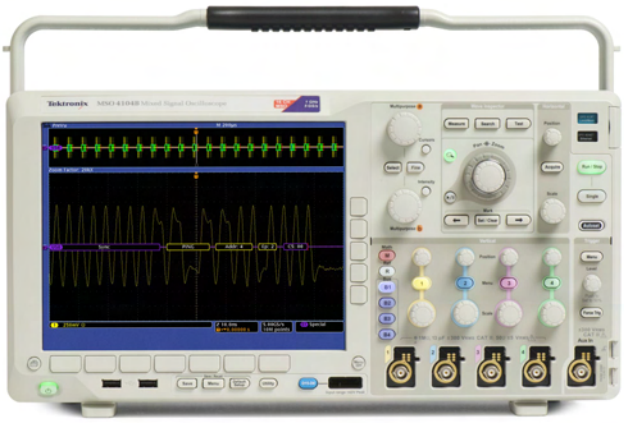
Mixed Signal Oscilloscopes

MSO4000B, DPO4000B Series Data Sheet



Features & Benefits

Key Performance Specifications

- 1 GHz, 500 MHz, 350 MHz Bandwidth Models
- 4 Analog Channel Models
- 16 Digital Channels (MSO Series)
- Up to 5 GS/s Sample Rate on All Channels
- 20 Megapoint Record Length on All Channels
- >50,000 wfm/s Maximum Waveform Capture Rate
- Standard Passive Voltage Probes with Less than 4 pF Capacitive Loading and 500 MHz or 1 GHz Analog Bandwidth
- Suite of Advanced Triggers

Ease of Use Features

- Wave Inspector® Controls provide Easy Navigation and Automated Search of Waveform Data
- 41 Automated Measurements, Waveform Histograms, and FFT Analysis for Simplified Waveform Analysis
- TekVPI® Probe Interface supports Active, Differential, and Current Probes for Automatic Scaling and Units
- 10.4 in. (264 mm) Bright XGA Color Display
- Small Footprint and Lightweight – Only 5.8 in. (147 mm) deep and 11 lb. (5 kg)

Connectivity

- Two USB 2.0 Host Ports on the Front Panel and Two on the Rear Panel for Quick and Easy Data Storage, Printing, and Connecting a USB Keyboard
- USB 2.0 Device Port on Rear Panel for Easy Connection to a PC or Direct Printing to a PictBridge®-compatible Printer
- Integrated 10/100/1000BASE-T Ethernet Port for Network Connection and Video Out Port to Export the Oscilloscope Display to a Monitor or Projector

Optional Serial Triggering and Analysis

- Automated Serial Triggering, Decode, and Search Options for I^2C, SPI, USB, Ethernet, CAN, LIN, FlexRay, RS-232/422/485/UART, MIL-STD-1553, and I^2S/LJ/RJ/TDM

Mixed Signal Design and Analysis (MSO Series)

- Automated Triggering, Decode, and Search on Parallel Buses
- Per-channel Threshold Settings
- Multichannel Setup and Hold Triggering
- MagniVu™ High-speed Acquisition Provides 60.6 ps Fine Timing Resolution on Digital Channels

Optional Application Support

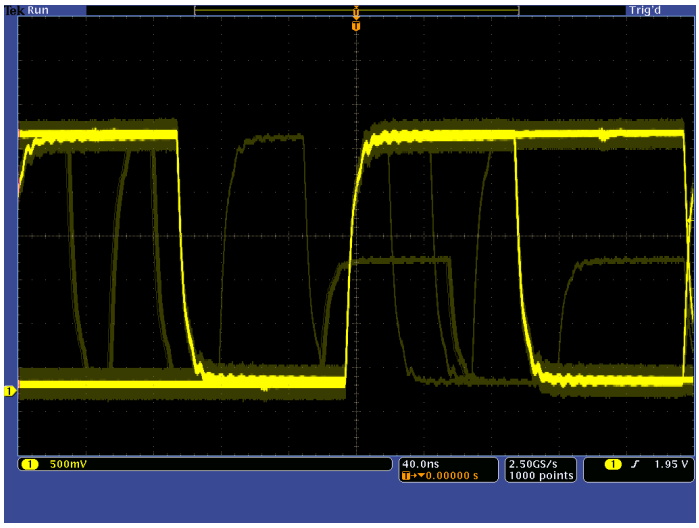
- Power Analysis
- Limit and Mask Testing
- HDTV and Custom Video Analysis

Feature-rich Tools for Debugging Mixed Signal Designs

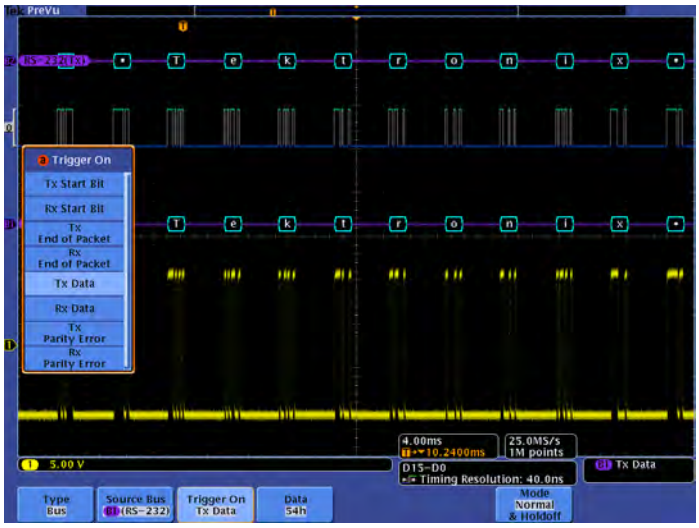
With the MSO/DPO4000B Mixed Signal Oscilloscope Series, you can analyze up to 20 analog and digital signals with a single instrument to quickly find and diagnose problems in complex designs. Bandwidths up to 1 GHz and a minimum of 5X oversampling on all channels ensure you have the performance you need to see fast-changing signal details. To capture long windows of signal activity while maintaining fine timing resolution, the MSO/DPO4000B Series offers a deep record length of 20M points standard on all channels.

With Wave Inspector® controls for rapid waveform navigation, automated serial and parallel bus analysis, limit and mask testing, and automated power analysis – the MSO/DPO4000B Oscilloscope Series from Tektronix provides the feature-rich tools you need to simplify and speed debug of your complex design.

Tektronix®



Discover – Fast waveform capture rate - over 50,000 wfm/s - maximizes the probability of capturing elusive glitches and other infrequent events.



Capture – Triggering on a specific transmit data packet going across an RS-232 bus. A complete set of triggers, including triggers for specific serial packet content, ensures you quickly capture your event of interest.

Comprehensive Features Speed Every Stage of Debug

The MSO/DPO4000B Series offers a robust set of features to speed every stage of debugging your design – from quickly discovering an anomaly and capturing it, to searching your waveform record for the event and analyzing its characteristics and your device's behavior.

Discover

To debug a design problem, first you must know it exists. Every design engineer spends time looking for problems in their design, a time-consuming and frustrating task without the right debug tools.

The MSO/DPO4000B Series offers the industry's most complete visualization of signals, providing fast insight into the real operation of your device. A fast waveform capture rate - greater than 50,000 waveforms per second - enables you to see glitches and other infrequent transients within seconds, revealing the true nature of device faults. A digital phosphor display with intensity grading shows the history of a signal's activity by intensifying areas of the signal that occur more frequently, providing a visual display of just how often anomalies occur.

Capture

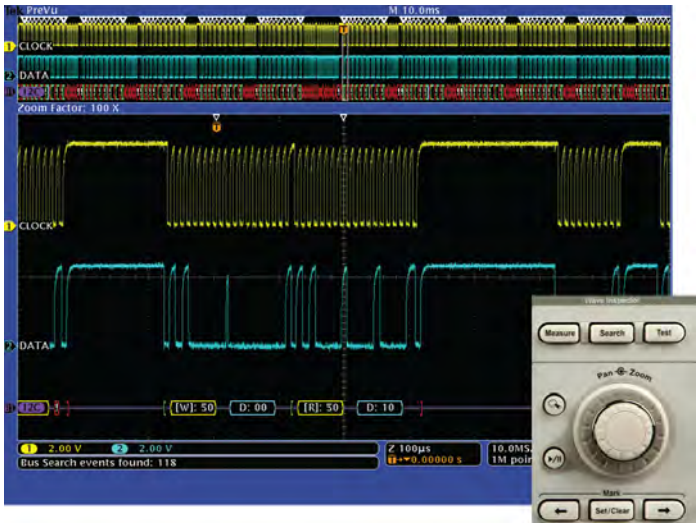
Discovering a device fault is only the first step. Next, you must capture the event of interest to identify root cause.

Accurately capturing any signal of interest begins with proper probing. The MSO/DPO4000B Series includes four low-capacitance probes for accurate signal capture. These industry-first high-impedance passive voltage probes have less than 4 pF of capacitive loading to minimize the affect of the probe on your circuit's operation, offering the performance of an active probe with the flexibility of a passive probe.

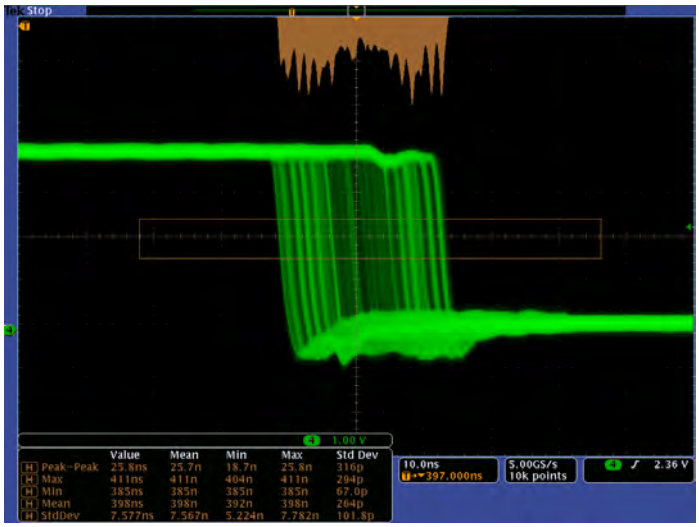
The MSO/DPO4000B Series provides a complete set of triggers – including runt, timeout, logic, pulse width/glitch, setup/hold violation, serial packet, and parallel data – to help quickly find your event. With up to a 20M point record length, you can capture many events of interest, even thousands of serial packets, in a single acquisition for further analysis while maintaining high resolution to zoom in on fine signal details.

From triggering on specific packet content to automatic decode in multiple data formats, the MSO/DPO4000B Series provides integrated support for the industry's broadest range of serial buses – I^2C, SPI, USB, Ethernet, CAN, LIN, FlexRay, RS-232/422/485/UART, MIL-STD-1553, and I^2S/LJ/RJ/TDM. The ability to decode up to four serial and/or parallel buses simultaneously means you gain insight into system-level problems quickly.

To further help troubleshoot system-level interactions in complex embedded systems, the MSO4000B Series offers 16 digital channels in addition to its analog channels. Since the digital channels are fully integrated into the oscilloscope, you can trigger across all input channels, automatically time correlating all analog, digital, and serial signals. The MagniVu™ high-speed acquisition enables you to acquire fine signal detail (up to 60.6 ps resolution) around the trigger point for precision measurements. MagniVu is essential for making accurate timing measurements for setup and hold, clock delay, signal skew, and glitch characterization.



Search – I²C decode showing results from a Wave Inspector search for Address value 50. Wave Inspector controls provide unprecedented efficiency in viewing and navigating waveform data.



Analyze – Waveform histogram of a falling edge showing the distribution of edge position (jitter) over time. Included are numeric measurements made on the waveform histogram data. A comprehensive set of integrated analysis tools speeds verification of your design's performance.

Search

Finding your event of interest in a long waveform record can be time consuming without the right search tools. With today's record lengths pushing beyond a million data points, locating your event can mean scrolling through thousands of screens of signal activity.

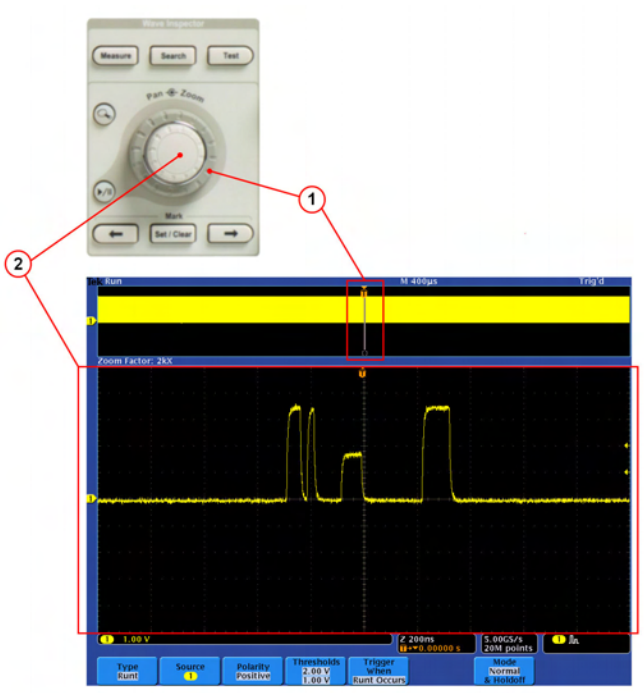
The MSO/DPO4000B Series offers the industry's most comprehensive search and waveform navigation with its innovative Wave Inspector® controls. These controls speed panning and zooming through your record. With a unique force-feedback system, you can move from one end of your record to the other in just seconds. User marks allow you to mark any location that you may want to reference later for further investigation. Or, automatically search your record for criteria you define. Wave Inspector will instantly search your entire record, including analog, digital, and serial bus data. Along the way it will automatically mark every occurrence of your defined event so you can quickly move between events.

Analyze

Verifying that your prototype's performance matches simulations and meets the project's design goals requires analyzing its behavior. Tasks can range from simple checks of rise times and pulse widths to sophisticated power loss analysis and investigation of noise sources.

The MSO/DPO4000B Series offers a comprehensive set of integrated analysis tools including waveform- and screen-based cursors, 41 automated measurements, advanced waveform math including arbitrary equation editing, waveform histograms, FFT analysis, and trend plots for visually determining how a measurement is changing over time. Specialized application support for serial bus analysis, power supply design, limit and mask testing, and video design and development is also available.

For extended analysis, National Instrument's LabVIEW SignalExpress™ Tektronix Edition provides over 200 built-in functions including time and frequency domain analysis, data logging, and customizable reports.



Wave Inspector controls provide unprecedented efficiency in viewing, navigating, and analyzing waveform data. Zip through your 20M point record by turning the outer pan control (1). Get from the beginning to end in seconds. See something of interest and want to see more details? Just turn the inner zoom control (2).

Wave Inspector® Navigation and Search

A 20M point record length represents thousands of screens of information. The MSO/DPO4000B Series enables you to find your event in seconds with Wave Inspector, the industry's best tool for navigation and search.

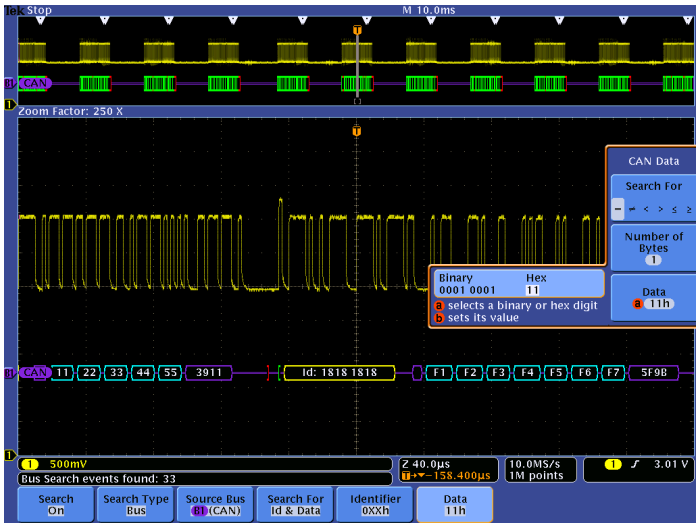
Wave Inspector offers the following innovative controls:

Zoom/Pan

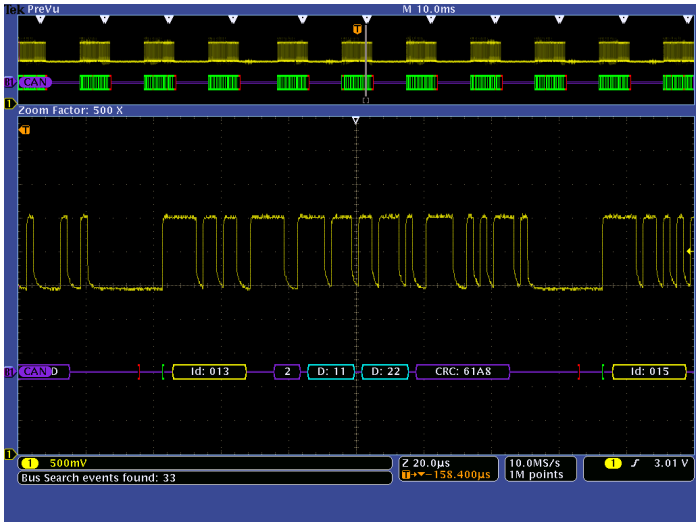
A dedicated, two-tier front-panel control provides intuitive control of both zooming and panning. The inner control adjusts the zoom factor (or zoom scale); turning it clockwise activates zoom and goes to progressively higher zoom factors, while turning it counterclockwise results in lower zoom factors and eventually turning zoom off. No longer do you need to navigate through multiple menus to adjust your zoom view. The outer control pans the zoom box across the waveform to quickly get to the portion of waveform you are interested in. The outer control also utilizes force feedback to determine how fast to pan on the waveform. The farther you turn the outer control, the faster the zoom box moves. Pan direction is changed by simply turning the control the other way.

Play/Pause

A dedicated **Play/Pause** front-panel button scrolls the waveform across the display automatically while you look for anomalies or an event of interest. Playback speed and direction are controlled using the intuitive pan control. Once again, turning the control further makes the waveform scroll faster and changing direction is as simple as turning the control the other way.



Search step 1: You define what you would like to find.



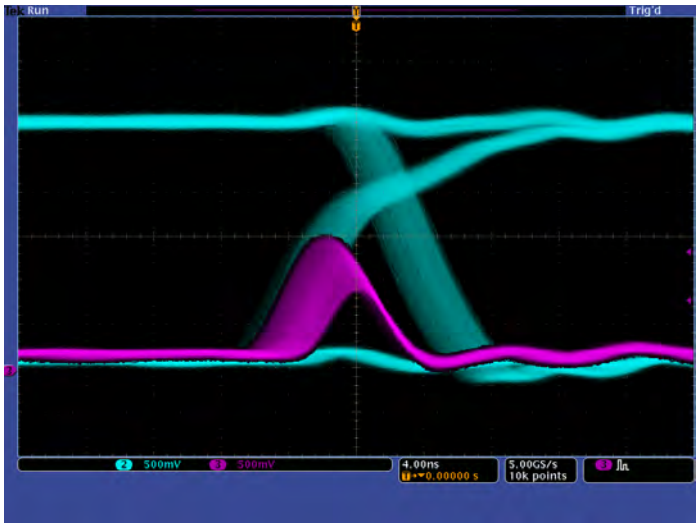
Search step 2: Wave Inspector automatically searches through the record and marks each event with a hollow white triangle. You can then use the **Previous** and **Next** buttons to jump from one event to the next.

User Marks

Press the **Set Mark** front-panel button to place one or more marks on the waveform. Navigating between marks is as simple as pressing the **Previous** (←) and **Next** (→) buttons on the front panel.

Search Marks

The **Search** button allows you to automatically search through your long acquisition looking for user-defined events. All occurrences of the event are highlighted with search marks and are easily navigated to, using the front-panel **Previous** (←) and **Next** (→) buttons. Search types include edge, pulse width/glitch, timeout, runt, logic, setup and hold, rise/fall time, parallel bus, and I^2C, SPI, USB, Ethernet, CAN, LIN, FlexRay, RS-232/422/485/UART, MIL-STD-1553, and I^2S/LJ/RJ/TDM packet content.



Digital phosphor technology enables greater than 50,000 wfm/s waveform capture rate and real-time intensity grading on the MSO/DPO4000B Series.

Digital Phosphor Technology

The MSO/DPO4000B Series' digital phosphor technology provides you with fast insight into the real operation of your device. Its fast waveform capture rate - greater than 50,000 wfm/s - gives you a high probability of quickly seeing the infrequent problems common in digital systems: runt pulses, glitches, timing issues, and more.

Waveforms are superimposed with one another and waveform points that occur more frequently are intensified. This quickly highlights the events that over time occur more often or, in the case of infrequent anomalies, occur less often.

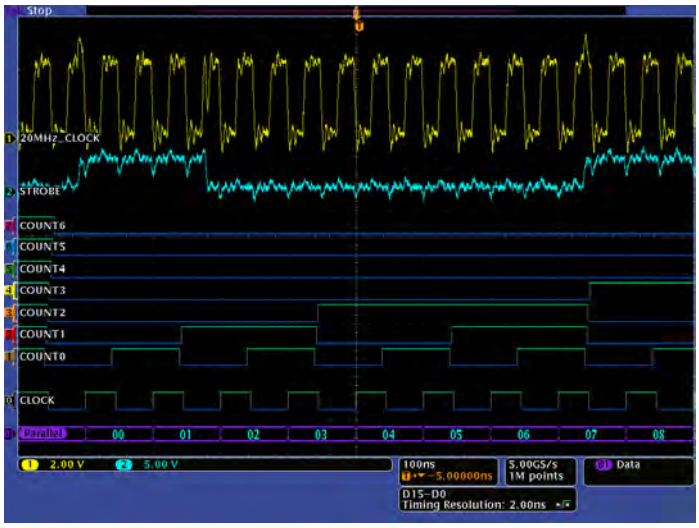
With the MSO/DPO4000B Series, you can choose infinite persistence or variable persistence (including zero persistence), determining how long the previous waveform acquisitions stay on-screen. This allows you to determine how often an anomaly is occurring.

Accurate High-speed Probing

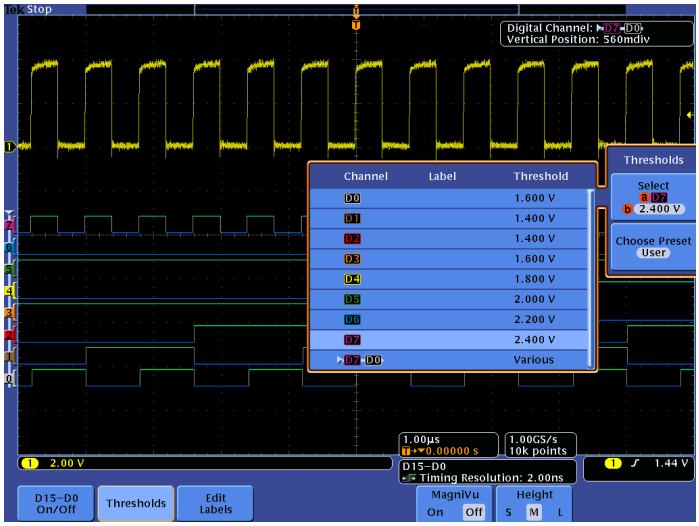
The TPP Series probes, included standard with every MSO/DPO4000B Series oscilloscope, provide up to 1 GHz of analog bandwidth, and less than 4 pF of capacitive loading. The extremely low capacitive loading minimizes adverse affects on your circuits and is more forgiving of longer ground leads. And, since the probe bandwidth matches your oscilloscope bandwidth, you can see the high-frequency components in your signal which is critical for high-speed applications. The TPP Series passive voltage probes offer all the benefits of general-purpose probes like high dynamic range, flexible connection options, and robust mechanical design, while providing the performance of active probes.

Mixed Signal Design and Analysis (MSO Series)

The MSO4000B Series Mixed Signal Oscilloscopes provide 16 digital channels. These channels are tightly integrated into the oscilloscope's user interface, simplifying operation and making it possible to solve mixed-signal issues easily.



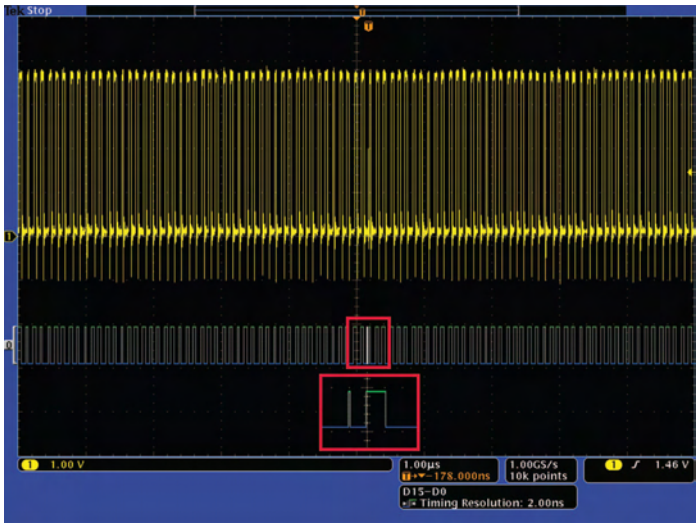
The MSO Series provides 16 integrated digital channels enabling you to view and analyze time-correlated analog and digital signals.



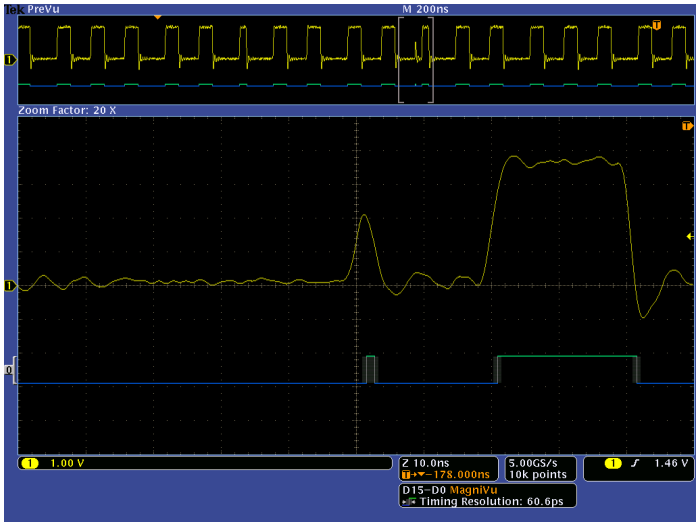
With the color-coded digital waveform display, groups are created by simply placing digital channels together on the screen, allowing the digital channels to be moved as a group. You can set threshold values for each channel, enabling support for up to 16 different logic families.

Color-coded Digital Waveform Display

The MSO4000B Series has redefined the way you view digital waveforms. One common problem shared by both logic analyzers and mixed signal oscilloscopes is determining if data is a one or a zero when zoomed in far enough that the digital trace stays flat all the way across the display. The MSO4000B Series has color-coded digital traces, displaying ones in green and zeros in blue.



White edges indicate additional information is available by zooming in. As shown here, zooming in on the white edge reveals a hidden glitch.



The MagniVu high-resolution record provides 60.6 ps timing resolution, enabling you to make critical timing measurements on your digital waveforms.

The multiple transition detection hardware of the MSO4000B Series will show you a white edge on the display when the system detects multiple transitions. White edges indicate that more information is available by zooming in or acquiring at faster sampling rates. In most cases zooming in will reveal the pulse that was not viewable with the previous settings. If the white edge is still present after zooming in as far as possible, this indicates that increasing the sample rate on the next acquisition will reveal higher frequency information than the previous settings could acquire.



The P6616 MSO probe offers two eight-channel pods to simplify connecting to your device.

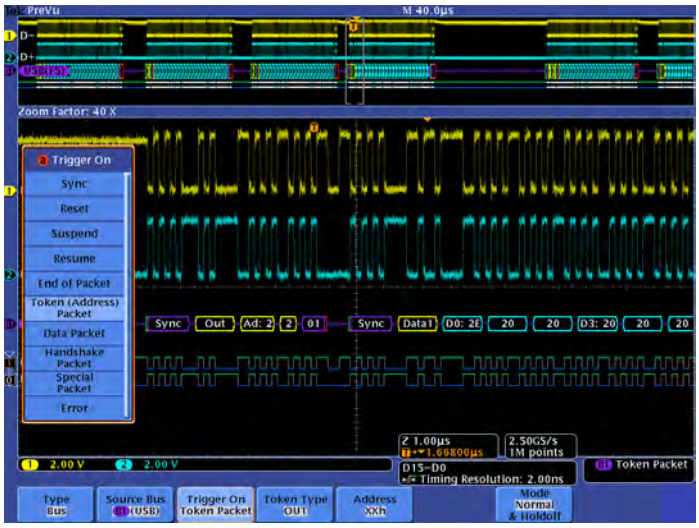
The MSO4000B Series simplifies channel setup by allowing you to group digital waveforms and enter waveform labels by using a USB keyboard. By simply placing digital waveforms next to each other, they form a group. Once a group is formed, you can position all the channels contained in that group collectively. This greatly reduces the normal setup time associated with positioning channels individually.

MagniVu™ High-speed Acquisition

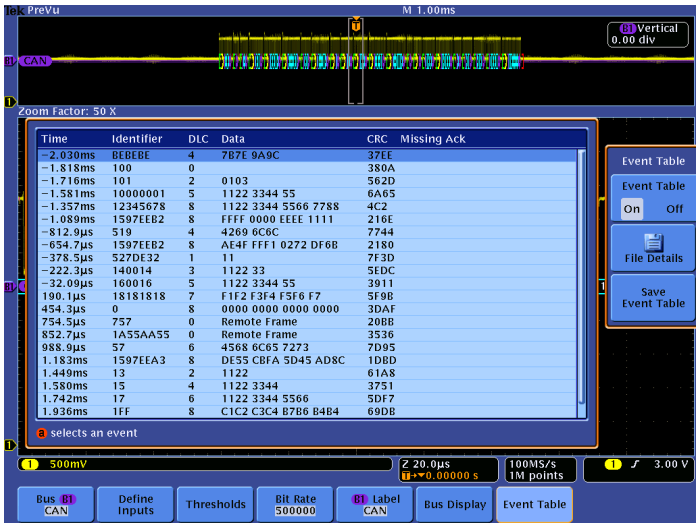
The main digital acquisition mode on the MSO4000B Series will capture up to 20M points at 500 MS/s (2 ns resolution). In addition to the main record, the MSO4000B Series provides an ultra high-resolution record called MagniVu which acquires 10,000 points at up to 16.5 GS/s (60.6 ps resolution). Both main and MagniVu waveforms are acquired on every trigger and can be switched between in the display at any time, running or stopped. MagniVu provides significantly finer timing resolution than comparable MSOs on the market, instilling confidence when making critical timing measurements on digital waveforms.

P6616 MSO Probe

This unique probe design offers two eight-channel pods. Each channel ends with a probe tip featuring a recessed ground for simplified connection to the device under test. The coax on the first channel of each pod is colored blue making it easy to identify. The common ground uses an automotive-style connector making it easy to create custom grounds for connecting to the device under test. When connecting to square pins, the P6616 has an adapter that attaches to the probe head extending the probe ground flush with the probe tip so you can attach to a header. The P6616 offers outstanding electrical characteristics, having only 3 pF of capacitive loading, a 100 kΩ input resistance, and capable of acquiring toggle rates >500 MHz and pulses as short as 1 ns in duration.



Triggering on a specific OUT Token packet on a USB full-speed serial bus. The yellow waveform is the D+ and the blue waveform is the D–. A bus waveform provides decoded packet content including Start, Sync, PID, Address, End Point, CRC, Data values, and Stop.



Event table showing decoded Identifier, DLC, DATA, and CRC for every CAN packet in a long acquisition.

Serial Triggering and Analysis (Optional)

On a serial bus, a single signal often includes address, control, data, and clock information. This can make isolating events of interest difficult. The MSO/DPO4000B Series offers a robust set of tools for debugging serial buses with automatic trigger, decode, and search for I²C, SPI, USB, Ethernet, CAN, LIN, FlexRay, RS-232/422/485/UART, MIL-STD-1553, and I²S/LJ/RJ/TDM.

Serial Triggering

Trigger on packet content such as start of packet, specific addresses, specific data content, unique identifiers, etc. on popular serial interfaces such as I²C, SPI, USB, Ethernet, CAN, LIN, FlexRay, RS-232/422/485/UART, MIL-STD-1553, and I²S/LJ/RJ/TDM.

Bus Display

Provides a higher-level, combined view of the individual signals (clock, data, chip enable, etc.) that make up your bus, making it easy to identify where packets begin and end and identifying subpacket components such as address, data, identifier, CRC, etc.

Bus Decoding

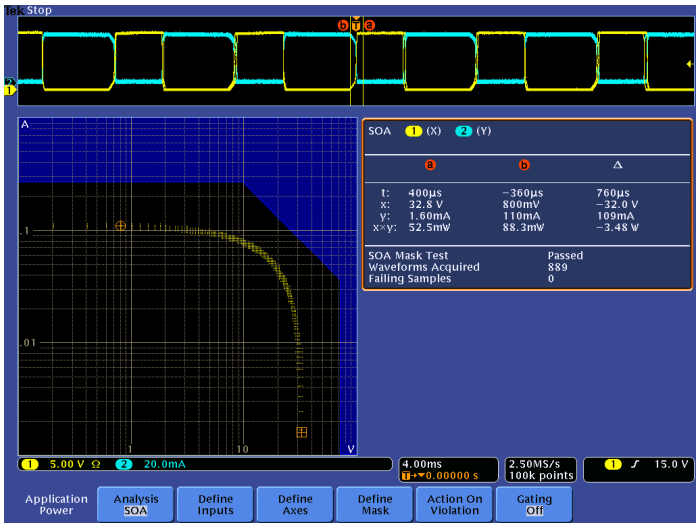
Tired of having to visually inspect the waveform to count clocks, determine if each bit is a 1 or a 0, combine bits into bytes, and determine the hex value? Let the oscilloscope do it for you! Once you've set up a bus, the MSO/DPO4000B Series will decode each packet on the bus, and display the value in hex, binary, decimal (USB, Ethernet, MIL-STD-1553, LIN, and FlexRay only), signed decimal (I²S/LJ/RJ/TDM only), or ASCII (USB, Ethernet, and RS-232/422/485/UART only) in the bus waveform.

Event Table

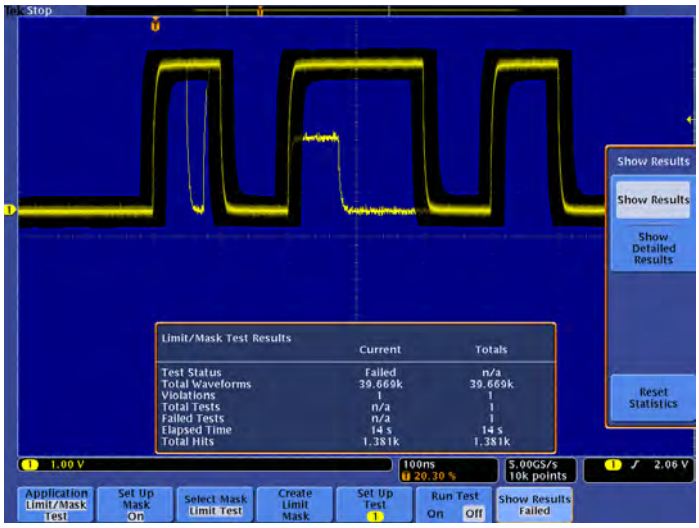
In addition to seeing decoded packet data on the bus waveform itself, you can view captured packets in a tabular view much like you would see in a software listing. Packets are time stamped and listed consecutively with columns for each component (Address, Data, etc.).

Search

Serial triggering is very useful for isolating the event of interest, but once you've captured it and need to analyze the surrounding data, what do you do? In the past, users had to manually scroll through the waveform counting and converting bits and looking for what caused the event. With the MSO/DPO4000B Series, you can have the oscilloscope automatically search through the acquired data for user-defined criteria including serial packet content. Each occurrence is highlighted by a search mark. Rapid navigation between marks is as simple as pressing the **Previous** (←) and **Next** (→) buttons on the front panel.



Safe operating area measurement. Automated power measurements enable quick and accurate analysis of common power parameters.



Limit Test showing a mask created from a golden waveform and compared against a live signal. Results showing statistical information about the test are displayed.

Power Analysis (Optional)

Ever increasing consumer demand for longer battery-life devices and for green solutions that consume less power require power-supply designers to characterize and minimize switching losses to improve efficiency. In addition, the supply's power levels, output purity, and harmonic feedback into the power line must be characterized to comply with national and regional power quality standards. Historically, making these and many other power measurements on an oscilloscope has been a long, manual, and tedious process. The MSO/DPO4000B Series optional power analysis tools greatly simplify these tasks, enabling quick and accurate analysis of power quality, switching loss, harmonics, safe operating area (SOA), modulation, ripple, and slew rate (di/dt, dv/dt). Completely integrated into the oscilloscope, the power analysis tools provide automated, repeatable power measurements with a touch of a button; no external PC or complex software setup is required.

Limit/Mask Testing (Optional)

A common task during the development process is characterizing the behavior of certain signals in a system. One method, called limit testing, is to compare a tested signal to a known good or "golden" version of the same signal with user-defined vertical and horizontal tolerances. Another common method, called mask testing, is to compare a tested signal to a mask, looking for where a signal under test violates the mask. The MSO/DPO4000B Series offers both limit and mask testing capability useful for long-term signal monitoring, characterizing signals during design, or testing on a production line. A robust set of telecommunications and computer standards are provided to test for compliance to a standard.

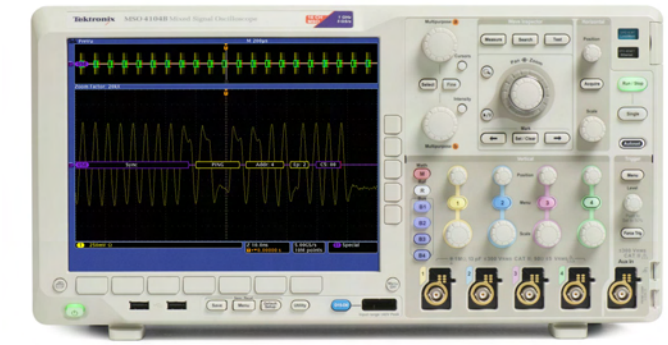
Additionally, custom masks can be created and used for characterizing signals. Tailor a test to your specific requirements by defining test duration in number of waveforms or time, a violation threshold that must be met before considering a test a failure, counting hits along with statistical information, and actions upon violations, test failure, and test complete. Whether specifying a mask from a known good signal or from a custom or standard mask, conducting pass/fail tests in search of waveform anomalies such as glitches has never been easier.

Video Design and Development

Many video engineers have remained loyal to analog oscilloscopes, believing the intensity gradations on an analog display are the only way to see certain video waveform details. The MSO/DPO4000B Series fast waveform capture rate, coupled with its intensity-graded view of the signal, provides the same information-rich display as an analog oscilloscope, but with much more detail and all the benefits of digital oscilloscopes.

Standard features such as IRE and mV graticules, holdoff by fields, video polarity, and an Autoset smart enough to detect video signals, make the MSO/DPO4000B Series the easiest to use oscilloscope on the market for video applications. And with up to a 1 GHz bandwidth and four analog inputs, the MSO/DPO4000B Series provides ample performance for analog and digital video use.

The MSO/DPO4000B Series video functionality is further extended with the optional DPO4VID video application module. DPO4VID provides the industry's most complete suite of HDTV and custom (nonstandard) video triggers.



The MSO/DPO4000B Series is designed to make your work easier. The large, high-resolution display shows intricate signal details. Dedicated front-panel controls simplify operation. Two USB host ports on the front panel allow you to easily transfer screenshots, instrument settings, and waveform data to a USB thumb drive.



The MSO/DPO4000B Series' compact form factor frees up valuable space on your bench or desktop.

Designed to Make Your Work Easier

Large, High-resolution Display

The MSO/DPO4000B Series features a 10.4 in. (264 mm) bright, LED backlit XGA color display for seeing intricate signal details.

Dedicated Front-panel Controls

Per-channel vertical controls provide simple and intuitive operation. No longer do you need to share one set of vertical controls across all four channels.

Connectivity

Two USB host ports on the front panel enable easy transfer of screenshots, instrument settings, and waveform data to a USB thumb drive. The rear panel contains two additional USB host ports and a USB device port for controlling the oscilloscope remotely from a PC or for connecting a USB keyboard. The USB device port can also be used to print directly to a PictBridge®-compatible printer. An integrated 10/100/1000BASE-T Ethernet port enables easy connection to networks and a Video Out port allows the oscilloscope display to be exported to an external monitor or projector. The instrument can mount external network drives for easy storage of screen images, setup files, or data files. Setup or data files can then be directly recalled and loaded into the oscilloscope from the network drive location. The MSO/DPO4000B Series is LXI Class-C compliant.

Compact Form Factor

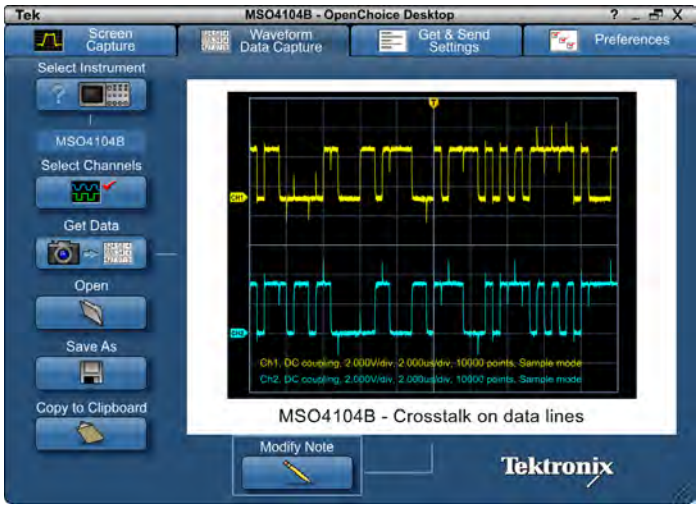
A compact, portable form factor allows the MSO/DPO4000B Series to be easily moved between labs and, with a depth of just 5.8 in. (147 mm), it saves you valuable space on your test bench.



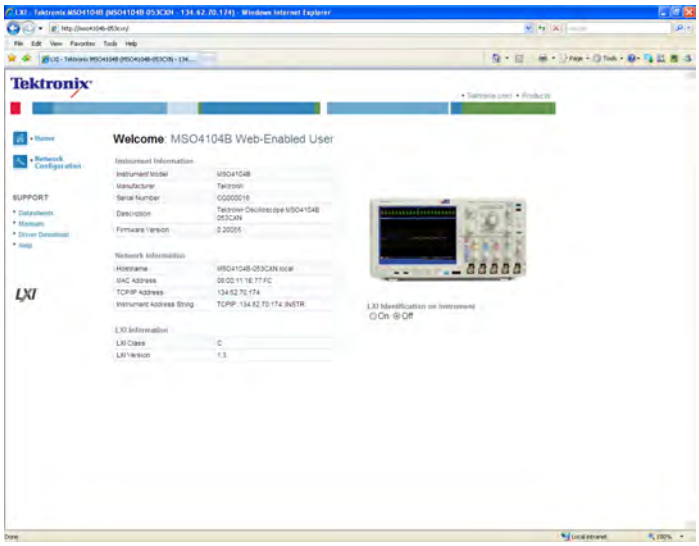
TekVPI probe interface simplifies connecting your probes to the oscilloscope.

TekVPI® Probe Interface

The TekVPI probe interface sets the standard for ease of use in probing. In addition to the secure, reliable connection that the interface provides, TekVPI probes feature status indicators and controls, as well as a probe menu button right on the compensation box itself. This button brings up a probe menu on the oscilloscope display with all relevant settings and controls for the probe. The TekVPI interface enables direct attachment of current probes without requiring a separate power supply. TekVPI probes can be controlled remotely through USB, GPIB, or LAN, enabling more versatile solutions in ATE environments.



OpenChoice® Desktop software enables seamless connection between the oscilloscope and your PC.



The LXI web interface provides access to network settings, enables remote instrument control and is accessible from any standard web browser.

Extended Analysis

Acquiring data and measurements from the MSO/DPO4000B Series is as simple as connecting a USB cable from the oscilloscope to your PC. Key software applications – NI LabVIEW SignalExpress™ Tektronix Edition, OpenChoice® Desktop, and Microsoft Excel and Word toolbars – are included standard with each oscilloscope to enable fast and easy direct communication with your Windows PC.

NI LabVIEW SignalExpress Tektronix Edition enables you to instantly acquire, generate, analyze, compare, import, and save measurement data and signals using an intuitive drag-and-drop user interface that does not require any programming. The optional Professional Version offers over 200 built-in functions that provide additional signal processing, advanced analysis, sweeping, and user-defined step capabilities.

For simple tasks, the included OpenChoice Desktop enables fast and easy communication between the oscilloscope and your PC through USB or LAN for transferring settings, waveforms, and screen images.

The MSO/DPO4000B Series can also be connected to your network using the LAN port. The included LXI web interface provides information about the current configuration of your MSO/DPO4000B Series oscilloscope, including network configuration. You can make changes to the network configuration of your MSO/DPO4000B Series oscilloscope directly from the web interface through a password-protected web page. Additionally, the popular e*Scope® remote instrument control is enabled on the MSO/DPO4000B Series. It continues to offer control of instrument settings, saving of screen images and instrument data, and saving/loading of instrument setups through a standard web browser.

Characteristics

Vertical System Analog Channels

Characteristic	DPO4034B MSO4034B	DPO4054B MSO4054B	DPO4104B MSO4104B
Input Channels		4	
Analog Bandwidth (–3 dB) 5 mV/div - 1 V/div	350 MHz	500 MHz	1 GHz
Calculated Rise Time 5 mV/div (typical)	1 ns	700 ps	350 ps
Hardware Bandwidth Limits		20 MHz or 250 MHz	
Input Coupling		AC, DC	
Input Impedance		1 MΩ ±1%, 50 Ω ±1%	
Input Sensitivity, 1 MΩ		1 mV/div to 10 V/div	
Input Sensitivity, 50 Ω		1 mV/div to 1 V/div	
Vertical Resolution		8 bits (11 bits with Hi Res)	
Max Input Voltage, 1 MΩ		300 V_{RMS} CAT II with peaks ≤ ±425 V	
Max Input Voltage, 50 Ω		5 V_{RMS} with peaks < ±20 V	
DC Gain Accuracy		±1.5%, derated at 0.10%/°C above 30 °C	
Channel-to-Channel Isolation	≥100:1 at ≤100 MHz and ≥30:1 at >100 MHz up to the rated bandwidth for any two channels having equal volts/div settings		

Offset Range

Range	1 MΩ	50 Ω
1 mV/div to 50 mV/div	±1 V	±1 V
50.5 mV/div to 99.5 mV/div	±0.5 V	±0.5 V
100 mV/div to 500 mV/div	±10 V	±10 V
505 mV/div to 995 mV/div	±5 V	±5 V
1 V/div to 5 V/div	±100 V	±5 V
5.05 V/div to 10 V/div	±50 V	NA

Vertical System Digital Channels

Characteristic	All MSO4000B Models
Input Channels	16 Digital (D15 - D0)
Thresholds	Per-channel Thresholds
Threshold Selections	TTL, CMOS, ECL, PECL, User Defined
User-defined Threshold Range	±40 V
Maximum Input Voltage	±42 V_{peak}
Threshold Accuracy	±(100 mV + 3% of threshold setting)
Input Dynamic Range	30 V_{p-p} ≤200 MHz 10 V_{p-p} >200 MHz
Minimum Voltage Swing	400 mV
Input Impedance	100 kΩ
Probe Loading	3 pF
Vertical Resolution	1 bit

Horizontal System Analog Channels

Characteristic	DPO4034B MSO4034B	DPO4054B MSO4054B	DPO4104B MSO4104B
Maximum Sample Rate (All channels)	2.5 GS/s	2.5 GS/s	5 GS/s
Maximum Record Length (All channels)		20M points	
Maximum Duration at Highest Sample Rate (All channels)	8 ms	8 ms	4 ms
Time Base Range		1 ns to 1,000 s	400 ps to 1,000 s
Time Base Delay Time Range		–10 divisions to 5000 s	
Channel-to-Channel Deskew Range		±125 ns	
Time Base Accuracy		±5 ppm over any ≥1 ms interval	

Horizontal System Digital Channels

Characteristic	All MSO4000B Models
Maximum Sample Rate (Main)	500 MS/s (2 ns resolution)
Maximum Record Length (Main)	20M points
Maximum Sample Rate (MagniVu)	16.5 GS/s (60.6 ps resolution)
Maximum Record Length (MagniVu)	10k points centered around the trigger
Minimum Detectable Pulse Width (Typical)	1 ns
Channel-to-Channel Skew (Typical)	200 ps
Maximum Input Toggle Rate	500 MHz Maximum frequency sine wave that can accurately be reproduced as a logic square wave. Requires the use of a short ground extender on each channel. This is the maximum frequency at the minimum swing amplitude. Higher toggle rates can be achieved with higher amplitudes.

Trigger System

Characteristic	Description
Main Trigger Modes	Auto, Normal, and Single
Trigger Coupling	DC, AC, HF reject (attenuates >50 kHz), LF reject (attenuates <50 kHz), noise reject (reduces sensitivity)
Trigger Holdoff Range	20 ns to 8 s

Trigger Level Range

Characteristic	Description
Any Channel	±8 divisions from center of screen
External (Auxiliary Input)	±8 V

Trigger Sensitivity

Characteristic	Description
Internal DC Coupled	
1 MΩ Path (All models)	For 1 mV/div to 4.98 mV/div; 0.75 div from DC to 50 MHz, increasing to 1.3 div at rated bandwidth
50 Ω Path (MSO/DPO4054B, MSO/DPO4034B)	For ≥5 mV/div; 0.4 div from DC to 50 MHz, increasing to 1 div at rated bandwidth
50 Ω Path (MSO/DPO4104B)	0.4 div from DC to 50 MHz, increasing to 1 div at rated bandwidth
External	
Auxiliary Input	200 mV from DC to 50 MHz, increasing to 500 mV at rated bandwidth

Trigger Modes

Mode	Description
Edge	Positive or negative slope on any channel or front-panel auxiliary input. Coupling includes DC, AC, HF reject, LF reject, and noise reject
Sequence (B-trigger)	Trigger Delay by Time – 4 ns to 8 s. Or Trigger Delay by Events – 1 to 4,000,000 events
Pulse Width	Trigger on width of positive or negative pulses that are >, <, =, or ≠ a specified period of time (4 ns to 8 s)
Timeout	Trigger when no pulse is detected within a specified time (4 ns to 8 s)
Runt	Trigger on a pulse that crosses one threshold but fails to cross a second threshold before crossing the first again
Logic	Trigger when any logical pattern of channels goes false or stays true for specified period of time (4 ns to 8 s). Any input can be used as a clock to look for the pattern on a clock edge. Pattern (AND, OR, NAND, NOR) specified for all analog and digital input channels defined as High, Low, or Don't Care
Setup and Hold	Trigger on violations of both setup time and hold time between clock and data present on any of the input channels
Rise/Fall Time	Trigger on pulse edge rates that are faster or slower than specified. Slope may be positive, negative, or either
Video	Trigger on all lines, odd, even, or all fields on NTSC, PAL, and SECAM video signals
Extended Video (Optional)	Trigger on 480p/60, 576p/50, 720p/30, 720p/50, 720p/60, 875i/60, 1080i/50, 1080i/60, 1080p/24, 1080p/24sF, 1080p/25, 1080p/30, 1080p/50, 1080p/60, and custom bi-level and tri-level sync video standards
I^2C (Optional)	Trigger on Start, Repeated Start, Stop, Missing ACK, Address (7 or 10 bit), Data, or Address and Data on I^2C buses up to 10 Mb/s
SPI (Optional)	Trigger on SS active, MOSI, MISO, or MOSI and MISO on SPI buses up to 50 Mb/s

Mode	Description
USB (Optional)	Low-speed: Trigger on Sync, Reset, Suspend, Resume, End of Packet, Token (Address) Packet, Data Packet, Handshake Packet, Special Packet, Error. Token packet trigger – Any token type, SOF, OUT, IN, SETUP; Address can be specified for Any Token, OUT, IN, and SETUP token types. Address can be further specified to trigger on ≤, <, =, >, ≥, ≠ a particular value, or inside or outside of a range. Frame number can be specified for SOF token using binary, hex, unsigned decimal and don't care digits. Data packet trigger – Any data type, DATA0, DATA1; Data can be further specified to trigger on ≤, <, =, >, ≥, ≠ a particular data value, or inside or outside of a range. Handshake packet trigger – Any handshake type, ACK, NAK, STALL. Special packet trigger – Any special type, Reserved. Error trigger – PID Check, CRC5 or CRC16, Bit Stuffing.
	Full-speed: Trigger on Sync, Reset, Suspend, Resume, End of Packet, Token (Address) Packet, Data Packet, Handshake Packet, Special Packet, Error. Token packet trigger – Any token type, SOF, OUT, IN, SETUP; Address can be specified for Any Token, OUT, IN, and SETUP token types. Address can be further specified to trigger on ≤, <, =, >, ≥, ≠ a particular value, or inside or outside of a range. Frame number can be specified for SOF token using binary, hex, unsigned decimal and don't care digits. Data packet trigger – Any data type, DATA0, DATA1; Data can be further specified to trigger on ≤, <, =, >, ≥, ≠ a particular data value, or inside or outside of a range. Handshake packet trigger – Any handshake type, ACK, NAK, STALL. Special packet trigger – Any special type, PRE, Reserved. Error trigger – PID Check, CRC5 or CRC16, Bit Stuffing.
	High-speed: Trigger on Sync, Reset, Suspend, Resume, End of Packet, Token (Address) Packet, Data Packet, Handshake Packet, Special Packet, Error. Token packet trigger – Any token type, SOF, OUT, IN, SETUP; Address can be specified for Any Token, OUT, IN, and SETUP token types. Address can be further specified to trigger on ≤, <, =, >, ≥, ≠ a particular value, or inside or outside of a range. Frame number can be specified for SOF token using binary, hex, unsigned decimal and don't care digits. Data packet trigger – Any data type, DATA0, DATA1, DATA2, DATAM; Data can be further specified to trigger on ≤, <, =, >, ≥, ≠ a particular data value, or inside or outside of a range. Handshake packet trigger – Any handshake type, ACK, NAK, STALL, NYET. Special packet trigger – Any special type, ERR, SPLIT, PING, Reserved. SPLIT packet components that can be specified include: Hub Address Start/Complete – Don't Care, Start (SSPLIT), Complete (CSPLIT) Port Address Start and End bits – Don't Care, Control/Bulk/Interrupt (Full-speed Device, Low-speed Device), Isochronous (Data is Middle, Data is End, Data is Start, Data is All) Endpoint Type – Don't Care, Control, Isochronous, Bulk, Interrupt Error trigger – PID Check, CRC5 or CRC16, Any. High-speed support only available on MSO4104B and DPO4104B models.
Ethernet (Optional)	10BASE-T: Trigger on Start Frame Delimiter, MAC Addresses, MAC Q-Tag Control Information, MAC Length/Type, IP Header, TCP Header, TCP/IPv4/MAC Client Data, End of Packet, FCS (CRC) Error. MAC Addresses – Trigger on Source and Destination 48-bit address values. MAC Q-Tag Control Information – Trigger on Q-Tag 32-bit value. MAC Length/Type – Trigger on ≤, <, =, >, ≥, ≠ a particular 16-bit value, or inside or outside of a range. IP Header – Trigger on IP Protocol 8-bit value, Source Address, Destination Address. TCP Header – Trigger on Source Port, Destination Port, Sequence Number, and Ack Number. TCP/IPv4/MAC Client Data – Trigger on ≤, <, =, >, ≥, ≠ a particular data value, or inside or outside of a range. Selectable number of bytes to trigger on from 1-16. Byte offset options of Don't Care, 0-1499.
	100BASE-TX: Trigger on Start Frame Delimiter, MAC Addresses, MAC Q-Tag Control Information, MAC Length/Type, IP Header, TCP Header, TCP/IPv4/MAC Client Data, End of Packet, Idle, FCS (CRC) Error. MAC Addresses – Trigger on Source and Destination 48-bit address values. MAC Q-Tag Control Information – Trigger on Q-Tag 32-bit value. MAC Length/Type – Trigger on ≤, <, =, >, ≥, ≠ a particular 16-bit value, or inside or outside of a range. IP Header – Trigger on IP Protocol 8-bit value, Source Address, Destination Address. TCP Header – Trigger on Source Port, Destination Port, Sequence Number, and Ack Number. TCP/IPv4/MAC Client Data – Trigger on ≤, <, =, >, ≥, ≠ a particular data value, or inside or outside of a range. Selectable number of bytes to trigger on from 1-16. Byte offset options of Don't Care, 0-1499.
CAN (Optional)	Trigger on Start of Frame, Frame Type (data, remote, error, overload), Identifier (standard or extended), Data, Identifier and Data, End of Frame, Missing ACK, or Bit Stuffing Error on CAN signals up to 1 Mb/s. Data can be further specified to trigger on ≤, <, =, >, ≥, or ≠ a specific data value. User-adjustable sample point is set to 50% by default
LIN (Optional)	Trigger on Sync, Identifier, Data, Identifier and Data, Wakeup Frame, Sleep Frame, Errors such as Sync, Parity, or Checksum Errors up to 100 Kb/s (by LIN definition, 20 Kb/s)
FlexRay (Optional)	Trigger on Start of Frame, Type of Frame (Normal, Payload, Null, Sync, Startup), Identifier, Cycle Count, Complete Header Field, Data, Identifier and Data, End of Frame or Errors such as Header CRC, Trailer CRC, Null Frame, Sync Frame, or Startup Frame Errors up to 100 Mb/s
RS-232/422/485/UART (Optional)	Trigger on Tx Start Bit, Rx Start Bit, Tx End of Packet, Rx End of Packet, Tx Data, Rx Data, Tx Parity Error, and Rx Parity Error up to 10 Mb/s
MIL-STD-1553 (Optional)	Trigger on Sync, Word Type, Parity Error. Data can be further specified to trigger on ≤, <, =, >, ≥, ≠ a specific data value, or inside or outside of a range.

Mode	Description
I²S/LJ/RJ/TDM (Optional)	Trigger on Word Select, Frame Sync, or Data. Data can be further specified to trigger on ≤, <, =, >, ≥, ≠ a specific data value, or inside or outside of a range Maximum data rate for I²S/LJ/RJ is 12.5 Mb/s Maximum data rate for TDM is 25 Mb/s
Parallel (Available on MSO models only)	Trigger on a parallel bus data value. Parallel bus can be from 1 to 20 bits in size. Binary and Hex radices are supported

Acquisition Modes

Mode	Description
Sample	Acquire sampled values
Peak Detect	Captures glitches as narrow as 800 ps (1 GHz models) or 1.6 ns (500 MHz and 350 MHz models) at all sweep speeds
Averaging	From 2 to 512 waveforms included in average
Envelope	Min-Max envelope reflecting Peak Detect data over multiple acquisitions
Hi Res	Real-time boxcar averaging reduces random noise and increases vertical resolution
Roll	Scrolls waveforms right to left across the screen at sweep speeds slower than or equal to 40 ms/div

Waveform Measurements

Measurement	Description
Cursors	Waveform and Screen
Automatic Measurements	29, of which up to four can be displayed on-screen at any one time. Measurements include: Period, Frequency, Delay, Rise Time, Fall Time, Positive Duty Cycle, Negative Duty Cycle, Positive Pulse Width, Negative Pulse Width, Burst Width, Phase, Positive Overshoot, Negative Overshoot, Peak-to-Peak, Amplitude, High, Low, Max, Min, Mean, Cycle Mean, RMS, Cycle RMS, Positive Pulse Count, Negative Pulse Count, Rising Edge Count, Falling Edge Count, Area and Cycle Area
Measurement Statistics	Mean, Min, Max, Standard Deviation
Reference Levels	User-definable reference levels for automatic measurements can be specified in either percent or units
Gating	Isolate the specific occurrence within an acquisition to take measurements on, using either the screen or waveform cursors
Waveform Histogram	A waveform histogram provides an array of data values representing the total number of hits inside of a user-defined region of the display. A waveform histogram is both a visual graph of the hit distribution as well as a numeric array of values that can be measured. Sources – Channel 1, Channel 2, Channel 3, Channel 4, Ref 1, Ref 2, Ref 3, Ref 4, Math Types – Vertical, Horizontal
Waveform Histogram Measurements	Waveform Count, Hits in Box, Peak Hits, Median, Max, Min, Peak-to-Peak, Mean, Standard Deviation, Sigma 1, Sigma 2, Sigma 3

Waveform Math

Characteristic	Description
Arithmetic	Add, subtract, multiply, and divide waveforms
Math Functions	Integrate, Differentiate, FFT
FFT	Spectral magnitude
	FFT Vertical Scale: Linear RMS or dBV RMS
	FFT Window Settings: Rectangular, Hamming, Hanning, Blackman Harris
Advanced Math	Define extensive algebraic expressions including waveforms, reference waveforms, math functions. Perform math on math using complex equations (FFT, Intg, Diff, Log, Exp, Sqrt, Abs, Sine, Cosine, Tangent, Rad, Deg), scalars, up to two user-adjustable variables and results of parametric measurements (Period, Freq, Delay, Rise, Fall, PosWidth, NegWidth, BurstWidth, Phase, PosDutyCycle, NegDutyCycle, PosOverShoot, NegOverShoot, PeakPeak, Amplitude, RMS, CycleRMS, High, Low, Max, Min, Mean, CycleMean, Area, CycleArea, and trend plots) e.g. (Intg(Ch1–Mean(Ch1))×1.414×VAR1)

Power Measurements (Optional)

Measurement	Description
Power Quality Measurements	V_{RMS}, $V_{Crest\ Factor}$, Frequency, I_{RMS}, $I_{Crest\ Factor}$, True Power, Apparent Power, Reactive Power, Power Factor, Phase Angle
Switching Loss Measurements	Power Loss: T_{on}, T_{off}, Conduction, Total
	Energy Loss: T_{on}, T_{off}, Conduction, Total
Harmonics	THD-F, THD-R, RMS measurements
	Graphical and table displays of harmonics
	Test to IEC61000-3-2 Class A and MIL-STD-1399
Ripple Measurements	V_{ripple} and I_{ripple}
Modulation Analysis	Graphical display of +Pulse Width, –Pulse Width, Period, Frequency, +Duty Cycle, and –Duty Cycle modulation types
Safe Operating Area	Graphical display and mask testing of switching device safe operating area measurements
dV/dt and dI/dt Measurements	Cursor measurements of slew rate

Limit/Mask Testing (Optional)

Characteristic	Description
Included Standard Masks	ITU-T, ANSI T1.102, USB
Test Source	Limit Test: Any Ch1 - Ch4 or any R1 - R4 Mask Test: Any Ch1 - Ch4
Mask Creation	Limit test vertical tolerance from 0 to 1 division in 1 m division increments; Limit test horizontal tolerance from 0 to 500 m division in 1 m division increments
	Load standard mask from internal memory
	Load custom mask from text file with up to 8 segments
Mask Scaling	Lock to Source ON (mask automatically re-scales with source-channel settings changes) Lock to Source OFF (mask does not re-scale with source-channel settings changes)
Test Criteria Run Until	Minimum number of waveforms (from 1 to 1,000,000; Infinity) Minimum elapsed time (from 1 second to 48 hours; Infinity)
Violation Threshold	From 1 to 1,000,000
Actions on Test Failure	Stop acquisition, save screen image to file, save waveform to file, print screen image, trigger out pulse, set remote interface SRQ
Actions on Test Complete	Trigger out pulse, set remote interface SRQ
Results Display	Test status, total waveforms, number of violations, violation rate, total tests, failed tests, test failure rate, elapsed time, total hits for each mask segment

Software

Software	Description
NI LabVIEW SignalExpress Tektronix Edition	A fully interactive measurement software environment optimized for the MSO/DPO4000B Series, enables you to instantly acquire, generate, analyze, compare, import, and save measurement data and signals using an intuitive drag-and-drop user interface that does not require any programming. Standard MSO/DPO4000B Series support for acquiring, controlling, viewing, and exporting your live signal data is permanently available through the software. The full version (SIGEXPTE) adds additional signal processing, advanced analysis, mixed signal, sweeping, limit testing, and user-defined step capabilities and is available for a 30-day trial period standard with each instrument.
OpenChoice® Desktop	Enables fast and easy communication between a Windows PC and the MSO/DPO4000B Series, using USB or LAN. Transfer and save settings, waveforms, measurements, and screen images. Included Word and Excel toolbars automate the transfer of acquisition data and screen images from the oscilloscope into Word and Excel for quick reporting or further analysis.
IVI Driver	Provides a standard instrument programming interface for common applications such as LabVIEW, LabWindows/CVI, Microsoft .NET and MATLAB.
e*Scope®	Enables control of the MSO/DPO4000B Series over a network connection through a standard web browser. Simply enter the IP address or network name of the oscilloscope followed by :81 (to represent connecting through Port 81) and a web page will be served to the browser
LXI Class C Web Interface	Connect to the MSO/DPO4000B Series through a standard web browser by simply entering the oscilloscope's IP address or network name in the address bar of the browser. The web interface enables viewing of instrument status and configuration, and status and modification of network settings. All web interaction conforms to LXI Class C specification.

Display Characteristics

Characteristic	Description
Display Type	10.4 in. (264 mm) liquid-crystal TFT color display
Display Resolution	1,024 horizontal × 768 vertical pixels (XGA)
Waveform Styles	Vectors, Dots, Variable Persistence, Infinite Persistence
Graticules	Full, Grid, Solid, Cross Hair, Frame, IRE, and mV
Format	YT and simultaneous XY/YT
Waveform Capture Rate	>50,000 wfm/s maximum

Input/Output Ports

Port	Description
USB 2.0 High-speed Host Port	Supports USB mass storage devices, printers and keyboard. Two ports on front and two ports on rear of instrument
USB 2.0 Device Port	Rear-panel connector allows for communication/control of oscilloscope through USBTMC or GPIB (with a TEK-USB-488), and direct printing to all PictBridge-compatible printers
LAN Port	RJ-45 connector, supports 10/100/1000 Mb/s
XGA Video Port	DB-15 female connector, connect to show the oscilloscope display on an external monitor or projector
Auxiliary Input	Front-panel BNC connector. Input Impedance 1 MΩ. Max input 300 V_{RMS} CAT II with peaks ≤ ±425 V
Probe Compensator Output	Front-panel pins Amplitude: 2.5 V Frequency: 1 kHz
Auxiliary Out	Rear-panel BNC connector V_{OUT} (Hi): ≥2.5 V open circuit, ≥1.0 V 50 Ω to ground V_{OUT} (Lo): ≤0.7 V into a load of ≤4 mA; ≤0.25 V 50 Ω to ground Output can be configured to provide a pulse out signal when the oscilloscope triggers, the internal oscilloscope reference clock out, or an event out for limit/mask testing
External Reference In	Time-base system can phase lock to an external 10 MHz reference (10 MHz ±1%)
Kensington Lock	Rear-panel security slot connects to standard Kensington lock

LAN eXtensions for Instrumentation (LXI)

Characteristic	Description
Class	LXI Class C
Version	V1.3

Power Source

Characteristic	Description
Power Source Voltage	100 to 240 V ±10%
Power Source Frequency	45 to 66 Hz (85 to 264 V) 360 to 440 Hz (100 to 132 V)
Power Consumption	225 W maximum

Physical Characteristics

Dimensions	mm	in.
Height	229	9.0
Width	439	17.3
Depth	147	5.8
Weight	**kg**	**lb.**
Net	5	11
Shipping	10.7	23.6
Rackmount Configuration	5U	
Cooling Clearance	2 in. (51 mm) required on left side and rear of instrument	
VESA Mount	Standard (MIS-D 100) 100 mm VESA mounting points on rear of instrument	

Environmental

Characteristic	Description
Temperature	
Operating	0 ºC to +50 ºC
Nonoperating	–20 ºC to +60 ºC
Humidity	
Operating	High: 40 ºC to 50 ºC, 10% to 60% Relative Humidity Low: 0 ºC to 40 ºC, 10% to 90% Relative Humidity
Nonoperating	High: 40 ºC to 60 ºC, 5% to 60% Relative Humidity Low: 0 ºC to 40 ºC, 5% to 90% Relative Humidity
Altitude	
Operating	9,843 ft. (3,000 m)
Nonoperating	30,000 ft. (9,144 m)
Regulatory	
Electromagnetic Compatibility	EC Council Directive 2004/108/EC
Safety	UL61010-1, Second Edition; CSA61010-1 Second Edition, EN61010-1:2001; IEC 61010-1:2001

Ordering Information

MSO/DPO4000B Family

Model	Description
DPO4000B Models	
DPO4034B	350 MHz, 2.5 GS/s, 20M record length, 4-channel digital phosphor oscilloscope
DPO4054B	500 MHz, 2.5 GS/s, 20M record length, 4-channel digital phosphor oscilloscope
DPO4104B	1 GHz, 5 GS/s, 20M record length, 4-channel digital phosphor oscilloscope
MSO4000B Models	
MSO4034B	350 MHz, 2.5 GS/s, 20M record length, 4+16 channel mixed signal oscilloscope
MSO4054B	500 MHz, 2.5 GS/s, 20M record length, 4+16 channel mixed signal oscilloscope
MSO4104B	1 GHz, 5 GS/s, 20M record length, 4+16 channel mixed signal oscilloscope

All Models Include: One passive voltage probe per analog channel (TPP0500 500 MHz, 10X, 3.9 pF for 500 MHz and 350 MHz models; TPP1000 1 GHz, 10X, 3.9 pF for 1 GHz models), Front Cover (200-5130-xx), User Manual (071-2810-xx), Documentation CD (063-4300-xx), OpenChoice® Desktop Software, NI LabVIEW SignalExpress™ Tektronix Edition Software, Calibration Certificates document measurement traceability to National Metrology Institute(s) – the Quality System this product is manufactured in is ISO9001 registered, power cord, accessory bag (016-2029-xx) and a three-year warranty. Please specify power plug and manual language version when ordering.

MSO Models also Include: One P6616 16-channel logic probe and a logic probe accessory kit (020-2662-xx).

Application Modules

Module	Description
DPO4AERO	Aerospace Serial Triggering and Analysis Module. Enables triggering on packet-level information on MIL-STD-1553 buses as well as analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time-stamp information. Signal Inputs – Any Ch1 - Ch4 (and any D0 - D15 on MSO models) Recommended Probing – Single ended
DPO4AUDIO	Audio Serial Triggering and Analysis Module. Enables triggering on packet-level information on I²S, LJ, RJ, and TDM audio buses as well as analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time-stamp information. Signal Inputs – Any Ch1 - Ch4 (and any D0 - D15 on MSO models) Recommended Probing – I²S, LJ, RJ, TDM: Single ended
DPO4AUTO	Automotive Serial Triggering and Analysis Module. Enables triggering on packet-level information on CAN and LIN buses as well as analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time-stamp information. Signal Inputs – LIN: Any Ch1 - Ch4 (and any D0 - D15 on MSO models); CAN: Any Ch1 - Ch4 (and any D0 - D15 on MSO models), single-ended probing only Recommended Probing – LIN: Single ended; CAN: Single ended or differential
DPO4AUTOMAX	Extended Automotive Serial Triggering and Analysis Module. Enables triggering on packet-level information on CAN, LIN, and FlexRay buses as well as analytical tools such as digital views of the signal, bus views, packet decoding, search tools, packet decode tables with time-stamp information, and eye diagram analysis software. Signal Inputs – LIN: Any Ch1 - Ch4 (and any D0 - D15 on MSO models); CAN: Any Ch1 - Ch4 (and any D0 - D15 on MSO models), single-ended probing only; FlexRay: Any Ch1 - Ch4 (and any D0 - D15 on MSO models), single-ended probing only Recommended Probing – LIN: Single ended; CAN, FlexRay: Single ended or differential
DPO4COMP	Computer Serial Triggering and Analysis Module. Enables triggering on packet-level information on RS-232/422/485/UART buses as well as analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time-stamp information. Signal Inputs – Any Ch1 - Ch4 (and any D0 - D15 on MSO models), single-ended probing only Recommended Probing – RS-232/UART: Single ended; RS-422/485: Differential
DPO4EMBD	Embedded Serial Triggering and Analysis Module. Enables triggering on packet-level information on I²C and SPI buses as well as analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time-stamp information. Signal Inputs – I²C: Any Ch1 - Ch4 (and any D0 - D15 on MSO models); SPI: Any Ch1 - Ch4 (and any D0 - D15 on MSO models) Recommended Probing – I²C, SPI: Single ended
DPO4ENET	Ethernet Serial Triggering and Analysis Module. Enables triggering on packet-level information on 10BASE-T and 100BASE-TX buses as well as analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time-stamp information. Signal Inputs – Any Ch1 - Ch4 Recommended Probing – 10BASE-T: Single ended or differential; 100BASE-TX: Differential
DPO4USB	USB Serial Triggering and Analysis Module. Enables triggering on packet-level content for low-speed, full-speed, and high-speed USB serial buses. Also enables analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time-stamp information for low-speed, full-speed, and high-speed USB serial buses. Signal Inputs – Low-speed and Full-speed: Any Ch1 - Ch4 (and any D0 - D15 on MSO models) for single ended, Any Ch1 - Ch4 for differential; High-speed: Any Ch1 - Ch4 Recommended Probing – Low-speed and Full-speed: Single ended or differential; High-speed: Differential USB high-speed supported only on MSO4104B and DPO4104B models
DPO4PWR	Power Analysis Application Module. Enables quick and accurate analysis of power quality, switching loss, harmonics, safe operating area (SOA), modulation, ripple, and slew rate (dI/dt, dV/dt)
DPO4LMT	Limit and Mask Testing Application Module. Enables testing against limit templates generated from "golden" waveforms and mask testing using custom or standard telecommunications or computer masks
DPO4VID	HDTV and Custom (nonstandard) Video Triggering Module

Instrument Options

Power Plug Options

Option	Description
Opt. A0	North America
Opt. A1	Universal Euro
Opt. A2	United Kingdom
Opt. A3	Australia
Opt. A5	Switzerland
Opt. A6	Japan
Opt. A10	China
Opt. A11	India
Opt. A99	No power cord or AC adapter

Language Options*[1]

Option	Description
Opt. L0	English manual
Opt. L1	French manual
Opt. L2	Italian manual
Opt. L3	German manual
Opt. L4	Spanish manual
Opt. L5	Japanese manual
Opt. L6	Portuguese manual
Opt. L7	Simplified Chinese manual
Opt. L8	Traditional Chinese manual
Opt. L9	Korean manual
Opt. L10	Russian manual
Opt. L99	No manual

*[1] Language options include a translated front-panel overlay for the selected language(s).

Service Options*[2]

Option	Description
Opt. CA1	Provides a single calibration event, or coverage for the designated calibration interval, whichever comes first.
Opt. C3	Calibration Service 3 years
Opt. C5	Calibration Service 5 years
Opt. D1	Calibration Data Report
Opt. D3	Calibration Data Report 3 years (with Opt. C3)
Opt. D5	Calibration Data Report 5 Years (with Opt. C5)
Opt. R5	Repair Service 5 years (including warranty)

*[2] Probes and accessories are not covered by the oscilloscope warranty and service offerings. Refer to the datasheet of each probe and accessory model for its unique warranty and calibration terms.

Recommended Probes

Tektronix offers over 100 different probes to meet your application needs. For a comprehensive listing of available probes, please visit www.tektronix.com/probes.

Probe	Description
TPP0500	500 MHz, 10X TekVPI® passive voltage probe with 3.9 pF input capacitance
TPP1000	1 GHz, 10X TekVPI passive voltage probe with 3.9 pF input capacitance
TAP1500	1.5 GHz TekVPI active single-ended voltage probe
TDP1500	1.5 GHz TekVPI differential voltage probe with ±25 V differential input voltage
TDP1000	1 GHz TekVPI differential voltage probe with ±42 V differential input voltage
TDP0500	500 MHz TekVPI differential voltage probe with ±42 V differential input voltage
TCP0150	20 MHz TekVPI 150 Ampere AC/DC current probe
TCP0030	120 MHz TekVPI 30 Ampere AC/DC current probe
P5200	1.3 kV, 25 MHz high-voltage differential probe
P5205*[3]	1.3 kV, 100 MHz high-voltage differential probe
P5210*[3]	5.6 kV, 50 MHz high-voltage differential probe
P5100	2.5 kV, 100X high-voltage passive probe

*[3] Requires TekVPI® to TekProbe BNC adapter (TPA-BNC).

Recommended Accessories

Accessory	Description
077-0512-xx	Service Manual (English only)
SIGEXPTE	NI LabVIEW SignalExpress™ Tektronix Edition Software (Full Version)
FPGAView-xx	MSO Support for Altera and Xilinx FPGAs
TPA-BNC	TekVPI-to-TekProbe BNC Adapter
TEK-USB-488	GPIB-to-USB Adapter
ACD4000B	Soft Transit Case
HCTEK54	Hard Transit Case (Requires ACD4000B)
RMD5000	Rackmount Kit
TEK-DPG	Deskew Pulse Generator
067-1686-xx	Deskew Fixture

Warranty

Three-year warranty covering all parts and labor, excluding probes.

CE

ISO 9001 Product(s) are manufactured in ISO registered facilities.

GPIB IEEE-488 Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.

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For Further Information. Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit **www.tektronix.com**

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