DEBUG IN HIGH DEFINITION

HDO9000

1 GHz – 4 GHz Oscilloscopes

HD 1024

HD1024 Technology	The HDO9000 with **HD1024 Technology** provides
Superior User Experience	exceptional signal fidelity with 10-bit resolution
Powerful, Deep Toolbox	and a superior oscilloscope experience
Exceptional Serial Data Tools	to deliver faster time to insight.

teledynelecroy.com/hdo9000

High Definition Oscilloscopes with HD Technology have a variety of benefits that allow the user to debug in high definition. Waveforms displayed by High Definition Oscilloscopes are cleaner and crisper. More signal details can be seen and measured; these measurements are made with unmatched precision resulting in better test results and shorter debug time.

A critical element of the HDO9000 is HD1024 technology, which provides 10 bits of vertical resolution with 4 GHz bandwidth. As with all members of Teledyne LeCroy's HDO family, the HDO9000 utilizes an exceptionally low-noise system architecture that delivers outstanding effective number of bits (ENOB).

Dynamic ADC Reconfiguration

HD1024 technology enables dynamic reconfiguration of the ADC to achieve 10 bits of vertical resolution. By automatically determining the best ADC configuration under each specific measurement condition, the HDO9000 always provides the optimal resolution. The ADC can be set to 8, 9, or 10 bit configurations.

HD Summary

The HDO9000 conveniently displays an overview of the HD1024 operation which can be accessed via the HD descriptor box.

Optimized Filtering

HD1024 high definition technology makes use of optimized filtering to provide additional resolution beyond 10-bits; extending up to 13.8 bits. When operating in low sample rate conditions, an anti-aliasing filter is automatically applied to reduce excess out-of-band noise. Additionally, resolution can be improved by applying a manual bandwidth limit on an individual channel.

	HDO4000	HDO6000	HDO8000	HDO9000
HD Technology	HD4096 12 bits	HD4096 12 bits	HD4096 12 bits	HD1024 10 bits
Bandwidth	200 MHz - 1 GHz	350 MHz - 1 GHz	350 MHz - 1 GHz	1 GHz - 4 GHz
Input Channels	2, 4	4	8	4
Sample Rate	2.5 GS/s	2.5 GS/s	2.5 GS/s	40 GS/s
Analysis Capability	Basic	Advanced	Advanced	Exceptional

HD4096 high definition technology consists of high sample rate 12-bit ADCs, high signal-to-noise ratio amplifiers and a low-noise system architecture. This technology enables High Definition Oscilloscopes to capture and display signals of up to 1 GHz with high sample rate and 16 times more resolution than other oscilloscopes.
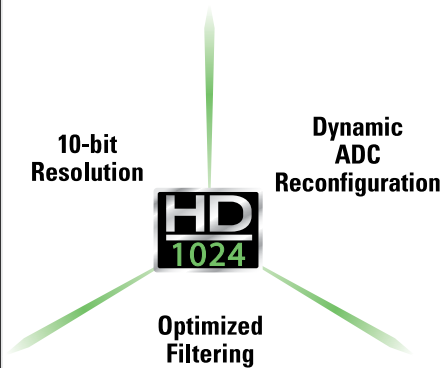
DEBUG IN HIGH DEFINITION

HDO9000

HD1024
High Definition Technology

10-bit Resolution

Dynamic ADC Reconfiguration

HD 1024

Optimized Filtering

HD1024 technology enables 10 bits of vertical resolution with 4 GHz bandwidth

- Clean, Crisp Waveforms
- More Signal Details
- Unmatched Measurement Precision

Deep Toolbox

OBSESSED WITH TOOLS

HDO9000 has the greatest breadth and depth of tools, ensuring quick resolution of the most complicated debug tasks.

Color Overlays

Jitter Track

Jitter Spectrum

WaveScan

Drag and Drop

All Instance

The HDO9000 with **HD1024 Technology** provides **exceptional signal fidelity** with 10-bit resolution and a **superior oscilloscope experience** to deliver **faster time to insight.**

1	HD1024 Technology
2	Superior User Experience
3	Powerful, Deep Toolbox
4	Exceptional Serial Data Tools

Faster Time to Insight

Insight alone is not enough.

Markets and **technologies** change too rapidly.

The **timing** of **critical design decisions** is significant.

Faster Time to Insight is what matters.

TIME TO **INSIGHT**™

MAUI – SUPERIOR USER EXPERIENCE

MAUI – Most Advanced User Interface was developed to put all the power and capabilities of the modern oscilloscope right at your fingertips. Designed for touch; all important oscilloscope controls are accessed through the intuitive touch screen. Built for simplicity; time saving shortcuts and intuitive dialogs simplify setup. Made to solve; a deep set of debug and analysis tools helps identify problems and find solutions quickly.

Designed for Touch

MAUI is designed for touch. Operate the oscilloscope just like a phone or tablet with the most unique touch screen features on any oscilloscope. All important controls are always one touch away. Touch the waveform to position or zoom in for more details using intuitive actions.

Built for Simplicity

MAUI is built for simplicity. Basic waveform viewing and measurement tools as well as advanced math and analysis capabilities are seamlessly integrated in a single user interface. Time saving shortcuts and intuitive dialogs simplify setup and shorten debug time.

Made to Solve

MAUI is made to solve. A deep set of integrated debug and analysis tools help identify problems and find solutions quickly. Unsurpassed integration provides critical flexibility when debugging. Solve problems fast with powerful analysis tools.

MAUI with OneTouch

MAUI with OneTouch introduces a new paradigm for oscilloscope user experience. Dramatically reduce setup time with revolutionary drag and drop actions to copy and setup channels, math functions, and measurement parameters without lifting a finger. Use common gestures like drag, drop, and flick to instinctively interact with the oscilloscope. Quickly enable a new channel, math or measurement using the "Add New" button and simply turn off any trace or parameter with a flick of the finger. These OneTouch innovations provide unsurpassed efficiency in oscilloscope operation.

● MAUI   ● Unique to OneTouch
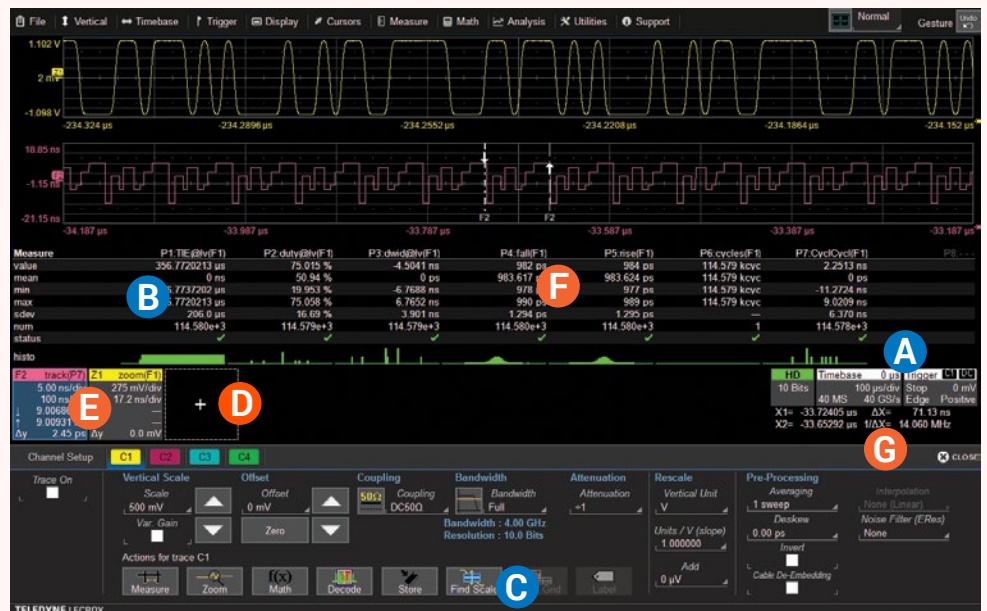
A Channel, timebase, and trigger descriptors provide easy access to controls without navigating menus.

B Configure parameters by touching measurement results.

C Shortcuts to commonly used functions are displayed at the bottom of the channel, math and memory menus.

D Use the "Add New" button for one-touch trace creation.

E Drag to change source, copy setup, turn on new trace, or move waveform location.

F Drag to copy measurement parameters to streamline setup process.

G Drag to quickly position cursors on a trace.

Periodic Table of Oscilloscope Tools categories:

Capture	View	Measure	Math	Analyze	Document

Column headers: Triggering · Acquire · Display Grids · Display Views · Zooming · Parameters · Parameter Analysis · Functions · Advanced Functions · Pass/Fail · Anomaly Detection · Serial Decode · Serial Message Analysis · Clock & Timing Jitter · Serial Data Jitter · Serial Data Analysis · Application Packages · Document

KEY

Element:
- Number
- Category
- MAUI Icon
- Name
- 106 Crosstalk Analysis

▲ Invented by LeCroy
★ Unique to LeCroy

Our Heritage

Teledyne LeCroy's 50+ year heritage has its origins in the high-speed collection of data in the field of high-energy physics, and the processing of long records to extract meaningful insight. We didn't invent the oscilloscope, but we did invent the digital oscilloscope, which can take full advantage of advanced digital signal processing and waveshape analysis tools to provide unparalleled insight.

Our Obsession

Our developers are true to our heritage – they are more obsessed with making better and smarter tools than anybody else. Our tools and operating philosophy are standardized across much of our product line for a consistent user experience. Our mission is to help you use these tools to understand problems, including the ones you don't even know you have. Our deep toolbox inspires insight; and your moment of insight is our reward.

Our Invitation

Our Periodic Table of Oscilloscope Tools provides a framework to understand the toolsets that Teledyne LeCroy has created and deployed in our oscilloscopes. Visit our interactive website to learn more about what we offer and how we can help you develop and debug more efficiently.

teledynelecroy.com/tools

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HDO9000 High Definition Oscilloscopes leverage HD1024 technology to deliver 10 bits of resolution up to 4 GHz of bandwidth. HD1024 technology ensures that optimal resolution is always provided under each measurement condition for exceptional signal fidelity. The integration of a large, bright 15.4" capacitive touch screen and the MAUI with OneTouch user interface results in an unsurpassed user experience. Equipped with a 40 GS/s sample rate and an extensive toolbox the HDO9000 debugs in high definition to provide uncompromised measurement performance.

Key Features

10 bit resolution; up to 13.8 bits with Optimized Filtering

1 GHz - 4 GHz bandwidths

Up to 40 GS/s sample rate

15.4" capacitive touch screen

MAUI with OneTouch
- Designed for touch
- Built for simplicity
- Made to solve

Advanced Tools
- Jitter and Timing Analysis Capabilities
- WaveScan – Search and Find
- LabNotebook Documentation and Report Generation
- History Mode - Waveform Playback

Optional Software Packages
- Advanced Customization
- Digital Filtering
- Spectrum Analysis
- Device and Switching Power Supply Analysis
- Comprehensive set of serial data analysis, debug, validation and compliance tools

16 digital channels with 1.25 GS/s
- Analog and Digital Cross-Pattern Triggering
- Digital Pattern Search and Find
- Analog and Digital Timing Measurements
- Logic Gate Emulation
- Activity Indicators

HD1024 Technology

HD1024 high definition technology enables 10 bits of vertical resolution with 4 GHz bandwidth. The HDO9000 automatically and dynamically determines the best ADC configuration under each specific measurement condition to always provide the optimal resolution.

Powerful, Deep Toolbox

The standard collection of math, measurement, debug, and documentation tools provides unsurpassed analysis capabilities. Application-specific packages enable streamlined debugging for common design/validation scenarios. The advanced customization option (XDEV) enables user-defined parameters and math functions providing unique and limitless analysis capability.

15.4" Capacitive Touch Screen

The HDO9000 and MAUI with OneTouch allows users to perform all common operations with a single touch of the display, optimizing for convenience and efficiency. Meanwhile, the 15.4" high resolution capacitive touch screen's bright display and quick responsiveness further enhances the inherent efficiency and intuitiveness of MAUI with OneTouch.

Exceptional Serial Data Tools

A wide a variety of application packages are available to meet all serial data test challenges, ranging from automated compliance packages to flexible debug toolkits. A suite of protocol specific measurement and eye diagram packages are available to complement the industry's most intuitive trigger and decode packages.

Key Attributes

1. 15.4" high resolution WXGA capacitive touch screen display

2. MAUI with OneTouch user interface optimized for convenience and efficiency

3. "Add New" button for fast waveform creation

4. HD1024 technology provides 10-bit resolution up to 4 GHz

5. Serial trigger captures signals up to 3 Gb/s

6. "Push" Knobs – All knobs have push functionality that provide shortcuts to common actions such as Set to Variable, Find Trigger Level, Zero Offset, and Zero Delay

7. Waveform Control Knobs – Control channel, zoom, math and memory traces with the multiplexed vertical and horizontal knobs

8. Dedicated Cursor Knob – Select type of cursor, position them on your signal, and read values without ever opening a menu

9. Dedicated buttons to quickly access popular debug tools.

10. Mixed Signal Capability - Debug complex embedded designs with integrated 16 channel mixed signal capability

11. Reference Clock Input/Output connectors for connecting to other equipment

12. Easy connectivity with four USB 3.1 ports and three USB 2.0 ports

13. USBTMC (Test and Measurement Class) over USB 3.1 for fast data offload

The HDO9000 High Definition Oscilloscopes offer powerful mixed signal solutions that combine high definition analog channels with the flexibility of digital inputs. The HDO9000-MS models are equipped with an integrated 16 digital channels and a 1.25 GS/s sampling rate which creates an all-in-one debug machine.

Integrated 16-Channel Mixed Signal Capability

With embedded systems growing more complex, powerful mixed signal debug capabilities are an essential part of modern oscilloscopes. The 16 integrated digital channels and set of tools designed to view, measure and analyze analog and digital signals enable fast debugging of mixed signal designs.

Advanced Digital Debug Tools

Using the powerful parallel pattern search capability of WaveScan, patterns across many digital lines can be isolated and analyzed. Identified patterns are presented in a table with timestamp information and enables quick searching for each pattern occurrence.

Use a variety of the many timing parameters to measure and analyze the characteristics of digital busses. Powerful tools like tracks, trends, statistics and histicons provide additional insight and help find anomalies.

Quickly see the state of all the digital lines at the same time using convenient activity indicators.

Simulate complete digital designs using logic gate emulation. When used with the web editor, many logic gates can be combined together in one math function to simulate complex logic designs. Choose from AND, OR, NAND, NOR, XOR, NOT and D Flip Flop gates.

Extensive Triggering

Flexible analog and digital cross-pattern triggering across all 20 channels provides the ability to quickly identify and isolate problems in an embedded system. Event triggering can be configured to arm on an analog signal and trigger on a digital pattern.
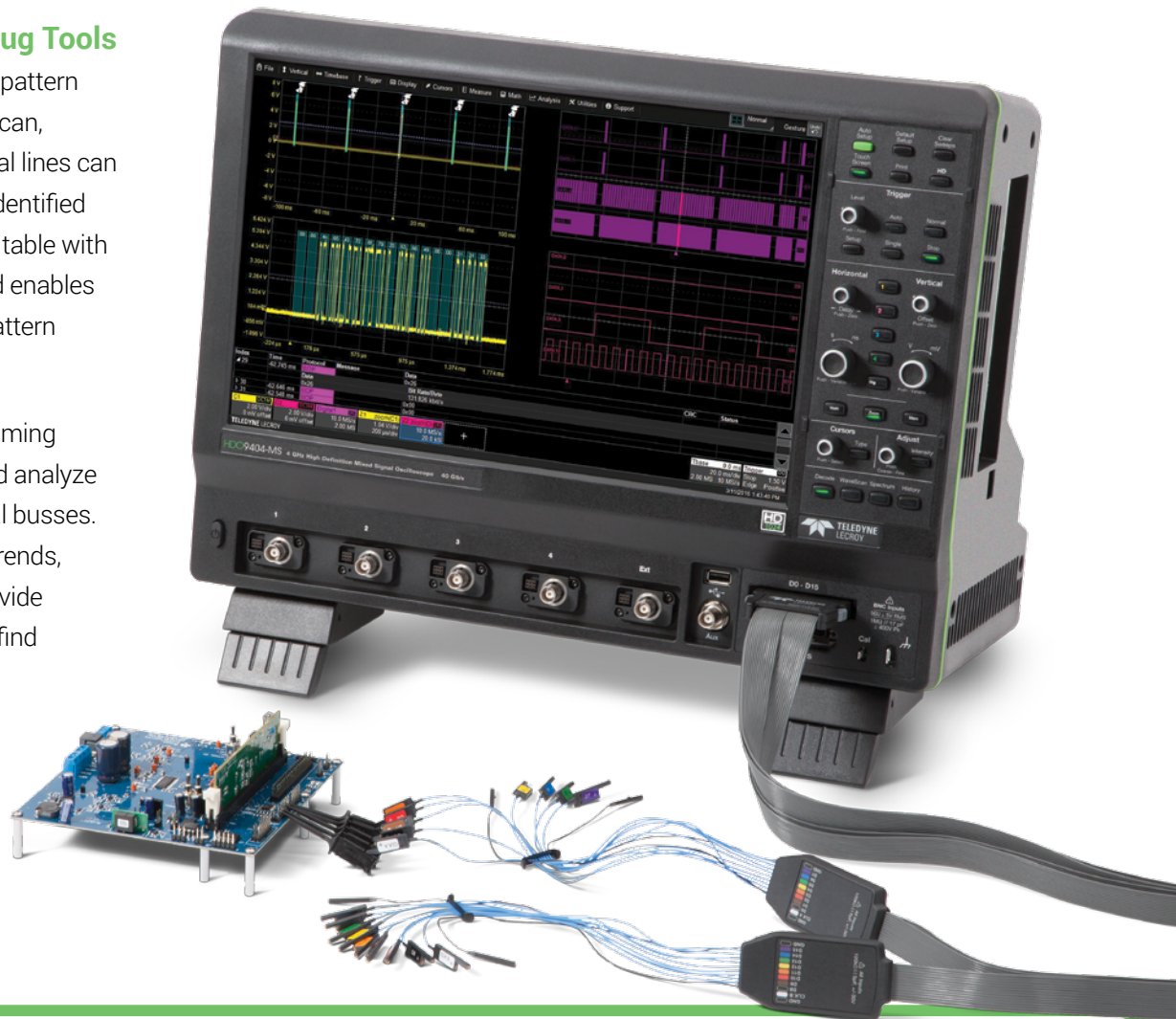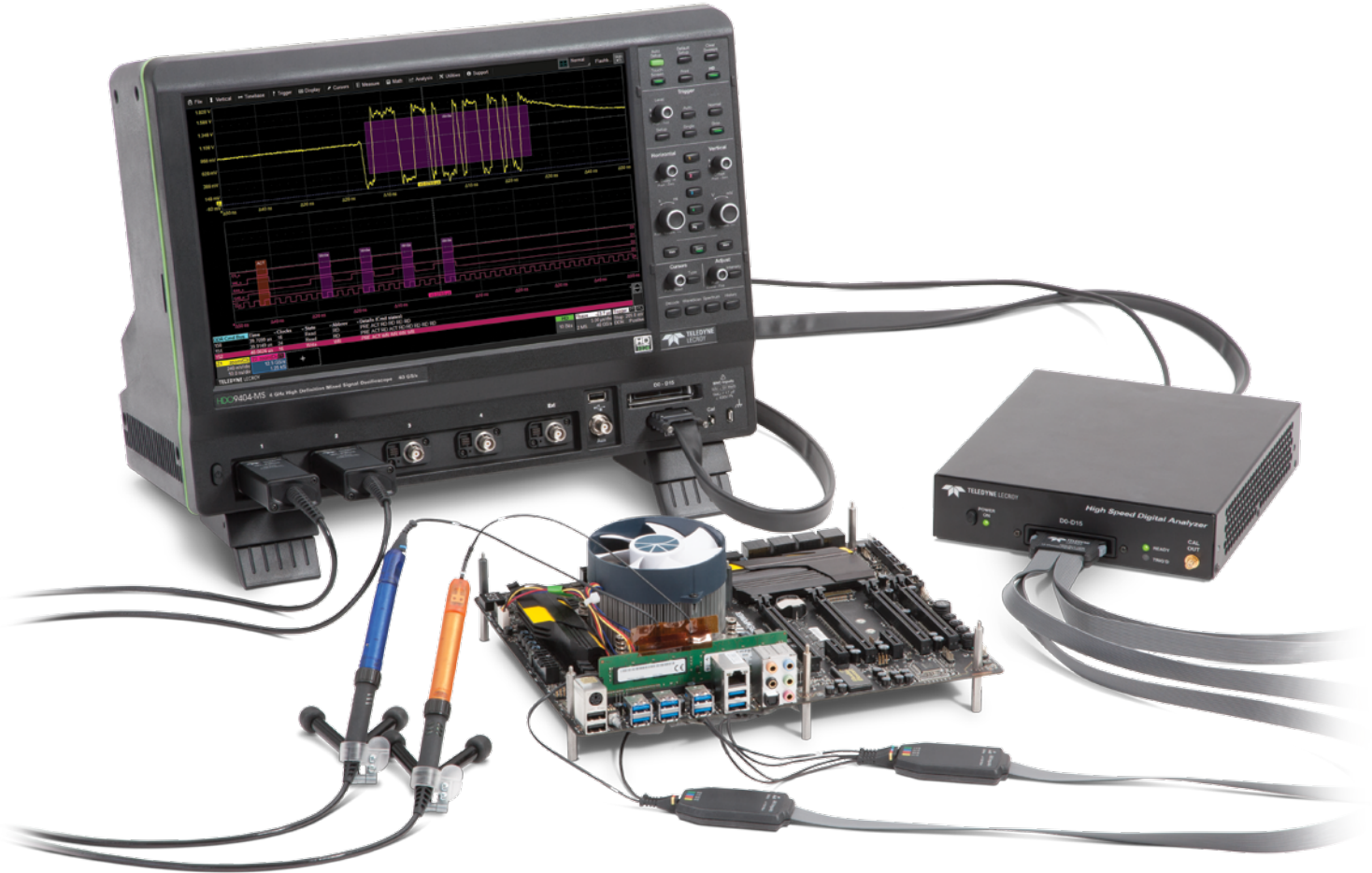
For applications demanding even higher-performance mixed-signal acquisition capabilities, the HDA125 High-speed Digital Analyzer can be easily added to the HDO9000. With 12.5 GS/s digital sampling rate on 18 input channels and the revolutionary QuickLink probing solution, validation of challenging interfaces such as DDR memory has never been simpler or more comprehensive.

Ultimate Mixed-signal Performance

With industry-leading sensitivity and a sample time of 80 ps per point, the HDA125 can accurately acquire and display digital signals up to 6 Gb/s. Combined with superior probe tip impedance (110 kΩ, 0.12pF differential), for minimal signal loading, the result is the highest-fidelity digital signal acquisition system available.

Unique Probing Solution

One of the most challenging aspects of high-speed embedded test is simply getting the signals from the system under test to the instrumentation with sufficient fidelity. The HDA125 is built around Teledyne LeCroy's revolutionary QuickLink probing concept - enabling high signal quality, easy access to remote test points, and simple transitions from digital to analog probing.

Enhanced DDR Debug

Teledyne LeCroy already offers the industry's only dedicated DDR Debug Toolkit, designed to simplify challenging memory interface validation. Adding the HDA125 allows the DDR command bus to be directly acquired and integrated into the analysis, enabling advanced command triggering and sophisticated, searchable bus state viewing.

Serial Trigger, Decode, Measure/Graph, and Eye Diagrams

Isolate events using the serial bus trigger and view color-coded protocol information on top of analog or digital waveforms. Timing and bus measurements allow quick and easy characterization of a serial data system. Serial (digital) data can be extracted and graphed to monitor system performance over time. Identify physical layer anomalies with eye diagram mask testing and mask failure locator.

WaveScan Advanced Search and Find Tool

Quickly scan analog, digital or parallel bus signals for runts, glitches or other anomalies with WaveScan.

Jitter and Timing Analysis

Understand system jitter performance of clock and data signals. Enable histograms, tracks, and spectrum plots to visualize the data.

Spectrum Analyzer Mode

View signal details in the frequency domain with a spectrum analyzer style user interface.

Sequence Mode Acquisition

Capture many fast pulses in quick succession or events separated by long periods of time.

History Mode Waveform Playback

Scroll back in time to isolate anomalies that have previously been captured to quickly find the source of the problem.

LabNotebook Documentation and Report Generation Tool

Save all results and data with a single button press and create custom reports with LabNotebook.

Use two independent input settings and frequency ranges for advanced spectrum analysis.

Spectrum Analyzer Option (HDO9K-SPECTRUM)

The Spectrum Analyzer mode provides a spectrum analyzer style user interface with controls for start/stop frequency or center frequency and span. The resolution bandwidth is automatically set for best analysis or can be manually selected. Vertical Scale can be selected in the desired units and the unique peak search automatically labels spectral components and presents frequency and level in an interactive table. To monitor how the spectrum changes over time, view the spectrogram which can display a 2D or 3D history of the frequency content.

Power Analyzer Software Option (HDO9K-PWR)

Quickly measure and analyze operating characteristics of power conversion circuits. Make automatic switching device measurements and identify areas of loss and conduction with color-coded overlay. Control loop modulation analysis and line power harmonic testing are all simplified with a dedicated user interface.

Digital Filter Software Option (HDO9K-DFP2)

DFP2 lets you implement Finite Impulse Response (FIR) or Infinite Impulse Response (IIR) filters to eliminate undesired spectral components, such as noise, and enhances your ability to examine important signal components. You can choose from a standard set of FIR or IIR filters or you can also design your own custom filters. Create and apply a variety of FIR and IIR digital filters to your capture waveforms or processed traces.
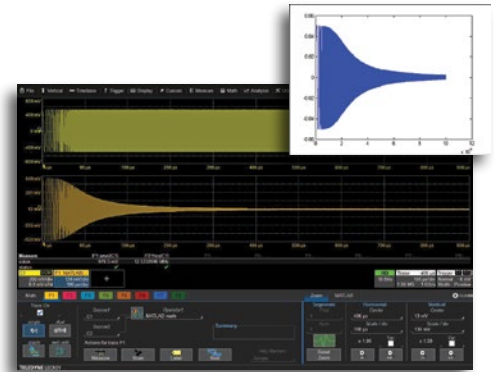
XDEV Advanced Customization Option (HDO9K-XDEV)

With the XDEV option, third party programs can be completely integrated into the oscilloscope's processing stream. Create customized math functions and parameters using C/C++, MATLAB, Excel, JScript or Visual Basic without ever leaving the oscilloscope application - and view the results directly on the oscilloscope, in real-time.

WaveScan Advanced Search

WaveScan provides powerful isolation capabilities that hardware triggers can't provide. WaveScan allows searching analog, digital or parallel bus signal in a single acquisition using more than 20 different criteria. Or, set up a scan condition and scan for an event over hours or even days.

Since the scanning "modes" are not simply copies of the hardware triggers, the utility and capability is much higher. For instance, there is no "frequency" trigger in any oscilloscope, yet WaveScan allows for "frequency" to be quickly "scanned." This allows the user to accumulate a data set of unusual events that are separated by hours or days, enabling faster debugging.

When used in multiple acquisitions, WaveScan builds on the traditional Teledyne LeCroy strength of fast processing of data. Quickly scan millions of events looking for unusual occurrences, and do it much faster and

more efficiently than other oscilloscopes can. Found events can be overlaid with the ScanOverlay to provide a quick comparison of events; measurement based scans populate the ScanHistogram to show the statistical distribution of the events.

Additionally, digital lines can be used as inputs into WaveScan to isolate and analyze patterns using the powerful parallel pattern search capability. Identified patterns are presented in a table with timestamp information and enables quick searching for each pattern occurrence.

Advanced Waveform Capture with Sequence Mode

Use Sequence mode to store up to 15,000 triggered events as "segments" into memory. This can be ideal when capturing many fast pulses in quick succession or when capturing events separated by long time periods, such as bursted serial data packets. Sequence mode provides timestamps for each acquisition and minimizes dead-time between triggers to less than 1 µs. Combine Sequence mode with serial triggers and decode to optimize the oscilloscope's memory usage.

Advanced Math and Measure

With many math functions and measurement parameters available, the HDO9000 can measure and analyze every aspect of analog and digital waveforms. Beyond just measuring waveforms, the HDO9000 provides statistics, histicons, tracks and trends to show how waveforms change over time. Measurements and math functions can be quickly copy and setup using MAUI with OneTouch.

History Mode Waveform Playback

Scroll back in time using History Mode to view previous waveforms and isolate anomalies. Use cursors and measurement parameters to quickly find the source of problems. History mode is always available with a single button press, no need to enable this mode and never miss a waveform.

Go Back in Time to Identify the Source of a Problem
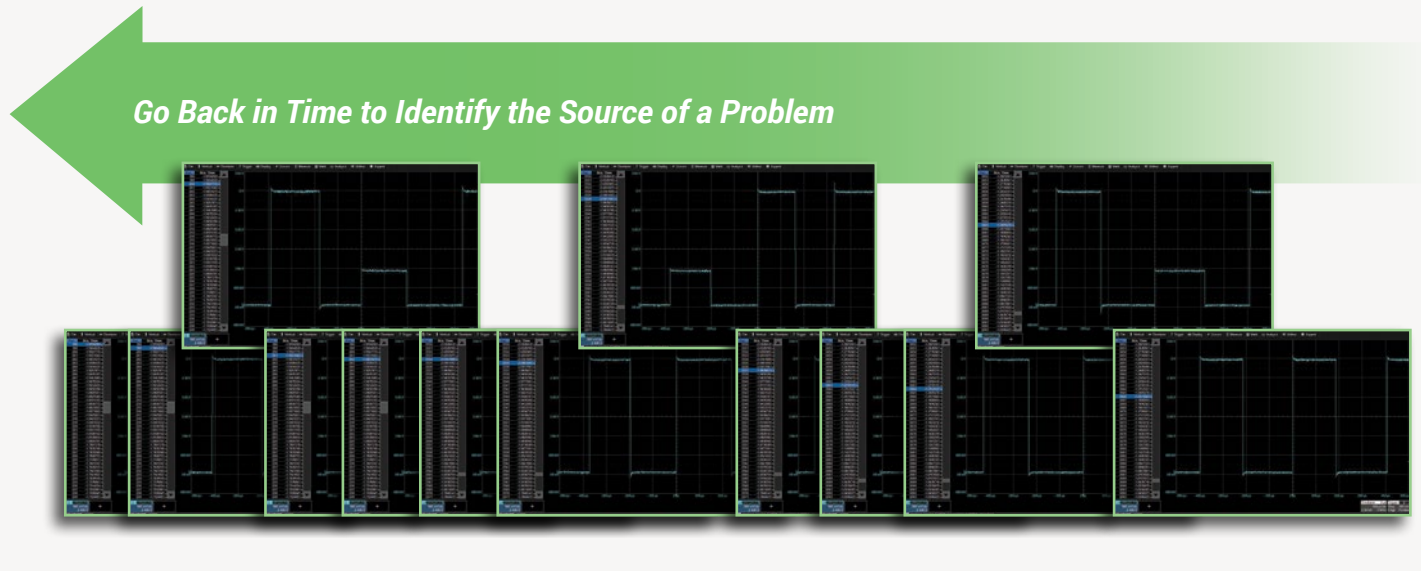
LabNotebook

The LabNotebook feature of HDO9000 is the ideal documentation tool. LabNotebook automatically saves all displayed waveforms, oscilloscope setup file, and a screen with a single button press, eliminating the need to navigate multiple menus to save all these files independently. Report files can be annotated and shared with colleagues to fully document all results. Easily recreate experiments and compare tests results amongst colleagues across the world by recalling LabNotebook files back onto the oscilloscope or view on a PC using WaveStudio.
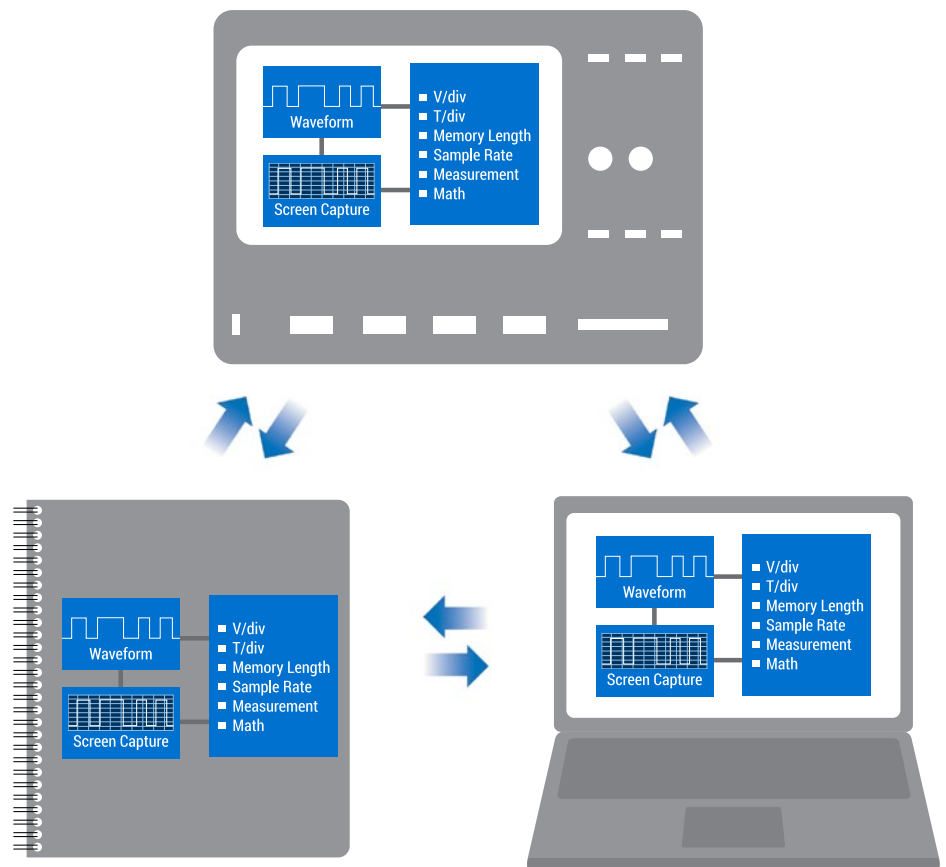
The HDO9000 features the widest range and most complete serial data debug and validation solutions.
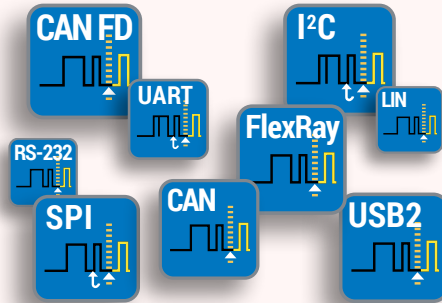
- Triggering
- Decoding
- Measurement and Graphing
- Eye Diagram and Physical Layer Analysis

Various compliance test, synchronized protocol decode views, and other advanced jitter analysis tools are also available.

Solutions address the following markets and applications:

- Embedded Computing
- Automotive
- Industrial
- Military and Avionics
- Peripherals
- Memory
- Handset/Mobile/Cellular
- High Speed Computing
- Data Storage
- Serial Digital Audio

Trigger

Powerful, flexible triggers designed by people who know the standards, with the unique capabilities you want to isolate unusual events. Conditional data triggering permits maximum flexibility and highly adaptable error frame triggering is available to isolate error conditions. Efficiently acquire bursted data using Sequence Mode to maximize the oscilloscope's memory usage. Sequence Mode enables the oscilloscope to ignore idle time and acquire only data of interest.

Decode

Decoded protocol information is color-coded to specific portions of the serial data waveform and transparently overlaid for an intuitive, easy-to-understand visual record. All decoded protocols are displayed in a single time-interleaved table. Touch a row in the interactive table to quickly zoom to a packet of interest and select a column header to create filter criteria, as is commonly done in spreadsheets. Easily search through long records for specific protocol events using the built-in search feature.
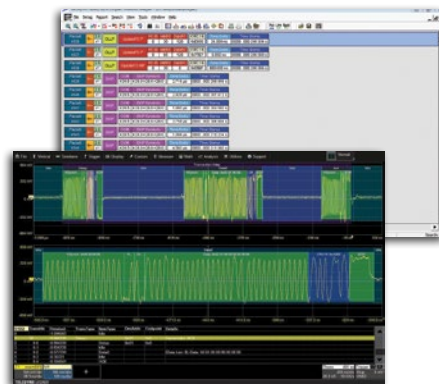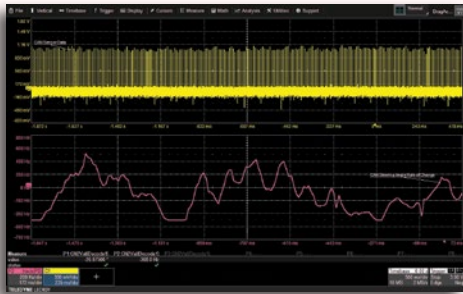

ProtoSync

ProtoSync combines the oscilloscope view with a simultaneous view of data link layer decodes on the same instrument. This combination makes ProtoSync very effective in debugging protocol-specific negotiation rates.

Compatible with PCI Express, USB 2.0, USB2-HSIC, SAS, SATA, and Fibre Channel.

M E

Measure/Graph

Quickly validate cause and effect with automated timing measurements to or from an analog signal or another serial message. Make multiple measurements in a single long acquisition to quickly acquire statistics during corner-case testing. Serial (digital) data can be extracted to an analog value and graphed to monitor system performance over time, as if it was probed directly. Complete validation faster and gain better insight.
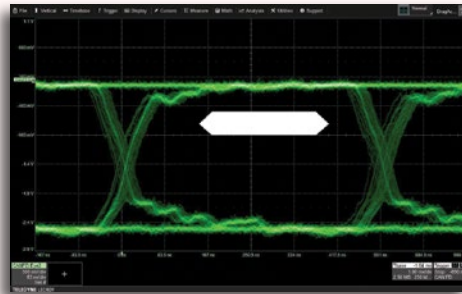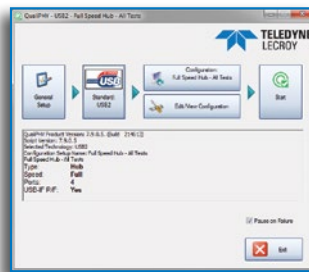
Eye Diagram

Rapidly display an eye diagram of your packetized low-speed serial data signal without additional setup time. Use eye parameters to quantify system performance and apply a standard or custom mask to identify anomalies. Mask failures can be indicated and can force the scope into Stop mode.

SDAII or DDR Debug (optional) create eye diagrams of streaming NRZ serial data or DDR signals, and measure and analyze jitter breakdown.

QualiPHY / Compliance

Compliance testing is a critical part of the design cycle in order to ensure that requirements are met. The QualiPHY framework provides an automated and easy-to-use compliance testing platform for a number of serial data standards.

QualiPHY™

HDO9000 Serial Data Protocol Support		Trigger	Decode	Measure/Graph	Eye Diagram	ProtoSync	QualiPHY
Embedded Computing	I^{2}C	•	•	•	•		
	SPI	•	•	•	•		
	UART-RS232	•	•	•	•		
	USB2-HSIC		•				
Automotive + Industrial	CAN	•	•	•	•		
	CAN FD	•	•	•	•		
	FlexRay	•	•	•	•		
	LIN	•	•	•	•		
	SENT		•				
	MOST50/150						•
	BroadR-Reach						•
Avionics	ARINC429		•	•	•		
	MIL-STD-1553	•	•	•	•		
	SPACEWIRE		•				
High Speed Computing, Storage +Peripherals	Ethernet (10/100Base-T)		•				•
	Ethernet (1000Base-T)						•
	USB 2.0	•	•	•	•	•	•
	8b/10b	•	•		•		
	Fibre Channel		•				
	SATA (1.5 & 3 Gb/s)	•	•		•		
	SAS (1.5 & 3 Gb/s)		•		•		
	PCI Express (Gen1)		•		•		
Memory	LPDDR2				•		•
	DDR2				•		•
	DDR3				•		•
MIPI	D-PHY/CSI-2/DSI		•		•		•
	DigRF3G		•	•			
	DigRFv4		•	•			
	UniPro		•				
	M-PHY		•		•		
Other	Audio (I²S, LJ, RJ, TDM)	•	•	•			
	Manchester		•				
	NRZ	•	•		•		

SDA II – Advanced Tools to Isolate and Analyze (HDO9K-SDAII)

Unleash the power of serial data analysis for understanding and characterizing a design, proving compliance, and understanding why a device or host fails compliance. The SDAII architecture provides fast updates and eye diagram creation. Combined with up to 128 Mpts record lengths and more complete jitter decomposition tools, SDA II provides a fast and complete understanding of why serial data fails a compliance test. Whether debugging eye pattern or other compliance test failures, the HDO9000 Oscilloscopes rapidly isolate the source of the problem.
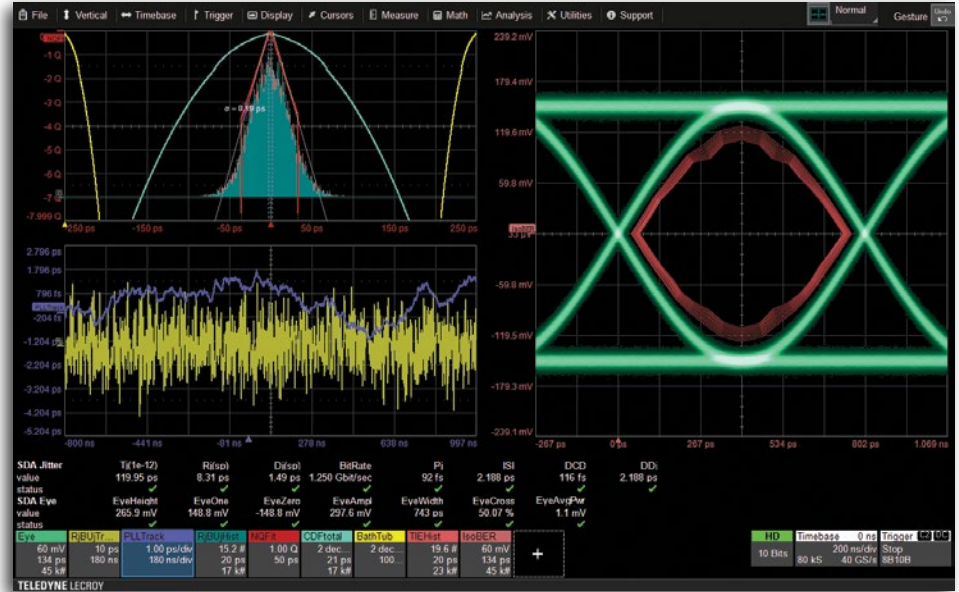
Advanced jitter decomposition methodologies and tools provide more information about root cause. Tj Analysis, RjBUj Analysis and DDj

Analysis are made simple with the deepest toolset dedicated to providing the highest level of insight into your serial data signals.

QualiPHY

QualiPHY is designed to reduce the time, effort, and specialized knowledge needed to perform compliance testing on high-speed serial buses.

- Guides the user through each test setup

- Performs each measurement in accordance with the relevant test procedure

- Compares each measured value with the applicable specification limits

- Fully documents all results

- QualiPHY helps the user perform testing the right way — every time

Supported Standards:
  - ENET
  - USB
  - DDR2, DDR3, LPDDR2
  - MIPI-DPHY
  - BroadR-Reach
  - MOST50, MOST150

Compliance Reports contain all of the tested values, the specific test limits and screen captures. Compliance Reports can be created as HTML, PDF or XML.
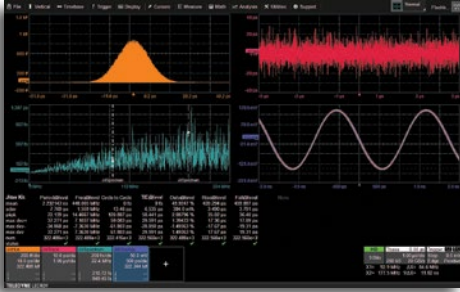
Jitter and Timing Analysis Option (HDO9K-JITKIT)

JITKIT makes it simple and easy to understand the basic system jitter performance of clock signals and clock-data activities, including period, half period, cycle-cycle, skew, amplitude, differential voltage crossing, slew rate, and a wide variety of other common jitter measurements.
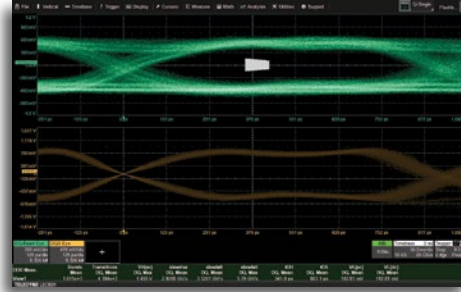
DDR Debug Toolkit (HDO9K-DDR3-Toolkit)

The DDR Debug Toolkit provides test, debug and analysis tools for the entire DDR design cycle. The unique DDR analysis capabilities provide automatic Read and Write burst separation, bursted data jitter analysis and DDR-specific measurement parameters. The HDO9000 supports both standard and custom speed grades of DDR2 and DDR3.

Before
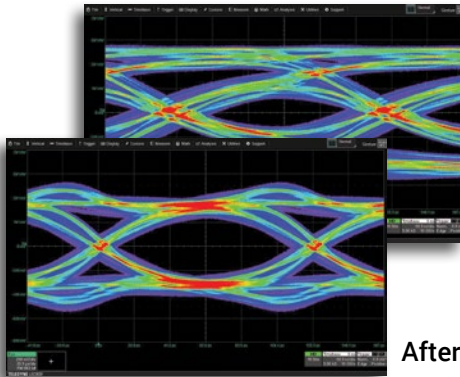
After

Eye Doctor II (HDO9K-EYEDRII)

The Eye Doctor II advanced signal integrity toolkit enables a complete set of channel emulation, de-embedding, and receiver equalization simulation tools. It provides capability to emulate a serial data link, de-embed or embed a fixture, cable or serial data channel, add or remove emphasis, and perform CTLE, FFE, or DFE equalization.

Q-Scape Multi-tab Display Architecture (HDO9K-Q-SCAPE)

Unique Q-Scape multitab display architecture speeds up your understanding of your design with 4x the display area. Acquired or calculated waveforms can be located on any of four different "tabbed" oscilloscope grid displays, with individually selectable grid styles available for each tab. Quickly move waveforms to different tabs through drag-and-drop.

Advanced Probe Interface

The advanced active probe interface gives tremendous flexibility for measuring high voltages, high frequencies, currents, or differential signals.

High Impedance Active Probes

High Bandwidth Differential Probes

High Voltage Differential Probes

High Voltage Passive Probes

Current Probes

SPECIFICATIONS

HD 1024

	HDO9104 HDO9104-MS	HDO9204 HDO9204-MS	HDO9304 HDO9304-MS	HDO9404 HDO9404-MS
Vertical - Analog Channels				
Analog Bandwidth @ 50 Ω (-3 dB)	1 GHz (≥ 2 mV/div)	2 GHz (≥ 5 mV/div)	3 GHz (≥ 5 mV/div)	4 GHz (≥ 5 mV/div)
Analog Bandwidth @ 1 MΩ (-3 dB) *	1 GHz (typical)	1 GHz (typical)	1 GHz (typical)	1 GHz (typical)
Rise Time (10−90%, 50 Ω)	415 ps (typical)	200 ps (typical)	134 ps (typical)	100 ps (typical)
Rise Time (20−80%, 50 Ω)	290 ps (typical)	146 ps (typical)	98 ps (typical)	75 ps (typical)
Input Channels	4			
Vertical Resolution	10 bits; up to 13.8 bits with Optimized Filtering			
Effective Number of Bits (ENOB) † **	7.9 bits	7.4 bits	7.0 bits	6.8 bits
Vertical Noise Floor (rms, 50 Ω) †				
1 mV/div	160 µV	160 µV	160 µV	160 µV
2 mV/div	160 µV	160 µV	160 µV	160 µV
5 mV/div	175 µV	225 µV	280 µV	317 µV
10 mV/div	184 µV	239 µV	295 µV	342 µV
20 mV/div	257 µV	351 µV	437 µV	509 µV
50 mV/div	435 µV	600 µV	743 µV	859 µV
100 mV/div	761 µV	1.05 mV	1.28 mV	1.48 mV
200 mV/div	2.73 mV	3.64 mV	4.53 mV	5.15 mV
500 mV/div	4.67 mV	5.98 mV	7.36 mV	8.37 mV
1 V/div	7.79 mV	10.8 mV	13.1 mV	14.9 mV
Sensitivity	**50 Ω**: 1 mV/div−1 V/div, fully variable; **1 MΩ**: 1 mV/div−10 V/div, fully variable			
DC Vertical Gain Accuracy (Gain Component of DC Accuracy)	±1% F.S. (typical), offset at 0 V			
Channel-Channel Isolation	> 100:1 up to rated BW (typical)		DC -2.5 GHz: >100:1; 2.5 GHz to rated BW: >30:1 (typical)	
Offset Range	**50 Ω:** **BWL ≤ 1 GHz** ±1.6 V @ 1 mV−4.95 mV/div, ±4 V @ 5 mV−9.9 mV/div, ±8 V @ 10 mV−19.8 mV/div, ±10 V @ 20 mV−1 V/div **BWL > 1 GHz** ±1.4 V @ 5 mV−100 mV/div, ±10 V @ 102 mV−1 V/div **1 MΩ:** ±1.6 V @ 1 mV−4.95 mV/div, ±4 V @ 5 mV−9.9 mV/div, ±8 V @ 10 mV−19.8 mV/div, ±16 V @ 20 mV−140 mV/div, ±80 V @ 142 mV−1.4 V/div, ±160 V @ 1.42 V−10 V/div			
DC Vertical Offset Accuracy	±(1.5% of offset setting +1% of full scale + 1 mV) (test limit)			
Maximum Input Voltage	**50 Ω**: 5 V$_{rms}$ ±10 V peak; **1 MΩ**: 400 V max. (DC + peak AC < 10 kHz)			
Input Coupling	1 MΩ: AC, DC, GND; 50 Ω: DC, GND			
Input Impedance	50 Ω ±2% or 1 MΩ ‖ 17pF, 10 MΩ ‖ 9.5 pF with supplied Probe			
Bandwidth Limiters	20 MHz, 200 MHz, 500 MHz	20 MHz, 200 MHz, 500 MHz, 1 GHz	20 MHz, 200 MHz, 500 MHz, 1 GHz, 2 GHz	20 MHz, 200 MHz, 500 MHz, 1 GHz, 2 GHz, 3 GHz

Horizontal - Analog Channels

Timebases	Internal timebase common to 4 input channels; an external clock may be applied at the EXT input

Time/Division Range	HD1024 on: 20 ps/div - 500 µs/div
	HD1024 off: 20 ps/div - 6.4 ks/div;
	     RIS available at ≤ 10 ns/div;
	     Roll Mode available at ≥ 100 ms/div and ≤ 5 MS/s

Clock Accuracy	≤ 1.5 ppm +(aging of 0.5 ppm/yr from last calibration)
Channel-Channel Deskew Range	±9 x time/div. setting, each channel
External Timebase Reference (Input)	10 MHz ±25 ppm
External Timebase Reference (Output)	10 MHz 3.5 dBm ±1 dBm, synchronized to reference being used by user (internal or external reference)
External Clock	DC to 100 MHz; (50 Ω/1 MΩ), Ext. BNC input, Minimum rise time and amplitude requirements apply at low frequencies

Acquisition - Analog Channels

Sample Rate (Single-Shot)	20 GS/s on 4 Ch; 40 GS/s on 2 Ch
Sample Rate (Repetitive)	200 GS/s for repetitive signals (20 ps/div to 10 ns/div)
Memory Length (4 Ch / 2 Ch) (Number of Segments)	64M / 128M (15,000)
Intersegment Time	1 µs
Averaging	Summed averaging to 1 million sweeps; continuous averaging to 1 million sweeps
Envelope (Extrema)	Envelope, floor, or roof for up to 1 million sweeps
Interpolation	Linear or Sin x/x (2 pt and 4 pt); automatically set when HD1024 is enabled

*   *When used with PP022 passive probe.*
** *Measured at half-bandwidth point, 100 mV/div, 90% full scale.*
†   *Measured with HD1024 enabled.*

| | HDO9104 | HDO9204 | HDO9304 | HDO9404 |
| | HDO9104-MS | HDO9204-MS | HDO9304-MS | HDO9404-MS |

Vertical, Horizontal, Acquisition - Digital Channels (-MS Models only)

Maximum Input Frequency	250 MHz
Minimum Detectable Pulse Width	2 ns
Input Dynamic Range	± 20V
Input Impedance (Flying Leads)	100 kΩ || 5 pF
Input Channels	16 Digital Channels
Maximum Input Voltage	±30V Peak
Minimum Input Voltage Swing	400mV
Threshold Groupings	Pod 2: D15 - D8, Pod 1: D7 - D0
Threshold Selections	TTL, ECL, CMOS (2.5 V, 3.3 V, 5 V), PECL, LVDS or User Defined
Threshold Accuracy	±(3% of threshold setting + 100mV)
User Defined Threshold Range	±10 V in 20 mV steps
User Defined Hysteresis Range	100 mV to 1.4 V in 100 mV steps
Sample Rate	1.25 GS/s
Record Length	128MS - 16 Channels
Channel-to-Channel Skew	350 ps

Triggering System

Modes	Normal, Auto, Single, and Stop
Sources	Any input channel, Ext, Ext/10, or line; slope and level unique to each source (except line trigger)
Coupling	DC, AC, HFRej, LFRej
Pre-trigger Delay	0 - 100% of memory size (adjustable in 1% increments or 100 ns)
Post-trigger Delay	0 - 10,000 divisions in real time mode, limited at slower time/div settings or in roll mode
Hold-off	From 2 ns up to 20 s or from 1 to 99,999,999 events
Internal Trigger Level Range	±4.1 div from center (typical)
External Trigger Level Range	Ext (±0.4 V); Ext/10 (±4 V)
Maximum Trigger Rate	1,000,000 waveforms/second (in Sequence Mode, up to 4 channels)

	HDO9104	HDO9204	HDO9304	HDO9404
Trigger Sensitivity with Edge Trigger (Ch 1−4)	2 div @ < 1 GHz 1.5 div @ < 500 MHz 1 div @ < 200 MHz 0.9 div @ < 10 MHz (DC, AC, and LFRej coupling)	2 div @ < 2 GHz 1.5 div @ < 1 GHz 1 div @ < 200 MHz 0.9 div @ < 10 MHz (DC, AC, and LFRej coupling)	2 div @ < 3 GHz 1.5 div @ < 1.5 GHz 1 div @ < 200 MHz 0.9 div @ < 10 MHz (DC, AC, and LFRej coupling)	2 div @ < 4 GHz 1.5 div @ < 2 GHz 1 div @ < 200 MHz 0.9 div @ < 10 MHz (DC, AC, and LFRej coupling)
External Trigger Sensitivity, (Edge Trigger)	2 div @ 1 GHz 1.5 div @ < 500 MHz 1 div @ < 200 MHz 0.9 div @ < 10 MHz (DC, AC, and LFRej coupling)			
Max. Trigger Frequency, SMART Trigger	1 GHz @ ≥ 10 mV/div (minimum triggerable width 750 ps)	2 GHz @ ≥ 10 mV/div (minimum triggerable width 400 ps)	2 GHz @ ≥ 10 mV/div (minimum triggerable width 270 ps)	2 GHz @ ≥ 10 mV/div (minimum triggerable width 200 ps)

Trigger Types

Edge	Triggers when signal meets slope (positive, negative, or either) and level condition
Width	Triggers on positive or negative glitches with widths selectable as low as 500 ps (depending on oscilloscope bandwidth) to 20 s, or on intermittent faults
Glitch	Triggers on positive or negative glitches with widths selectable as low as 200 ps (depending on oscilloscope bandwidth) to 20 s, or on intermittent faults
Window	Triggers when signal exits a window defined by adjustable thresholds
Pattern	Logic combination (AND, NAND, OR, NOR) of 5 inputs (4 channels and external trigger input. Each source can be high, low, or don't care. The High and Low level can be selected independently. Triggers at start or end of the pattern
TV-Composite Video	Triggers NTSC or PAL with selectable line and field; HDTV (720p, 1080i, 1080p) with selectable frame rate (50 or 60 Hz) and Line; or CUSTOM with selectable Fields (1−8), Lines (up to 2000), Frame Rates (25, 30, 50, or 60 Hz), Interlacing (1:1, 2:1, 4:1, 8:1), or Synch Pulse Slope (Positive or Negative)
Runt	Trigger on positive or negative runts defined by two voltage limits and two time limits. Select between 1 ns and 20 ns
Slew Rate	Trigger on edge rates. Select limits for dV, dt, and slope. Select edge limits between 1 ns and 20 ns
Interval	Triggers on intervals selectable between 1 ns and 20 s
Dropout	Triggers if signal drops out for longer than selected time between 1 ns and 20 s
Exclusion Triggering	Trigger on intermittent faults by specifying the expected behavior and triggering when that condition is not met
Measurement Trigger	Trigger on measurement values, Edge, Serial Pattern, Bus Pattern, Non-monotonic
Multi-stage: Qualified	Triggers on any input source only if a defined state or edge occurred on another input source. Delay between sources is selectable by time or events
Multi-stage: Qualified First	In Sequence acquisition mode, triggers repeatably on event B only if a defined pattern, state, or edge (event A) is satisfied in the first segment of the acquisition. Holdoff between sources is selectable by time or events
Multi-stage: Cascade (Sequence) Trigger, Capability	Arm on "A" event, then Trigger on "B" event. Or Arm on "A" event, then Qualify on "B" event, and Trigger on "C" event.

	HDO9104 HDO9104-MS	HDO9204 HDO9204-MS	HDO9304 HDO9304-MS	HDO9404 HDO9404-MS

Trigger Types (cont'd)

Multi-stage: Cascade (Sequence) Trigger, Types	Cascade A then B: Edge, Window, Pattern (Logic) Width, Glitch, Interval, Dropout, or Measurement. Measurement can be on Stage B only. Cascade A then B then C (Measurement): Edge, Window, Pattern (Logic), Width, Glitch, Interval, Dropout, or Measurement. Measurement can be on Stage C only. Cascade A then B then C: Edge, Window, Pattern (Logic). Cascade A then B then C then D: Edge, Window, Pattern (Logic), or Measurement. Measurement can be on Stage D only
Multi-stage: Cascade (Sequence) Trigger, Holdoff	Holdoff between A and B, B and C, C and D is selectable by time (1ns to 20s) or number of events. Measurement trigger selection as the last stage in a Cascade precludes a holdoff setting between the prior stage and the last stage.

Optional High-speed Serial Protocol Triggering (HDO9K-80B-8B10B TD)

Data Rates	150 Mb/s–3.125 Gb/s
Pattern Length	80-bits, NRZ or 8b/10b
Clock Recovery Jitter	1 ps_{rms} + 0.3% Unit Interval RMS for PRBS data patterns with 50% transition density
Hardware Clock Recovery Loop BW	PLL Loop BW = Fbaud/5500, 100 Mb/s to 2.488 Gb/s (typical)

Display System

Size	Color 15.4" widescreen capacitive touch screen
Resolution	WXGA; 1280 x 800 pixels
Number of Traces	Display a maximum of 16 traces. Simultaneously display channel, zoom, memory and math traces
Grid Styles	Auto, Single, Dual, Quad, Octal, X-Y, Single+X-Y, Dual+X-Y, Tandem, Quatro, Twelve, Sixteen
Waveform Representation	Sample dots joined, or sample dots only

Processor/CPU

Type	Intel® i5-3610 Dual Core, 2.7 GHz (or better)
Processor Memory	16 GB standard
Operating System	Microsoft Windows® 7 For Embedded Systems 64Bits
Real Time Clock	Date and time displayed with waveform in hardcopy files. SNTP support to synchronize to precision internal clocks

Connectivity

Ethernet Port	Supports 10/100/1000Base-T Ethernet interface (RJ45 port)
USB Host Ports	4 side USB 3.1 Gen1 ports, 2 side USB 2.0 ports, and 1 front USB 2.0 port support Windows compatible devices
USB Device Port	1 port - USBTMC over USB 3.1 Gen1
GPIB Port (Optional)	Supports IEEE–488.2 (External)
External Monitor Port	2 full-size DisplayPort connectors and 1 DVI-D. Includes support for extended desktop operation with WXGA resolution on second monitor
Remote Control	Via Windows Automation, or via Teledyne LeCroy Remote Command Set
Network Communication Standard	VXI-11 or VICP, LXI Class C (v1.2) Compliant
Peripheral Bus	Teledyne LeCroy LBUS standard

Power Requirements

Voltage	100–240 VAC ±10% at 50/60 Hz ±5%; 100–120 VAC ±10% at 400 Hz ±5%; Automatic AC Voltage Selection; Installation Category: 300 V CAT II
Nominal Power Consumption	415 W / 415 VA
Max Power Consumption	500 W / 500 VA (with all PC peripherals, active probes connected to 4 channels, and MSO active)

Environmental

Temperature (Operating)	+5 °C to +40 °C
Temperature (Non-Operating)	−20 °C to +60 °C
Humidity (Operating)	5% to 90% relative humidity (non-condensing) up to +31 °C Upper limit derates to 50% relative humidity (Non-condensing) at +40 °C
Humidity (Non-Operating)	5% to 95% relative humidity (non-condensing) as tested per MIL-PRF-28800F
Altitude (Operating)	Up to 3,000 m at or below +30 °C
Altitude (Non-Operating)	Up to 40,000 ft. (12,192 m)
Random Vibration (Operating)	0.31 g_{rms} 5 Hz to 500 Hz, 15 minutes in each of three orthogonal axes
Random Vibration (Non-Operating)	2.4 g_{rms} 5 Hz to 500 Hz, 15 minutes in each of three orthogonal axes
Functional Shock	30 g_{peak}, half sine, 11 ms pulse, 3 shocks (positive and negative) in each of three orthogonal axes, 18 shocks total

Size and Weight

Dimensions (HWD)	14.1" H x 17.5" W x 9.5" D (358 x 445 x 242 mm)
Weight	25.8 lbs. (11.7 kg)

Certifications

CE Certification UL and cUL Listing	CE Compliant, UL and cUL listed; Conforms to UL 61010-1 (3rd Edition), UL 61010-2-030 (1st Edition) CAN/CSA C22.2 No. 61010-1-12

Warranty and Service

	3-year warranty; calibration recommended annually. Optional service programs include extended warranty, upgrades, and calibration services

Standard

Math Tools

Display up to 12 math function traces (F1–F12). The easy-to-use graphical interface simplifies setup of up to two operations on each function trace, and function traces can be chained together to perform math-on-math.

absolute value	exp (base 10)	product (x)
average (summed)	fft (power spectrum, power average, magnitude, phase, up to 128 Mpts)	reciprocal
average (continuous)		rescale (with units)
correlation (two waveforms)		roof
	floor	(sinx)/x
derivative	integral	sparse
deskew (resample)	interpolate (cubic, quadratic, sinx/x)	square
difference (−)		square root
enhanced resolution (to 11 bits vertical)	invert (negate)	sum (+)
	log (base e)	zoom (identity)
envelope	log (base 10)	
exp (base e)		

Measure Tools

Display any 12 parameters together with statistics, including their average, high, low, and standard deviations. Histicons provide a fast, dynamic view of parameters and wave shape characteristics. Parameter Math allows addition, subtraction, multiplication, or division of two different parameters.

amplitude	level @ x	rms
area	maximum	std. deviation
base	mean	top
bit rate	median	width
cycles	minimum	phase
delay	narrow band phase	time @ minimum (min.)
Δ delay	narrow band power	time @ maximum (max.)
duty cycle	number of points	Δ time @ level
duration	+ overshoot	Δ time @ level from trigger
falltime (90−10%, 80−20%, @ level)	− overshoot	
	peak-to-peak	x @ max.
frequency	period	x @ min.
first	risetime (10−90%, 20−80%, @ level)	
last		

Pass/Fail Testing

Simultaneously test multiple parameters against selectable parameter limits or pre-defined masks. Pass or fail conditions can initiate actions including document to local or networked files, e-mail the image of the failure, save waveforms, send a pulse out at the front panel auxiliary BNC output, or (with the GPIB option) send a GPIB SRQ.

Standard (cont'd)

Basic Jitter and Timing Analysis

This package provides jitter timing and analysis using time, frequency, and statistical views for common timing parameters, and also includes other useful tools. Includes:

- "Track" graphs of all parameters, no limitation of number

– N-Cycle	– Width @ level	– Skew
– Edge to Edge	– Time Interval Error @ level	– Duty Cycle @ level
– Frequency @ level		– Duty Cycle Error
– Period @ level	– Setup	
– Half Period	– Hold	

- Edge @ lv parameter (counts edges)
- Histograms expanded with 19 histogram parameters and up to 2 billion events
- Trend (datalog) of up to 1 million events
- Persistence histogram, persistence trace (mean, range, sigma)

Software Options

Advanced Customization (HDO9K-XDEV)

Provides capability to create a math function or measurement parameter in MATLAB, Excel, C++, JavaScript, or Visual Basic Script (VBS) format and insert it into the oscilloscope's processing stream. All results are processed and displayed on the oscilloscope grid, and are available for further processing. Also permits the creation of customized plug-ins that can be inserted into the scope user interface, control of the scope via Visual Basic scripts embedded in customized functions, and use of Teledyne LeCroy's Custom DSO capabilities.

SDA II Serial Data Analysis Option (HDO9K-SDAII)

Total Jitter

A complete toolset is provided to measure total jitter. Eye Diagrams with millions of UI are quickly calculated from up to 128 Mpts records, and advanced tools may be used on the Eye Diagram to aid analysis. Complete TIE and Total Jitter (Tj) parameters and analysis functions are provided.

- Time Interval Error (TIE) Measurement Parameter, Histogram, Spectrum and Jitter Track
- Total Jitter (Tj) Measurement Parameter, Histogram, Spectrum
- Eye Diagram Display (sliced)
- Eye Diagram IsoBER (lines of constant Bit Error Rate)
- Eye Diagram Mask Violation Locator
- Eye Diagram Measurement Parameters

– Eye Height	– Eye Width	– Mask hits
– One Level	– Eye Crossing	– Mask out
– Zero Level	– Avg. Power	– Bit Error Rate
– Eye Amplitude	– Extinction Ratio	– Slice Width (setting)

- Q-Fit Tail Representation
- Bathtub Curve
- Cumulative Density Function (CDF)
- PLL Track

Software Options (cont'd)

SDA II Serial Data Analysis Option (HDO9K-SDAII) - *continued*

Jitter Decomposition Models
Two jitter decomposition methods are provided and simultaneously calculated to provide maximum measurement confidence. Q-Scale, CDF, Bathtub Curve, and all jitter decomposition measurement parameters can be displayed using either method.

- Spectral Method
- NQ-Scale Method

Random Jitter (Rj) and Non-Data Dependent Jitter (Rj+BUj)
- Random Jitter (Rj) Measurement Parameter
- Rj+BUj Histogram
- Rj+BUj Spectrum
- Rj+BUj Track

Deterministic Jitter (Dj)
- Deterministic Jitter (Dj) Measurement Parameter

Data Dependent Jitter (DDj)
- Data Dependent Jitter (DDj) Measurement Parameter
- DDj Histogram
- DDj Plot (by Pattern or N-bit Sequence)

Eye Doctor II Advanced Signal Integrity Tools (HDO9K-EYEDRII)

Complete set of channel emulation, de-embedding and receiver equalization simulation tools. Provides capability to emulate a serial data link, de-embed or embed a fixture, cable or serial data channel, add or remove emphasis, and perform CTLE, FFE, or DFE equalization.

Power Analyzer Option (HDO9K-PWR)

Power switching device measurements, control loop modulation analysis, and line power harmonic testing are all simplified with a dedicated user interface and automatic measurements.

Device Analysis
- Losses – Automatic measurement of turn-on, turn-off, and conduction loses as well as off-state power, total losses and switching frequency
- Safe Operating Area
- B-H-Hysteresis Curve
- Dynamic On-Resistance
- Dv/dt and di/vt

Control Loop Analysis
- Closed loop time-domain – Duty cycle, width, period or frequency

Line Power Analysis
- Power – Vrms, Irms, real-power, apparent power, power factor, crest factor
- Harmonics – EN61000-3-2 pre-compliance, Total Harmonic Distortion

Measurement Setup
- Controls for Deskew, DC fine adjust, probe integration, device zone identification

Cable De-embedding Option (HDO9K-CBL-DE-EMBED)

Removes cable effects from your measurements. Simply enter the S-parameters or attenuation data of the cable(s) then all of the functionality of the HDO9K can be utilized with cable effects de-embedded.

8b/10b Decode and 80-bit High Speed Serial Trigger Option (HDO9K-80B-8B10B TD)

Intuitive, color-coded serial trigger decode with powerful search capability enables captured waveforms to be searched for user-defined sequences of symbols. Multi-lane analysis decodes up to four simultaneously captured lanes. Includes 150 Mb/s to 3.125 Gb/s High-speed 80-bit Serial Pattern Trigger Option

Software Options (cont'd)

Serial Data Mask Option (HDO9K-SDM)

Create eye diagrams using a comprehensive list of standard eye pattern masks, or create a user-defined mask. Mask violations are clearly marked on the display for easy analysis.

Electrical Telecom Pulse Mask Test Option (HDO9K-ET-PMT)

Performs automated compliance mask tests on a wide range of electrical telecom standards.

Spectrum Analyzer Option (HDO9K-SPECTRUM)

Spectrum analyzer style user interface and advanced FFT capabilities.
- Automatic oscilloscope setup when selecting start/stop frequency or center frequency and span
- Resolution bandwidth automatically or manually controlled
- FFT Reference and vertical scale in dBm, dBV, dBmV, dBuV, Vrms or Arms
- Spectrogram provides 2D or 3D spectral history display
- Up to 100 automatic peak markers
- Up to 20 markers, either manually controlled or automatic which mark fundamental frequency and harmonics
- Math waveform analysis, additional output types:
  - Power density
  - Real
  - Imaginary
  - Magnitude squared

Disk Drive Measurements Option (HDO9K-DDM2)

This package provides disk drive parameter measurements and related mathematical functions for performing disk drive WaveShape Analysis.
- Disk Drive Parameters are as follows:

– amplitude asymmetry	– local time at minimum	– overwrite
– local base	– local time at maximum	– pulse width 50
– local baseline separation	– local time peak-trough	– pulse width 50 –
– local maximum		– pulse width 50 +
– local minimum	– local time over threshold	– resolution
– local number	– local time trough-peak	– track average amplitude
– local peak-peak		– track average amplitude –
– local time between events	– local time under threshold	– track average amplitude +
– local time between peaks	– narrow band phase	– auto-correlation s/n
– local time between troughs	– narrow band power	– non-linear transition shift

ORDERING INFORMATION

Product Description	Product Code
HDO9000 Oscilloscopes	
1 GHz, 10-bit, 20 GS/s, 4ch, 64 Mpts/Ch High Definition Oscilloscope with 15.4" WXGA capacitive touch screen. 40 GS/s, 128 Mpts/Ch in interleaved mode.	HDO9104
2 GHz, 10-bit, 20 GS/s, 4ch, 64 Mpts/Ch High Definition Oscilloscope with 15.4" WXGA capacitive touch screen. 40 GS/s, 128 Mpts/Ch in interleaved mode.	HDO9204
3 GHz, 10-bit, 20 GS/s, 4ch, 64 Mpts/Ch High Definition Oscilloscope with 15.4" WXGA capacitive touch screen. 40 GS/s, 128 Mpts/Ch in interleaved mode.	HDO9304
4 GHz, 10-bit, 20 GS/s, 4ch, 64 Mpts/Ch High Definition Oscilloscope with 15.4" WXGA capacitive touch screen. 40 GS/s, 128 Mpts/Ch in interleaved mode.	HDO9404
1 GHz, 10-bit, 20 GS/s, 4ch, 64 Mpts/Ch High Definition Mixed Signal Oscilloscope with 15.4" WXGA capacitive touch screen. 40 GS/s, 128 Mpts/Ch in interleaved mode.	HDO9104-MS
2 GHz, 10-bit, 20 GS/s, 4ch, 64 Mpts/Ch High Definition Mixed Signal Oscilloscope with 15.4" WXGA capacitive touch screen. 40 GS/s, 128 Mpts/Ch in interleaved mode.	HDO9204-MS
3 GHz, 10-bit, 20 GS/s, 4ch, 64 Mpts/Ch High Definition Mixed Signal Oscilloscope with 15.4" WXGA capacitive touch screen. 40 GS/s, 128 Mpts/Ch in interleaved mode.	HDO9304-MS
4 GHz, 10-bit, 20 GS/s, 4ch, 64 Mpts/Ch High Definition Mixed Signal Oscilloscope with 15.4" WXGA capacitive touch screen. 40 GS/s, 128 Mpts/Ch in interleaved mode.	HDO9404-MS

Product Description	Product Code
Included with Standard Configurations (HDO9000 and HDO9000-MS)	
÷10, 500 MHz Passive Probe (Qty. 4), Protective Cover, Getting Started Guide, Anti-virus Software (Trial Version), Microsoft Windows® 7 For Embedded Systems 64Bits, Commercial NIST Traceable Calibration with Certificate, Power Cable for the Destination Country, 3-year Warranty	
Included with HDO9000-MS	
16 Channel Digital Leadset, Extra Large Gripper Probe Set (Qty. 22), Ground Extenders (Qty. 20), Flexible Ground Leads (Qty. 5)	
Computer Upgrade	
256 GB Removable Solid State Drive Option	HDO9K-256GB-RSSD
Additional 256 GB Solid State Drive for use with RSSD option. Includes Microsoft Windows® 7 For Embedded Systems 64Bits, Teledyne LeCroy Oscilloscope Software and Critical Scope Operational File Duplicates.	HDO9K-256GB-RSD-02
High-speed Digital Analyzer Systems	
12.5 GS/s High-speed Digital Analyzer with 18ch QuickLink leadset and LBUS connection	HDA125-18-LBUS
12.5 GS/s High-speed Digital Analyzer with 9ch QuickLink leadset and LBUS connection	HDA125-09-LBUS
Oscilloscope Synchronization	
Hardware kit to allow for 8 channel synch capability to combine 2 HDO9000 High Definition Oscilloscopes	HDO9K-8CH-SYNCH

Product Description	Product Code
Serial Trigger and Decode	
MIL-STD-1553 Trigger and Decode Option	HDO9K-1553 TD
MIL-STD-1553 Trigger, Decode, Measure/Graph, and Eye Diagram Option	HDO9K-1553 TDME
8b10b Decode Option- Includes 80 bit 3.125 Gb/s serial trigger	HDO9K-80B-8b10b TD
AudioBus Trigger and Decode Option	HDO9K-Audiobus TD
AudioBus trigger, decode, and graph Option	HDO9K-Audiobus TDG
ARINC 429 Bus Symbolic Decode Option	HDO9K-ARINC429BUS DSYMBOLIC
ARINC 429 Bus Symbolic Decode, Measure/Graph, and Eye Diagram Option	HDO9K-ARINC429BUS DME SYMBOLIC
CAN FD Trigger and Decode Option	HDO9K-CAN FDBUS TD
CAN FD Trigger, Decode, Measure/Graph, and Eye Diagram Option	HDO9K-CAN FDBUS TDME
CAN FD Symbolic Trigger, Decode, and Measure/Graph, and Eye Diagram Option	HDO9K-CAN FDBUS TDME SYMBOLIC
CAN Trigger & Decode Option	HDO9K-CANBUS TD
CAN Trigger, Decode, Measure/Graph, and Eye Diagram Option	HDO9K-CANBUS TDME
CAN Symbolic Trigger, Decode, and Measure/Graph, and Eye Diagram Option	HDO9K-CANBUS TDME SYMBOLIC
DigRF 3G Bus Decode Option	HDO9K-DigRF3Gbus D
DigRF V4 Bus Decode Option	HDO9K-DigRFV4bus D
MIPI D-PHY CSI-2, DSI Bus Decode Option	HDO9K-DPHYbus D
MIPI D-PHY CSI-2, DSI Bus Decode and Physical Layer Test Option	HDO9K-DPHYbus DP
ENET Bus Decode Option	HDO9K-ENETbus D
Bundle: Includes I2C, SPI, UART-RS232 Trigger and Decode Option	HDO9K-EMB TD
Bundle: Incl. I2C, SPI, UART-RS232 Trigger, Decode, Measure/Graph, and Eye Diagram Option	HDO9K-EMB TDME
FibreChannel decode annotation Option	HDO9K-FCbus D
FlexRay Trigger and Decode Option	HDO9K-FLEXRAYBUS TD
FlexRay Trigger, Decode, Measure/Graph and Physical Layer Option	HDO9K-FLEXRAYBUS TDMP
I2C Trigger and Decode Option	HDO9K-I2CBUS TD
I2C Trigger, Decode, Measure/Graph, and Eye Diagram Option	HDO9K-I2CBUS TDME
LIN Trigger and Decode Option	HDO9K-LINBUS TD
LIN Trigger, Decode, Measure/Graph, and Eye Diagram Option	HDO9K-LINBUS TDME
Manchester Bus Decode Option	HDO9K-MANCHESTERbus D
MIPI M-PHY Bus Decode Option	HDO9K-MPHYbus D
MIPI M-PHY Bus Decode and Physical Layer Test Option	HDO9K-MPHYbus DP
NRZ Bus Decode Option	HDO9K-NRZbus D
PCIe Gen 1 Decode Option	HDO9K-PCIebus D
Serial Debug Toolkit - Measure Analyze Graph Option	HDO9K-PROTOBUS MAG
Decode Annotation and Protocol Analyzer Synchronization Option	HDO9K-ProtoSync
Decode Annotation and Protocol Analyzer+Bit Tracer Synchronization Option	HDO9K-ProtoSync-BT
SAS Decode annotation Option	HDO9K-SASbus D
SATA Trigger and Decode Option	HDO9K-SATAbus TD
SENT Bus Decode Option	HDO9K-SENTbus D
SpaceWire Decode Option	HDO9K-SPACEWIREbus D

Product Description	Product Code
Serial Trigger and Decode (cont'd)	
SPI Trigger and Decode Option	HDO9K-SPIBUS TD
SPI Trigger, Decode, Measure/Graph, and Eye Diagram Option	HDO9K-SPIBUS TDME
SPMI Decode Option	HDO9K-SPMIbus D
UART-RS232 Trigger and Decode Option	HDO9K-UART-RS232BUS TD
UART-RS232 Trigger, Decode, Measure/Graph, and Eye Diagram Option	HDO9K-UART-RS232BUS TDME
MIPI UniPro Protocol Decoder Software Option	HDO9K-UNIPRObus D
MPHY to UniPro Decoder Software Upgrade MPHY REQUIRED	HDO9K-UPG-MPHY-UNIPRObus D
USB 2.0 HSIC Decode Option	HDO9K-USB2-HSICbus D
USB 2.0 Trigger and Decode Option	HDO9K-USB2BUS TD
USB 2.0 Trigger, Decode, Measure/Graph, and Eye Diagram Option	HDO9K-USB2BUS TDME
Serial Data Compliance	
QualiPHY Enabled BroadR-Reach Software Option	QPHY-BroadR-Reach
QualiPHY Enabled Ethernet 10/100/1000BT Software Option	QPHY-ENET*
QualiPHY Enabled DDR2 Software Option	QPHY-DDR2
QualiPHY Enabled DDR3 Software Option	QPHY-DDR3
QualiPHY Enabled LPDDR2 Software Option	QPHY-LPDDR2
QualiPHY Enabled MIPI D-PHY Software Option	QPHY-MIPI-DPHY
QualiPHY Enabled MOST150Software Option	QPHY-MOST150
QualiPHY Enabled MOST50 Software Option	QPHY-MOST50
QualiPHY Enabled USB 2.0 Software Option	QPHY-USB ‡
10/100/1000Base-T Ethernet Test Fixture	TF-ENET-B**
USB 2.0 Compliance Test Fixture	TF-USB-B
GRL USB Power Delivery Compliance Test Software	GRL-USB-PD
GRL USB Type-C Test Controller - US Power Cord	GRL-USB-PD-C1

* TF-ENET-B required.   ‡ TF-USB-B required.
** Includes ENET-2CAB-SMA018 and ENET-2ADA-BNCSMA.

Product Description	Product Code
Serial Data Analysis	
Cable De-Embedding Option	HDO9K-CBL-DE-EMBED
Eye Doctor (Virtual Probe and Equalizer Emulation Bundle)	HDO9K-EYE-DRII
Serial Data Mask Software Option	HDO9K-SDM
SDAII Serial Data Analysis Option	HDO9K-SDAII
DDR Debug Toolkits	
DDR2 and LPDDR2 Debug Toolkit	HDO9K-DDR2-TOOLKIT
DDR3, DDR3L, LPDDR3, DDR2, and LPDDR2 Debug Toolkit	HDO9K-DDR3-TOOLKIT
DDR3, DDR3L, LPDDR3, DDR2, and LPDDR2 Debug Toolkit Upgrade	HDO9K-UPG-DDR3-TOOLKIT

ORDERING INFORMATION

Product Description	Product Code
Data Storage Software	
Advanced Optical Recording Measurement Package	HDO9K-AORM
Disk Drive Measurements Software Package	HDO9K-DDM2
Disk Drive Analyzer Software Package	HDO9K-DDA
Power Analysis Software	
Power Analyzer Software Option	HDO9K-PWR
Modulated Signal Analysis	
VectorLinQ – Flexible vector signal analysis for electrical signals (RF and baseband I-Q)	HDO9k-VECTORLINQ
Jitter Analysis Software	
Clock, Clock-Data Jitter Analysis And Views Of Time, Statistical, Spectral, and Jitter Overlay	HDO9K-JITKIT
Other Software Options	
Advanced Customization Option	HDO9K-XDEV
EMC Pulse Parameter Software Option	HDO9K-EMC
Electrical Telecom Mask Test Software Option	HDO9K-ET-PMT
Q-Scape Multi-tab Display Option	HDO9K-Q-SCAPE
Spectrum Analyzer and Advanced FFT Option	HDO9K-SPECTRUM
Digital Filtering Software	
Digital Filter Software Option	HDO9K-DFP2
Remote Control/Network Options	
External USB2 to GPIB Adaptor	USB2-GPIB
General Accessories	
Oscilloscope Cart with Additional Shelf and Drawer	OC1024-A
Oscilloscope Cart	OC1021-A
Rackmount, 8U Adaptor Kit	HDO9K-RACK
Keyboard, USB	KYBD-1
Soft Carrying Case	HDO9K-SOFTCASE
Probes	
Power/Voltage Rail Probe. 4 GHz bandwidth, 1.2x attenuation, ±30V offset, ±800mV	RP4030
High Voltage Fiber Optic Probe, 60 MHz Bandwidth	HVFO103
500 MHz Passive Probe, 2.5mm, 10:1, 10 MΩ	PP022
500 MHz Passive Probe, 5mm, 10:1, 10 MΩ	PP024
1 GHz, 0.9 pF, 1 MΩ High Impedance Active Probe	ZS1000
Set of 4 ZS1000, 1 GHz, 0.9 pF, 1 MΩ High Impedance Active Probe	ZS1000-QUADPAK
1.5 GHz, 0.9 pF, 1 MΩ High Impedance Active Probe	ZS1500
Set of 4 ZS1500, 1.5 GHz, 0.9 pF, 1 MΩ High Impedance Active Probe	ZS1500-QUADPAK
2.5 GHz, 0.9 pF, 1 MΩ High Impedance Active Probe	ZS2500
Set of 4 ZS2500, 2.5 GHz, 0.9 pF, 1 MΩ High Impedance Active Probe	ZS2500-QUADPAK
4 GHz, 0.6 pF, 1 MΩ High Impedance Active Probe	ZS4000
200 MHz, 3.5 pF, 1 MΩ Active Differential Probe, ±20 V	ZD200
500 MHz, 1.0 pF Active Differential Probe, ±8 V	ZD500
1 GHz, 1.0 pF Active Differential Probe, ±8 V	ZD1000
1.5 GHz, 1.0 pF Active Differential Probe, ±8 V	ZD1500
500 MHz, Active Differential Probe (÷1, ÷10, ÷100)	AP033

Product Description	Product Code
Probes (cont'd)	
WaveLink 4 GHz, 2.5 Vp-p Differential Probe System	D410-A-PS
WaveLink 4 GHz, 5 Vp-p Differential Probe System	D420-A-PS
WaveLink 4 GHz Differential Amplifier Module with Adjustable Tip	D400A-AT*
WaveLink ProBus Platform/Cable Assembly (4 GHz)	WL-PBus-CASE
1 Ch, 100 MHz Differential Amplifier with Precision Voltage Source	DA1855A
DA1855A with Rackmount	DA1855A-RM
2 Ch, 100 MHz Differential Amplifier with Precision Voltage Source	DA1855A-PR2
DA1855A with Rackmount (must be ordered at time of purchase, no retrofit)	DA1855A-PR2-RM
30 A; 50 MHz Current Probe – AC/DC; 30 Arms; 50 Apeak Pulse	CP030
30A, 50 MHz High Sensitivity Current Probe - AC/DC, 30 A rms, 50 A Peak Pulse, 1.5 meter cable	CP030A
30 A; 100 MHz Current Probe – AC/DC; 30 Arms; 50 Apeak Pulse	CP031
30A, 100 MHz High Sensitivity Current Probe - AC/DC, 30 A rms, 50 A Peak Pulse, 1.5 meter cable	CP031A
150 A; 10 MHz Current Probe – AC/DC; 150 Arms; 500 Apeak Pulse	CP150
500 A; 2 MHz Current Probe – AC/DC; 500 Arms; 700 Apeak Pulse	CP500
Deskew Calibration Source for CP031,CP031A, CP030, and CP030A	DCS015
Programmable Current Sensor to ProBus Adapter for use with third party current sensors	CA10
Set of 4 CA10 Programmable Current Sensor to ProBus Adapters for third-party current sensors	CA10-QUADPAK
100:1 400 MHz 50 MΩ 1 kV High-voltage Probe	HVP120
100:1 400 MHz 50 MΩ 4 kV High-Voltage Probe	PPE4KV
1000:1 400 MHz 50 MΩ 5 kV High-Voltage Probe	PPE5KV
1000:1 400 MHz 5 MΩ / 50 MΩ 6 kV High-Voltage Probe	PPE6KV
TekProbe to ProBus Probe Adapter	TPA10
Set of 4 TPA10 TekProbe to ProBus Probe Adapters. Includes soft carrying case	TPA10-QUADPAK
Optical-to-Electrical Converter, 500-870 nm ProBus BNC Connector	OE425
Optical-to-Electrical Converter, 950-1630 nm ProBus BNC Connector	OE455
1kV, 25 MHz High Voltage Differential Probe	HVD3102
1kV, 25 MHz High Voltage Differential Probe without tip Accessories	HVD3102-NOACC
1kV, 120 MHz High Voltage Differential Probe	HVD3106
1kV, 120 MHz High Voltage Differential Probe without tip Accessories	HVD3106-NOACC
2kV, 120 MHz High Voltage Differential Probe	HVD3206
2kV, 80 MHz High Voltage Differential Probe with 6m cable	HVD3206-6M
6kV, 100 MHz High Voltage Differential Probe	HVD3605
7.5 GHz Low Capacitance Passive Probe (÷10, 1 kΩ; ÷20, 500 Ω)	PP066

* For a complete probe, order a WL-PBUS-CASE Platform/Cable Assembly with the Adjustable Tip Module

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