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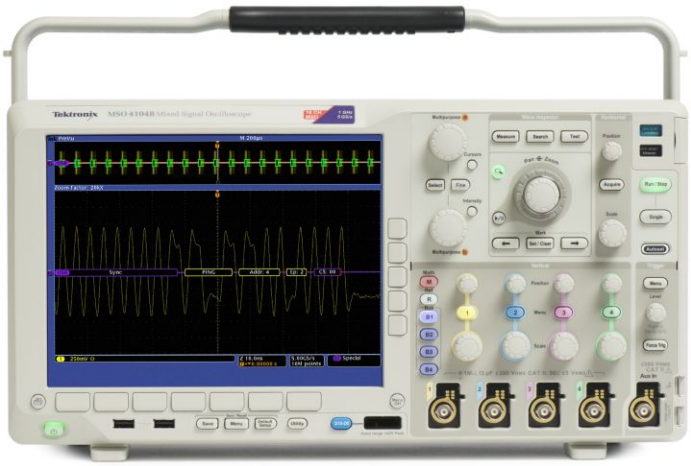
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Mixed Signal Oscilloscopes

MSO4000B, DPO4000B Series Datasheet



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 up to 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 deep record length of up to 20M points standard on all channels. And with Wave Inspector® controls for rapid waveform navigation, automated serial and parallel bus analysis, limit and mask testing, and automated power analysis – your Tektronix oscilloscope provides the feature-rich tools you need to simplify and speed debug of your complex design.

Key performance specifications

- 1 GHz, 500 MHz, 350 MHz, and 100 MHz bandwidth models
- 2 and 4 analog channel models
- Up to 5 GS/s sample rate on all channels
- Up to 20 mega-point 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

Key features

- Wave Inspector® controls provide easy navigation and automated search of waveform data
- 41 automated measurements, and FFT analysis for simplified waveform analysis
- 16 digital channels (MSO series)
- 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 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
- 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 the 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

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Optional application support

- Power analysis
- Limit and mask testing
- HDTV and custom video analysis

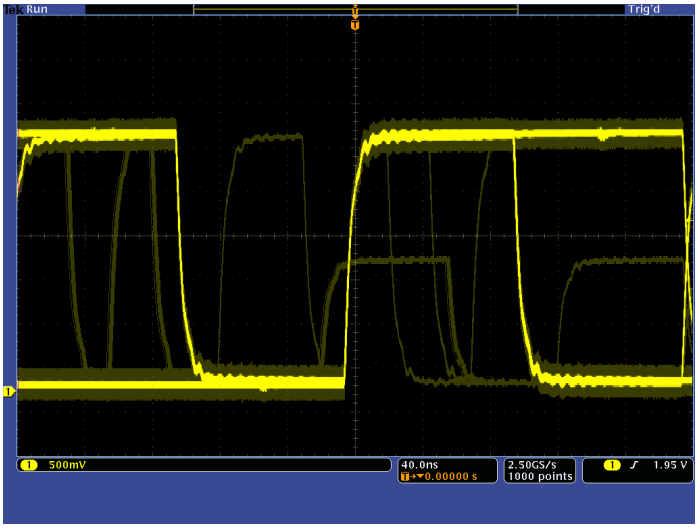
Comprehensive features speed every stage of debug

These oscilloscopes offer 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 industry's most complete visualization of signals provides 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.



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

Capture

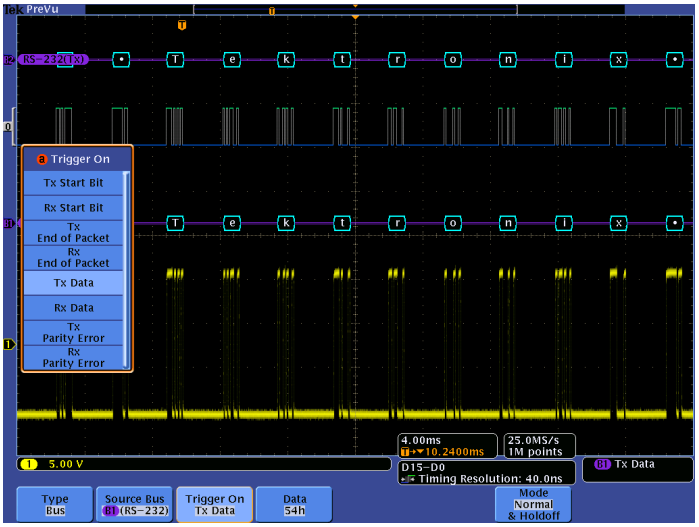
Discovering a device fault is only the first step. Next, you must capture the event of interest to identify root cause.

Accurately capturing any signal of interest begins with proper probing. Low-capacitance probes are included with the oscilloscope, one for each analog channel. 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.

A complete set of triggers - including runt, timeout, logic, pulse width/glitch, setup/hold violation, serial packet, and parallel data - help you 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 oscilloscope 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 oscilloscope 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 on these channels enables you to acquire fine signal detail (up to 60.6 ps resolution) around the trigger point for precision timing measurements. MagniVu is essential for making accurate timing measurements for setup and hold, clock delay, signal skew, and glitch characterization.



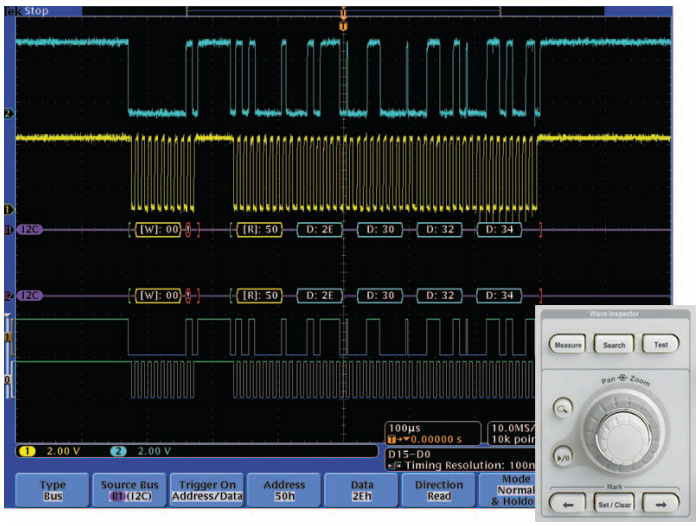
Capture - Triggering on a specific transmit data packet going across an RS-232 bus. A complete set of triggers, including triggers for specific serial packet content, ensures you quickly capture your event of interest.

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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 innovative Wave Inspector® controls give you the industry's most comprehensive search and waveform navigation capability. 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.



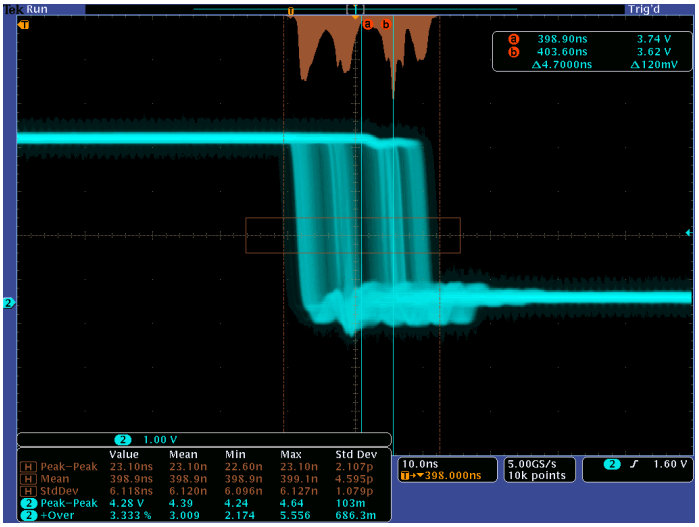
Search – I²C decode showing results from a Wave Inspector search for Address value 50. Wave Inspector controls provide unprecedented efficiency in viewing and navigating waveform data.

Analyze

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 oscilloscope offers a comprehensive set of integrated analysis tools including waveform- and screen-based cursors, automated measurements, advanced waveform math including arbitrary equation editing, 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, 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, limit testing, data logging, and customizable reports.



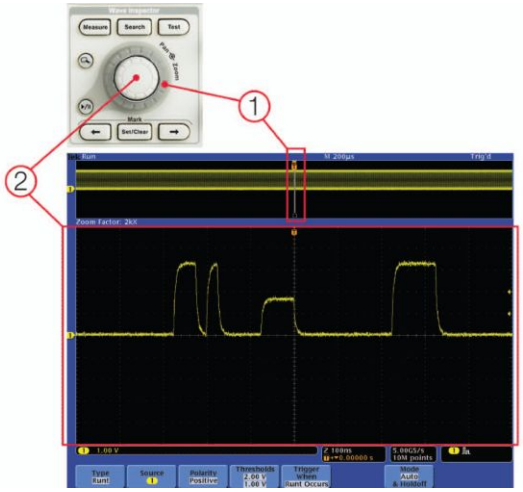
Analyze – Waveform histogram of a falling edge showing the distribution of edge position (jitter) over time. Included are numeric measurements made on the waveform histogram data. A comprehensive set of integrated analysis tools speeds verification of your design's performance.

Mixed domain analysis

Working with RF signals? Be sure to check out the MDO4000 Series - the world's first Mixed Domain Oscilloscope. Built on the MSO4000B oscilloscope platform, the MDO4000 Series offers a built-in spectrum analyzer (up to 6 GHz). This combination offers you the ability to capture time-correlated analog, digital, and RF signals in a single instrument. For more information on the MDO4000 Series, please visit www.tektronix.com/mdo4000.

Wave Inspector® navigation and search

With long record lengths, a single acquisition can include thousands of screens of waveform data. Wave Inspector®, the industry's best tool for navigation and search, enables you to find events of interest in seconds.



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

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Zoom and 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

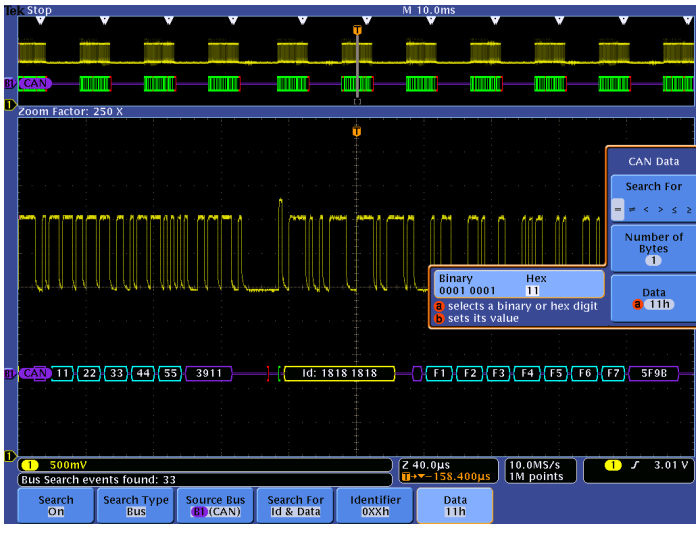
A dedicated **Play/Pause** front-panel button scrolls the waveform across the display automatically while you look for anomalies or an event of interest. Playback speed and direction are controlled using the intuitive pan control. Once again, turning the control further makes the waveform scroll faster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

User marks

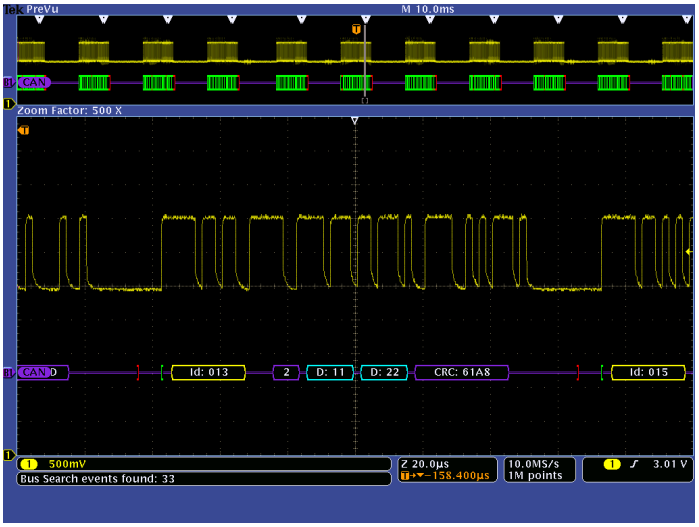
Press the **Set Mark** front-panel button to place one or more marks on the waveform. Navigating between marks is as simple as pressing the **Previous** (←) and **Next** (→) buttons on the front panel.

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.



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



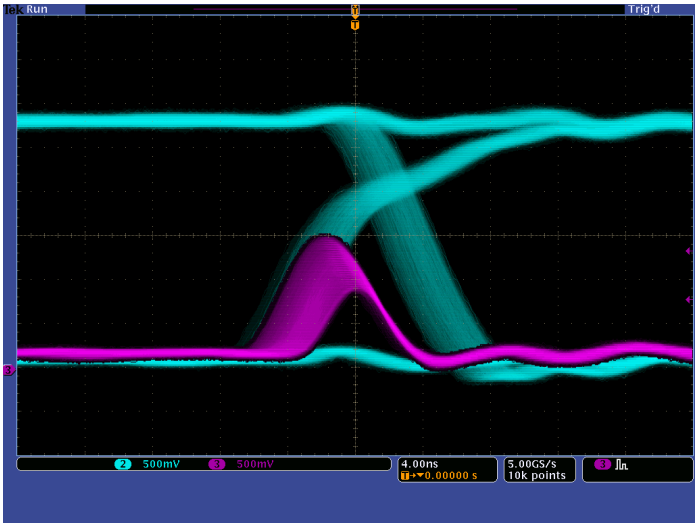
Search step 2: Wave Inspector automatically searches through the record and marks each event with a hollow white triangle. You can then use the Previous and Next buttons to jump from one event to the next.

Digital phosphor technology

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.

You can choose infinite persistence or variable persistence, determining how long the previous waveform acquisitions stay on-screen. This allows you to determine how often an anomaly is occurring.



Digital phosphor technology enables greater than 50,000 wfms/s waveform capture rate and real-time intensity grading.

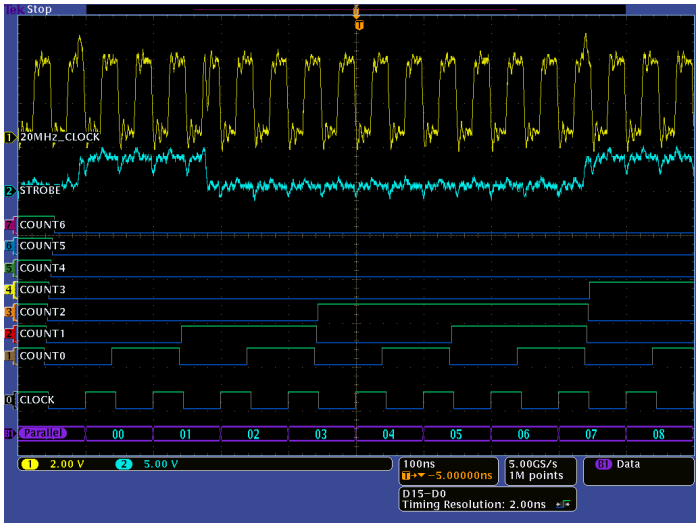
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Accurate high-speed probing

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 or exceeds 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. In addition, a low-attenuation, 2X version of the TPP probes is available for measuring low voltages. Unlike other low-attenuation passive probes, the TPP0502 has high bandwidth (500 MHz) as well as low capacitive loading (12.7 pF).

Mixed signal design and analysis (MSO series)

The MSO models provide 16 digital channels which are tightly integrated into the oscilloscope's user interface. This simplifies operation and makes it possible to solve mixed-signal issues easily.

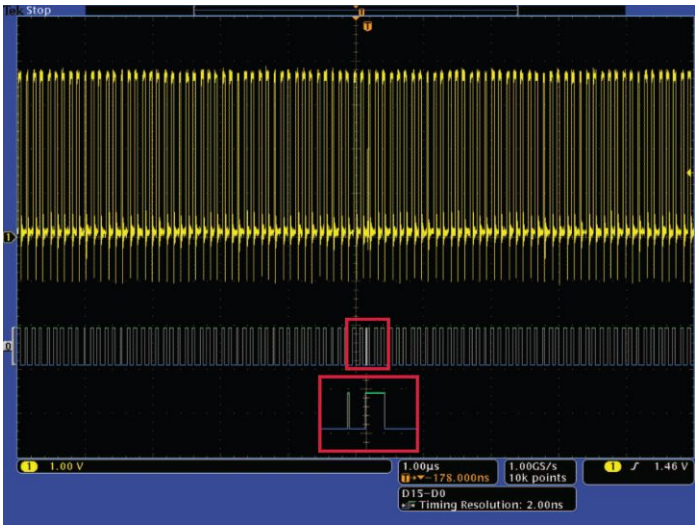


The MSO Series provides 16 integrated digital channels enabling you to view and analyze time-correlated analog and digital signals.

Color-coded digital waveform display

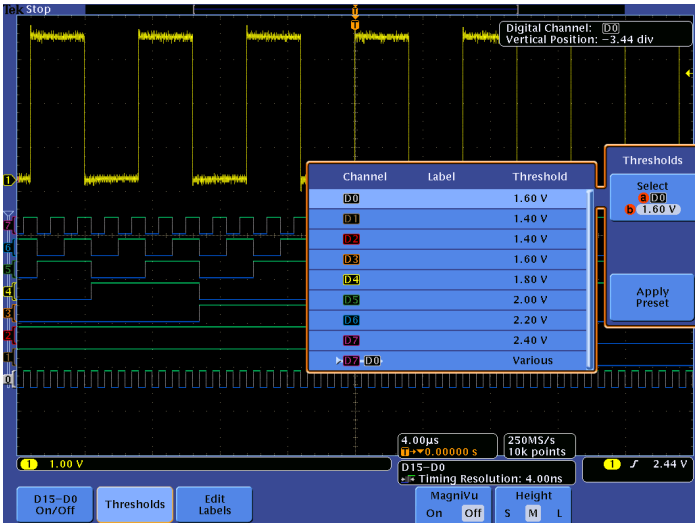
This oscilloscope has redefined the way you view digital waveforms. One common problem shared by both logic analyzers and mixed-signal oscilloscopes is determining if data is a one or a zero when zoomed in far enough that the digital trace stays flat all the way across the display. Color-coded digital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

The multiple transition detection hardware shows 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.



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

You can 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.



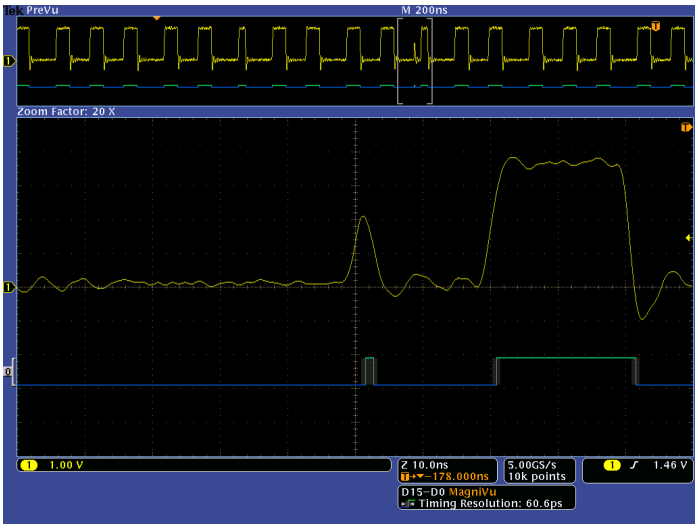
With color-coded digital waveform display, groups are created by simply placing digital channels together on the screen, allowing digital channels to be moved as a group. You can set threshold values for each channel, enabling support for up to 16 different logic families.

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.

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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 oscilloscope 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.



The MagniVu high-resolution record provides 60.6 ps timing resolution, enabling you to make critical timing measurements on your 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 is capable of acquiring toggle rates >500 MHz and pulses as short as 1 ns in duration.



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

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. Automatic trigger, decode, and search on bus events and conditions gives you a robust set of tools for debugging serial buses.



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.

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Capabilities of the serial triggering application modules

Technology		Trigger	Bus decode	Event table	Search	Order product
Embedded	I^2C	■	■	■	■	DPO3EMBD
	SPI	■	■	■	■	DPO3EMBD
Computer	RS232/422/485, UART	■	■	■	■	DPO3COMP
Automotive	CAN	■	■	■	■	DPO3AUTO
	LIN	■	■	■	■	DPO3AUTO
	FlexRay	■	■	■	■	DPO3FLEX
Military and aerospace	MIL-STD-1553	■	■	■	■	DPO3AERO
Audio	I^2S	■	■	■	■	DPO3AUDIO
	LJ, RJ	■	■	■	■	DPO3AUDIO
	TDM	■	■	■	■	DPO3AUDIO

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 I^2C, SPI, USB, Ethernet, CAN, LIN, FlexRay, RS-232/422/485/UART, MIL-STD-1553, and I^2S/LJ/RJ/TDM.

Bus display

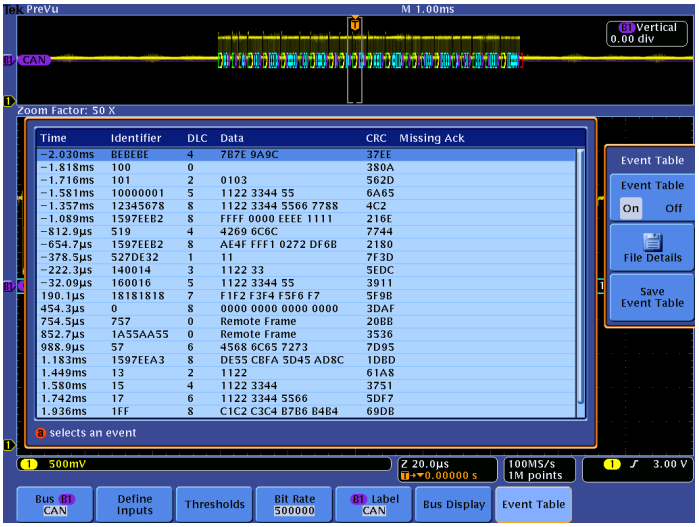
Provides a higher-level, combined view of the individual signals (clock, data, chip enable, etc.) that make up your bus, making it easy to identify where packets begin and end and identifying sub-packet components such as address, data, identifier, CRC, etc.

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 (I^2S/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 all 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.). You can save the event table data in .csv format.



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

Search (serial triggering)

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. 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.

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Power analysis (optional)

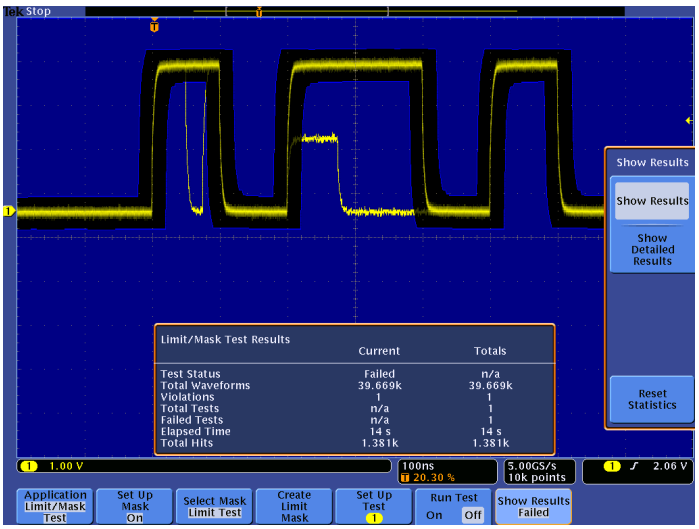
Ever increasing consumer demand for longer battery-life devices and for green solutions that consume less power require power-supply designers to characterize and minimize switching losses to improve efficiency. In addition, the supply's power levels, output purity, and harmonic feedback into the power 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 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.



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

Limit/Mask testing

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.



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.

Video design and development

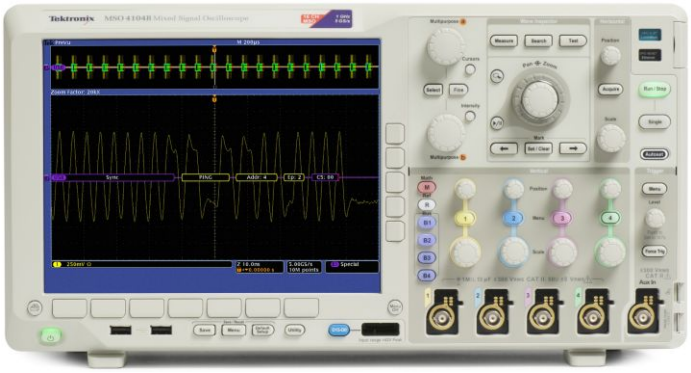
Many video engineers have remained loyal to analog oscilloscopes, believing the intensity gradations on an analog display are the only way to see certain video waveform details. The fast waveform capture rate, coupled with its intensity-graded view of the signal, provides the same information-rich display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

Standard features such as IRE and mV graticules, holdoff by fields, video polarity, and an Autoset smart enough to detect video signals, make these the easiest to use oscilloscopes on the market for video applications. And with high bandwidth and four analog inputs, the oscilloscope provides ample performance for analog and digital video use.

The video functionality is further extended with an optional video application module, which provides the industry's most complete suite of HDTV and custom (nonstandard) video triggers.

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Designed to make your work easier



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 screen shots, instrument settings, and waveform data to a USB mass storage device.



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

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 mass storage device. 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

With the compact, portable form factor, you can easily move the oscilloscope between labs. And with a depth of just 5.8 inches (147 mm), it saves you valuable space on your test bench.

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 comp 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.



TekVPI probe interface simplifies connecting your probes to the oscilloscope.

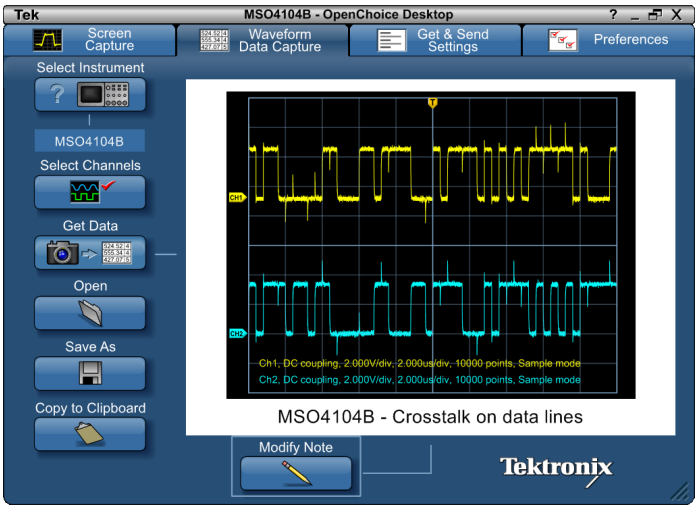
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Extended analysis

Exporting data and measurements is as simple as connecting a USB cable from the oscilloscope to your PC. Key software applications – NI LabVIEW SignalExpress™ Tektronix Edition LE, 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.

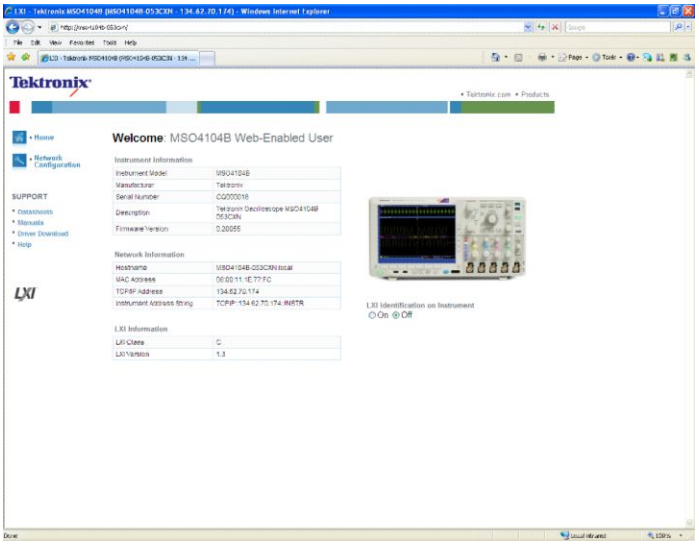
NI LabVIEW SignalExpress Tektronix Edition LE enables you to instantly acquire, generate, analyze, compare, import, and save measurement data and signals using an intuitive drag-and-drop user interface that does not require any programming. The optional Professional Version offers over 200 built-in functions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



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

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. The LXI web interface also provides remote instrument control through the popular e*Scope web-based instrument control capability. You can make changes to the network configuration, control instrument settings, save screen images and instrument data, and save/load instrument setups of your oscilloscope directly from the web interface through a password-protected web page.



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

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Specifications

All specifications apply to all models unless noted otherwise.

Model overview

	DPO4014B, MSO4014B	DPO4034B, MSO4034B	DPO4054B, MSO4054B	DPO4102B-L, MSO4102B-L	DPO4102B, MSO4102B	DPO4104B-L, MSO4104B-L	DPO4104B, MSO4104B
Analog channels	4	4	4	2	2	4	4
Bandwidth	100 MHz	350 MHz	500 MHz	1 GHz	1 GHz	1 GHz	1 GHz
Rise time	3.5 ns	1 ns	700 ps	350 ps	350 ps	350 ps	350 ps
Sample rate (1 ch)	2.5 GS/s	2.5 GS/s	2.5 GS/s	5 GS/s	5 GS/s	5 GS/s	5 GS/s
Sample rate (2 ch)	2.5 GS/s	2.5 GS/s	2.5 GS/s	2.5 GS/s	5 GS/s	5 GS/s	5 GS/s
Sample rate (4 ch)	2.5 GS/s	2.5 GS/s	2.5 GS/s	—	—	2.5 GS/s	5 GS/s
Record length (1 ch)	20M	20M	20M	5M	20M	5M	20M
Record length (2 ch)	20M	20M	20M	5M	20M	5M	20M
Record length (4 ch)	20M	20M	20M	—	—	5M	20M
Duration at highest sample rate	8 ms	8 ms	8 ms	1 ms	4 ms	1 ms	4 ms
Digital channels	MSO models add 16 digital channels to the corresponding DPO model						

Vertical system analog channels

Hardware bandwidth limits

≥350 MHz models 20 MHz or 250 MHz

100 MHz models 20 MHz

Input coupling AC, DC

Input impedance 1 MΩ ±1%, 50 Ω ±1%

Input sensitivity range

1 MΩ 1 mV/div to 10 V/div

50 Ω 1 mV/div to 1 V/div

Vertical resolution 8 bits (11 bits with Hi Res)

Maximum input voltage

1 MΩ 300 V_{RMS} CAT II with peaks ≤ ±425 V

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 Any two channels at equal vertical scale ≥100:1 at ≤100 MHz and ≥30:1 at >100 MHz up to the rated bandwidth

Offset range

Volts/div setting	Offset range	
	1 MΩ input	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	±10V
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

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Vertical system digital channels

Input channels	16 digital (D15 to D0)
Thresholds	Per-channel thresholds
Threshold selections	TTL, CMOS, ECL, PECL, User-defined
User-defined threshold range	±40 V
Threshold accuracy	±[100 mV + 3% of threshold setting]
Maximum input voltage	±42 V_{peak}
Input dynamic range	30 V_{p-p} ≤200 MHz
	10 V_{p-p} >200 MHz
Minimum voltage swing	400 mV
Probe loading	100 kΩ in parallel with 3 pF
Vertical resolution	1 bit

Horizontal system analog channels

Time base range	
1 GHz models	400 ps to 1000 s
≤ 500 MHz models	1 ns to 1000 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

Maximum sample rate (Main)	500 MS/s (2 ns resolution)
Maximum record length (Main)	20M points (5M points on -L models)
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.)

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Trigger system

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 sensitivity

Internal DC coupled

Trigger source	Sensitivity
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 (≤500 MHz models)	For ≥5 mV/div; 0.4 div from DC to 50 MHz, increasing to 1 div at rated bandwidth
50 Ω path (1 GHz models)	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 level ranges

Any input channel ±8 divisions from center of screen, ±8 divisions from 0 V when vertical LF reject trigger coupling is selected

Aux Input (external trigger) ±8 V

Line The line trigger level is fixed at about 50% of the line voltage.

Trigger frequency readout Provides 6-digit frequency readout of triggerable events.

Trigger types

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 inside/outside a specified period of time.

Timeout Trigger on an event which remains high, low, or either, for a specified time period (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. 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 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 analog and digital 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, Start of Frame, MOSI, MISO, or MOSI and MISO on SPI buses up to 50.0 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.

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USB: Low speed (optional)	Trigger on Sync Active, Start of Frame, 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.
USB: Full speed (optional)	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.
USB: High speed (optional)[1]	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, MDATA; 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.

1 High-speed support only available on models with 1 GHz analog channel bandwidth.

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Ethernet (optional) [2]	10BASE-T and 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, and FCS (CRC) Error. 100BASE-TX: Idle. 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.
MIL-STD-1553 (optional)	Trigger on Sync, Word Type [3] (Command, Status, Data), Command Word (set RT Address, T/R, Sub-address/Mode, Data Word Count/Mode Code, and Parity individually), Status Word (set RT Address, Message Error, Instrumentation, Service Request Bit, Broadcast Command Received, Busy, Subsystem Flag, Dynamic Bus Control Acceptance (DBCA), Terminal Flag, and Parity individually), Data Word (user-specified 16-bit data value), Error (Sync, Parity, Manchester, Non-contiguous data), Idle Time (minimum time selectable from 2 µs to 100 µs; maximum time selectable from 2 µs to 100 µs; trigger on < minimum, > maximum, inside range, outside range). RT Address can be further specified to trigger on =, ≠, <, >, ≤, ≥ a particular value, or inside or outside of a range.
I^2S/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 I^2S/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 16 bits (from the digital channels) plus 2 or 4 bits (from the analog channels) in size. Binary and Hex radices are supported.

Acquisition system

Acquisition Modes

Sample	Acquire sampled values.
Peak Detect	Captures glitches as narrow as 800 ps (1 GHz models) or 1.6 ns (≤500 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.

2 ≥350 MHz bandwidth models are recommended for 100BASE-TX

3 Trigger selection of Command Word will trigger on Command and ambiguous Command/Status words. Trigger selection of Status Word will trigger on Status and ambiguous Command/Status words.

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Waveform measurements

Cursors	Waveform and Screen.
Automatic measurements (time domain)	29, of which up to eight 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

Arithmetic	Add, subtract, multiply, and divide waveforms.
Math functions	Integrate, Differentiate, FFT.
FFT	Spectral magnitude. Set FFT Vertical Scale to Linear RMS or dBV RMS, and FFT Window to Rectangular, Hamming, Hanning, or Blackman-Harris.
Advanced math	Define extensive algebraic expressions including waveforms, reference waveforms, math functions (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)

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, Section 300A.
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.

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Limit/Mask testing (optional)

Included standard masks[4]	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

NI LabVIEW SignalExpress™ Tektronix Edition	A fully interactive measurement software environment optimized for your Tektronix oscilloscope, 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 support for acquiring, controlling, viewing, and exporting your live analog-channel 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 your oscilloscope 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® Web-based remote control	Enables control of the oscilloscope over a network connection through a standard web browser. Simply enter the IP address or network name of the oscilloscope and a web page will be served to the browser.
LXI Class C Web interface	Connect to the oscilloscope 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, status and modification of network settings, and instrument control through the e*Scope Web-based remote control. All Web interaction conforms to LXI Class C specification, version 1.3.

4 ≥350 MHz bandwidth models are recommended for mask testing on telecomm standards >55 Mb/s. 1 GHz bandwidth models are recommended for mask testing on high-speed (HS) USB.

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Display system

Display type	10.4 in. (264 mm) liquid-crystal TFT color display
Display resolution	1,024 horizontal × 768 vertical pixels (XGA)
Interpolation	Sin(x)/x
Waveform styles	Vectors, Dots, Variable Persistence, Infinite Persistence.
Graticules	Full, Grid, Cross Hair, Frame, IRE and mV.
Format	YT and simultaneous XY/YT
Maximum waveform capture rate	>50,000 wfm/s.

Input/output ports

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
Video out port	DB-15 female connector, connect to show the oscilloscope display on an external monitor or projector. XGA resolution.
Auxiliary input	Front-panel BNC connector. Input Impedance 1 MΩ. Max input 300 V_{RMS} CAT II with peaks ≤ ±425 V.
Probe compensator output voltage and frequency	Front-panel pins
Amplitude	0 to 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 input	Time-base system can phase lock to an external 10 MHz reference (10 MHz ±1%)
Kensington-style lock	Rear-panel security slot connects to standard Kensington-style lock.
VESA mount	Standard (MIS-D 100) 100 mm VESA mounting points on rear of instrument.

LAN eXtensions for Instrumentation (LXI)

Class	LXI Class C
Version	V1.3

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Power source

Power source voltage 100 to 240 V ±10%

Power source frequency 50 to 60 Hz ±10% at 100 to 240 V ±10%

400 Hz ±10% at 115 V ±13%

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

EMC, environment, and safety

Temperature

Operating 0 ºC to +50 ºC (+32 ºF to 122 ºF)

Nonoperating -20 ºC to +60 ºC (-4 ºF to 140 ºF)

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 3,000 meters (9,843 feet)

Nonoperating 9,144 meters (30,000 feet)

Regulatory

Electromagnetic compatibility EC Council Directive 2004/108/EC

Safety UL61010-1:2004, CAN/CSA-C22.2 No. 61010.1: 2004, Low Voltage Directive 2006/95/EC and EN61010-1:2001, IEC 61010-1:2001, ANSI 61010-1-2004, ISA 82.02.01

Ordering information

MSO/DPO4000B family

DPO4014B 100 MHz, 2.5/2.5/2.5 GS/s on 1/2/4 channels, 20M record length, 4-channel digital phosphor oscilloscope

DPO4034B 350 MHz, 2.5/2.5/2.5 GS/s on 1/2/4 channels, 20M record length, 4-channel digital phosphor oscilloscope

DPO4054B 500 MHz, 2.5/2.5/2.5 GS/s on 1/2/4 channels, 20M record length, 4-channel digital phosphor oscilloscope

DPO4102B-L 1 GHz, 5/2.5 GS/s on 1/2 channels, 5M record length, 2-channel digital phosphor oscilloscope

DPO4102B 1 GHz, 5/5 GS/s on 1/2 channels, 20M record length, 2-channel digital phosphor oscilloscope

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DPO4104B-L	1 GHz, 5/5/2.5 GS/s on 1/2/4 channels, 5M record length, 4-channel digital phosphor oscilloscope
DPO4104B	1 GHz, 5/5/5 GS/s on 1/2/4 channels, 20M record length, 4-channel digital phosphor oscilloscope
MSO4014B	100 MHz, 2.5/2.5/2.5 GS/s on 1/2/4 channels, 20M record length, 4+16 channel mixed signal oscilloscope
MSO4034B	350 MHz, 2.5/2.5/2.5 GS/s on 1/2/4 channels, 20M record length, 4+16 channel mixed signal oscilloscope
MSO4054B	500 MHz, 2.5/2.5/2.5 GS/s on 1/2/4 channels, 20M record length, 4+16 channel mixed signal oscilloscope
MSO4102B-L	1 GHz, 5/2.5 GS/s on 1/2 channels, 5M record length, 2+16 channel mixed signal oscilloscope
MSO4102B	1 GHz, 5/5 GS/s on 1/2 channels, 20M record length, 2+16 channel mixed signal oscilloscope
MSO4104B-L	1 GHz, 5/5/2.5 GS/s on 1/2/4 channels, 5M record length, 4+16 channel mixed signal oscilloscope
MSO4104B	1 GHz, 5/5/5 GS/s on 1/2/4 channels, 20M record length, 4+16 channel mixed signal oscilloscope

Standard accessories

Probes

≤500 MHz models	TPP0500, 500 MHz bandwidth, 10X, 3.9 pF. One passive voltage probe per analog channel.
1 GHz models	TPP1000, 1 GHz bandwidth, 10X, 3.9 pF. One passive voltage probe per analog channel.
MSO models also include	One P6616 16-channel logic probe and a logic probe accessory kit (020-2662-xx).

Accessories

200-5130-xx	Front cover
063-4300-xx	Documentation CD
016-2030-xx	Accessory bag
—	User manual
—	Power cord
—	OpenChoice® Desktop Software
—	NI LabVIEW SignalExpress™ Tektronix Edition Software
—	Calibration certificate documenting traceability to National Metrology Institute(s) and ISO9001 quality system registration

Warranty

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

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Application Modules

Application modules have licenses which can be transferred between an application module and an oscilloscope. The license may be contained in the module; allowing the module to be moved from one instrument to another. Or, the license can be contained in the oscilloscope; allowing the module to be removed and stored for safekeeping. Transferring the license to an oscilloscope and removing the module permits the use of more than 4 applications simultaneously.

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, Math, Ref1 - Ref4 Recommended Probing - Differential or single ended (only one single-ended signal required)
DPO4AUDIO	Audio Serial Triggering and Analysis Module. Enables triggering on packet-level information on I^2S, 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. [5] Signal Inputs - Any Ch1 - Ch4 (and any D0 - D15 on MSO models) Recommended Probing - 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) 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); FlexRay: Any Ch1 - Ch4 (and any D0 - D15 on MSO models) 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) 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 I^2C 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. [6] Signal Inputs - I^2C: Any Ch1 - Ch4 (and any D0 - D15 on MSO models); SPI: Any Ch1 - Ch4 (and any D0 - D15 on MSO models) Recommended Probing - Single ended
DPO4ENET	Ethernet Serial Triggering and Analysis Module. Enables triggering on packet-level information on 10BASE-T and 100BASE-TX [7] 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, Math, Ref1 - Ref4 Recommended Probing - 10BASE-T: Single ended or differential; 100BASE-TX: Differential

5 Not available on DPO4102B or DPO4102B-L models.

6 Only 2-wire SPI is supported on DPO4102B and DPO4102B-L models.

7 ≥350 MHz bandwidth models are recommended for 100BASE-TX

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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. [8]
	Signal Inputs - Low-speed and Full-speed: Any Ch1 - Ch4 (and any D0 - D15 on MSO models); Low-speed, Full-speed, and High-speed: Any Ch1 - Ch4, Math, Ref1 - Ref4
	Recommended Probing - Low-speed and Full-speed: Single ended or differential; High-speed: Differential
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. [9]
DPO4VID	HDTV and Custom (nonstandard) Video Triggering Module.

Instrument options

Power cord and plug options

Opt. A0	North America power plug (115 V, 60 Hz)
Opt. A1	Universal Euro power plug (220 V, 50 Hz)
Opt. A2	United Kingdom power plug (240 V, 50 Hz)
Opt. A3	Australia power plug (240 V, 50 Hz)
Opt. A5	Switzerland power plug (220 V, 50 Hz)
Opt. A6	Japan power plug (100 V, 110/120 V, 60 Hz)
Opt. A10	China power plug (50 Hz)
Opt. A11	India power plug (50 Hz)
Opt. A12	Brazil power plug (60 Hz)
Opt. A99	No power cord

Language options

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

8 USB high-speed supported only on models with 1 GHz analog channel bandwidth.

9 ≥350 MHz bandwidth models are recommended for mask testing on telecomm standards >55 Mb/s. 1 GHz bandwidth models are recommended for mask testing on high-speed (HS) USB.

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Opt. L10	Russian manual
Opt. L99	No manual

Language options include translated front-panel overlay for the selected language(s).

Service options

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)
Opt. SILV600	Standard warranty extended to 5 years

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 accessories

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.

TPP0500	500 MHz, 10X TekVPI® passive voltage probe with 3.9 pF input capacitance
TPP0502	500 MHz, 2X TekVPI® passive voltage probe with 12.7 pF input capacitance
TPP0850	2.5 kV, 800 MHz, 50X TekVPI® passive high-voltage probe
TPP1000	1 GHz, 10X TekVPI® passive voltage probe with 3.9 pF input capacitance
TAP1500	1.5 GHz TekVPI® active single-ended voltage probe
TCP0030	120 MHz TekVPI® 30 Ampere AC/DC current probe
TCP0150	20 MHz TekVPI® 150 Ampere AC/DC current probe
TDP0500	500 MHz TekVPI® differential voltage probe with ±42 V differential input voltage
TDP1000	1 GHz TekVPI® differential voltage probe with ±42 V differential input voltage
TDP1500	1.5 GHz TekVPI® differential voltage probe with ±8.5 V differential input voltage
THDP0200	±1.5 kV, 200 MHz TekVPI® high-voltage differential probe
THDP0100	±6 kV, 100 MHz TekVPI® high-voltage differential probe
TMDP0200	±750 V, 200 MHz TekVPI® high-voltage differential probe
P5100A	2.5 kV, 500 MHz, 100X high-voltage passive probe
P5200A	1.3 kV, 50 MHz high-voltage differential probe

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Accessories

077-0512-xx	Service manual (English only)
TPA-BNC	TekVPI® to TekProbe™ BNC adapter
TEK-DPG	TekVPI Deskew pulse generator signal source
067-1686-xx	Power measurement deskew and calibration fixture
SIGEXPTE	National Instruments LabVIEW Signal Express™ Tektronix Edition software – full version
FPGAView-A-MSO	Support for Altera FPGAs
TEK-USB-488	GPIB-to-USB adapter
ACD4000B	Soft transit case
HCTEK54	Hard transit case (requires ACD4000B)
RMD5000	Rackmount kit

CE

Tektronix is registered to ISO 9001 and ISO 14001 by SRI Quality System Registrar.

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

ASEAN / Australasia (65) 6356 3900
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Austria 00800 2255 4835*
Brazil +55 (11) 3759 7627
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Luxembourg +41 52 675 3777
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Russia & CIS +7 (495) 6647564
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Balkans, Israel, South Africa and other ISE Countries +41 52 675 3777
Canada 1 800 833 9200
Denmark +45 80 88 1401
Germany 00800 2255 4835*
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Mexico, Central/South America & Caribbean 52 (55) 56 04 50 90
Norway 800 16098
Portugal 80 08 12370
South Africa +41 52 675 3777
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* European toll-free number. If not accessible, call: +41 52 675 3777

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