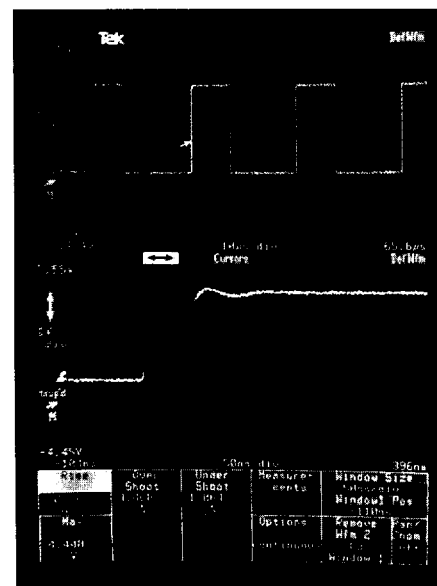


Figure 2. In the Annotation Mode, horizontal cursor bars and highlighting serve to focus your attention on the portion of the waveform being measured.

ANNOTATIONS

All of the 11403A 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, as well as the 10% and 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.

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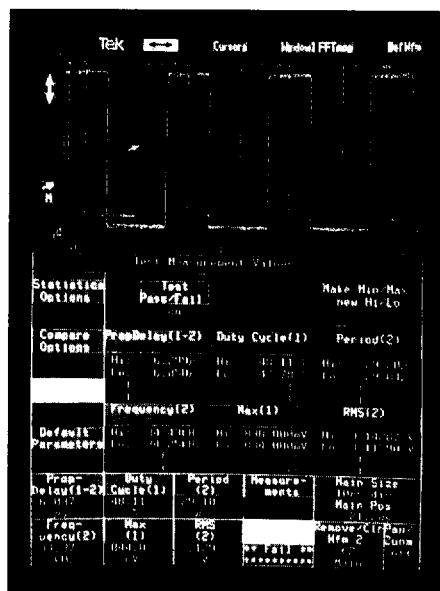


Figure 3. Pass/Fail testing offers a fast, easy method of adjusting circuit operation or sorting parts in production applications.

PASS/FAIL TESTING

The 11403A offers 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 falls between the set limits. If the test fails, the scale indicates whether the signal was high or low.

MULTIPLE WAVEFORM MEASUREMENTS

Adding to the capabilities of the 11403A 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 is equipped to handle up to three 11000 Series plug-ins. Several plug-ins are available, offering a range of bandwidths, channels, and input impedances to choose from. (For a list of plug-ins and characteristics, see page 90.) Plug-in installation is a simple matter of sliding each unit into place. Plug-ins are controlled through the main-frame, 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 NON-VOLATILE STORAGE

The standard 11403A is equipped with 512 K of volatile waveform acquisition and display memory, and 128 K 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 K of non-volatile memory for storage of waveforms and settings. This provides a total of 896 K of non-volatile memory – enough for approximately 450 waveforms of 1 K point record length.

DOCUMENTATION

Documenting your results with the 11403A 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 4).

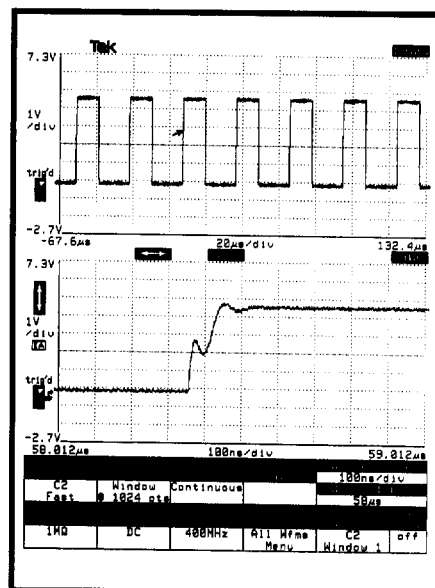


Figure 4. 11400 hardcopy output.

Applications

DEVICE CHARACTERIZATION

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

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POWER SUPPLY DESIGN

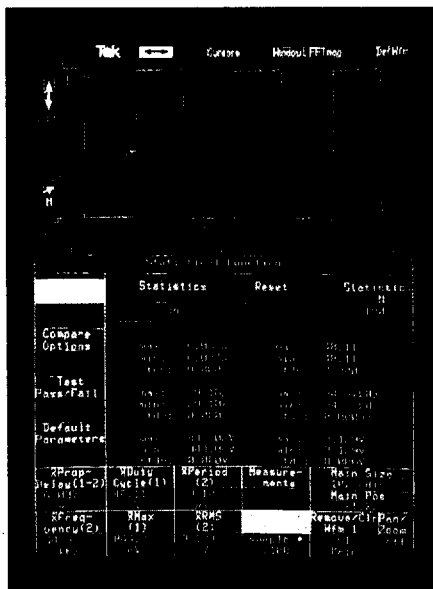
The 11403A with 11000 Series plug-ins provides AC coupling, fast overdrive recovery, high vertical resolution, and one-touch measurements, making this combination an ideal tool for power supply design. 11000 Series plug-in amplifiers have a wide range of calibrated offset and are unsurpassed in their ability to recover quickly from up to 8000 divisions*1 of overdrive.

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

PRODUCTION TESTING

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

*1 With an 11A33.



STATISTICAL ANALYSIS

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

Characteristics

VERTICAL SYSTEM WITH ENHANCED ACCURACY:

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

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

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

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

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

Equivalent-Time Bandwidth – 3 GHz max determined by plug-in. See page 90.

HORIZONTAL SYSTEM

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

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

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

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

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

Main Record Positioning – The main record is positioned with respect to the main trigger point. Pre-trigger: One record duration. Post-trigger: One record duration. Resolution: One main record point.

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

Window Record Positioning – The window records are positioned relative to a window trigger point that 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 occurs only 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 – \pm Full Scale.

Main Trigger, Coupling and Sensitivity:

Jitter (Typical, CSA 404 only) – 10 ps RMS; 70 ps p-p.

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

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

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

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

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

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

Holdoff Range:

Main Record – Min: 490 ns; max: 10 s.

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

MEASUREMENT SYSTEM

Waveform Processing Functions:

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

Arithmetic Operators – Add, subtract, multiply, divide.

MEASUREMENT SET

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

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

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

FFT – Spectral frequency, spectral magnitude, THD (Total Harmonic Distortion).

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

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

INPUTS/OUTPUTS

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

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

CRT AND DISPLAY FEATURES

CRT – Magnetic deflection, vertical raster-scan orientation. 7.5 in. diagonal color CRT in 11403A and CSA 404.

Colors (11403A and CSA 404) –

Eight-color set; selectable from a palette of 262,144 colors.

Video Resolution – 552 horizontal by 704 vertical displayed pixels.

ENVIRONMENTAL AND SAFETY

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

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

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

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

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

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

*¹ At minimum holdoff setting.

*² CSA 404 and 11403A option 1S only.

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PHYSICAL CHARACTERISTICS

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



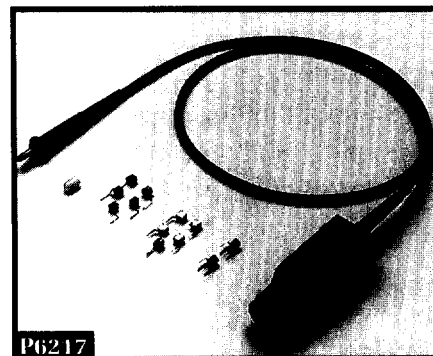
Accessory

K465

Instrument Cart

- Ergonomic design
- Simple height, angle, and shelf adjustments
- Durable steel and aluminum construction
- Large diameter smooth rolling casters
- Nylon safety straps included

For complete selection information on all Accessory products, see page 446.



P6217



Accessory

P6217 FET PROBE

Maximize Your Signal Acquisition Performance

- Wide Bandwidth (DC to >4 GHz)
- Minimal DUT Loading
<0.4 pF capacitive/>100 k Ω resistive
- Requires no additional cables or power supplies
- Smaller size than traditional active FET Probes

For complete selection information on all Accessory products, see page 446.

ORDERING INFORMATION

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1-GHz Color Digitizing Oscilloscope.....\$19,950

Includes: Tutorial (070-8190-00); User Reference (070-8191-00); Programmer Reference (070-8192-00); Quick Reference (070-8193-00); Service Reference (070-8194-00); Power Cord, U.S. 120 V (161-0066-00).

Opt. 1C – Cable Feedthrough+\$300

Opt. 1R – Rackmount Kit.....+\$250

Opt. 1S – Data Base Measurements.....+\$1,500

Opt. 2D – Expanded Memory.....+\$1,000

Opt. 4D – High-speed GPIB.....+\$400

INTERNATIONAL POWER PLUG OPTIONS

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

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

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

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

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

See General Customer Information Section for additional description.

RECOMMENDED ACCESSORIES

See page 446 for complete selection information.

CART

Instrument Tower. Order K465.....\$835

Power Strip – Four Outlet, 6 ft., Noise/Surge Suppression.

Order 131-5342-01\$48

Cables – GPIB, 2 m. Order 012-0991-00.....\$195

RS-232-C, 10 ft. Order 012-0911-00.....\$100

Centronics, 10 ft. Order 012-1233-00.....\$180

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

CAMERA/PLOTTER

Camera – Order C9 with Opt.11\$695

Four-color Pen Plotter – Order HC100, Opt. 01.....\$1,380

Product(s) available through your local Tektronix representative (listed in the back of this catalog) or call 1-800-426-2200.



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ISO 9001

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