Tektronix / MSO4000B, DPO4000B Series Mixed Signal Oscilloscope, Datasheet

MSO4000B, DPO4000B Series Mixed Signal Oscilloscope, Datasheet

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OVERVIEW

SPECIFICATIONS

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 M record length on all channels
- >340,000 wfm/s maximum waveform capture rate
- Standard passive voltage probes with 3.9 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
- 42 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 I²C, SPI, USB, Ethernet, CAN, LIN, FlexRay, RS-232/422/485/UART, MIL-STD-1553, and I²S/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 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

Optional application support

• Power analysis

- Limit and mask testing
- HDTV and custom video analysis

Need more performance?

Looking for an MSO at 100 MHz, 350 MHz, 500 MHz or 1 GHz? Need an integrated spectrum analyzer? Need to analyze analog, digital, and RF simultaneously? Consider the MDO4000B Series oscilloscopes, the world's first Mixed Domain Oscilloscope. www.tek.com/MDO4000



- Includes a 16 channel MSO
- 3 GHz and 6 GHz integrated spectrum analyzers
- · Simultaneous, time-correlated acquisition of analog, digital and RF
- 20 M record length

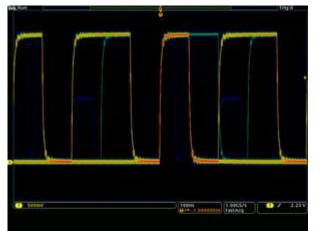
Comprehensive features speed every stage of debug

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 340,000 waveforms per second with FastAcq® – enables you to see glitches and other infrequent transients within seconds, revealing the true nature of device faults. A digital phosphor display with color- and intensity-grading shows the history of a signal's activity by using color or intensity in areas of the signal that occur more frequently, providing a visual display of just how often anomalies occur.



Discover – Digital phosphor technology with FastAcq enables greater than 340,000 wfms/s waveform capture rate and real-time color-intensity grading.

Capture

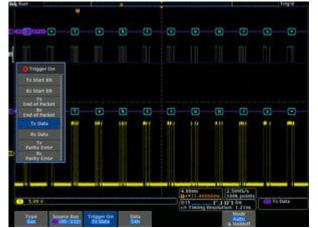
Discovering a device fault is only the first step. Next, you must capture the event of interest to identify root cause.

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 effect 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 - I²C, SPI, USB, Ethernet, CAN, LIN, FlexRay, RS-232/422/485/UART, MIL-STD-1553, and I²S/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.

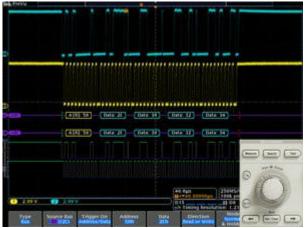


Capture - Triggering on a specific transmit data packet going across an RS-232 bus. A complete set of triggers, including triggers for specific serial packet content, ensures you quickly capture your event of interest.

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.



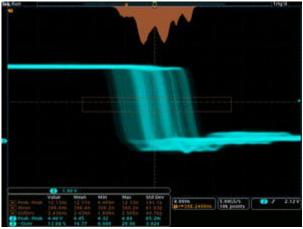
Search – I^2C decode showing results from a Wave Inspector search for Address value 50. Wave Inspector controls provide unprecedented efficiency in viewing and navigating waveform data.

Analyze

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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.

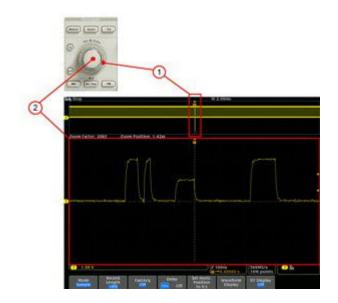
The oscilloscope offers a comprehensive set of integrated analysis tools including waveform- and screen-based cursors, automated measurements, advanced waveform math including arbitrary equation editing, FFT analysis, and trend plots for visually determining how a measurement is changing over time. Specialized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



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.

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).

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

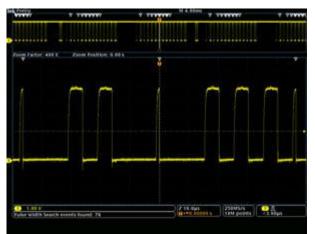
Press the Set Mark front-panel button to place one or more marks on the waveform. Navigating between marks is as simple as pressing the Previous (\leftarrow) and Next (\rightarrow) buttons on the front panel.

Search marks

The Search button allows you to automatically search through your long acquisition looking for userdefined events. All occurrences of the event are highlighted with search marks and are easily navigated to, using the front-panel Previous (\leftarrow) and Next (\rightarrow) buttons. Search types include edge, pulse width/glitch, timeout, runt, logic, setup and hold, rise/fall time, parallel bus, and I²C, SPI, USB, Ethernet, CAN, LIN, FlexRay, RS-232/422/485/UART, MIL-STD-1553, and I²S/LJ/RJ/TDM packet content. A search mark table provides a tabular view of the events found during the automated search. Each event is shown with a time stamp, making timing measurements between events easy.



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.

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Search step 3: The Search Mark table provides a tabular view of each of the events found by the automated search. Each event is shown with a time stamp making timing measurements between events easy.

Digital phosphor technology with FastAcq®

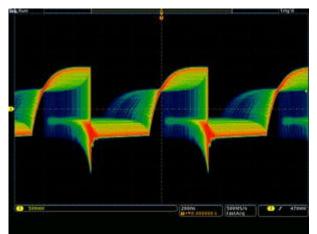
Digital phosphor technology with FastAcq provides you with fast insight into the real operation of your device. Its fast waveform capture rate – greater than 340,000 wfms/s – gives you a high probability of quickly seeing the infrequent problems common in digital systems: runt pulses, glitches, timing issues, and more.

To further enhance the visibility of rarely occurring events, intensity grading is used to indicate how often rare transients are occurring relative to normal signal characteristics. There are four waveform palettes available in FastAcq acquisition mode.

- The *Temperature palette* uses color-grading to indicate frequency of occurrence with hot colors like red/yellow indicating frequently occurring events and colder colors like blue/green indicating rarely occurring events.
- The *Spectral palette* uses color-grading to indicate frequency of occurrence with colder colors like blue indicating frequently occurring events and hot colors like red indicating rarely occurring events.
- The *Normal palette* uses the default channel color (like yellow for channel one) along with gray-scale to indicate frequency of occurrence where frequently occurring events are bright.
- The *Inverted palette* uses the default channel color along with gray- scale to indicate frequency of occurrence where rarely occurring events are bright.

These color palettes quickly highlight the events that over time occur more often or, in the case of infrequent anomalies, occur less often.

Infinite or variable persistence choices determine how long waveforms stay on the display, helping you to determine how often an anomaly is occurring.



Digital phosphor technology enables a greater than 340,000 wfm/s waveform capture rate and real-time intensity grading.

Accurate high-speed probing

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The TPP Series probes, included standard with every MSO/DPO4000B Series oscilloscope, provide up to 1 GHz of analog bandwidth, and 3.9 pF of capacitive loading. The extremely low capacitive loading minimizes adverse effects 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 highfrequency 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.

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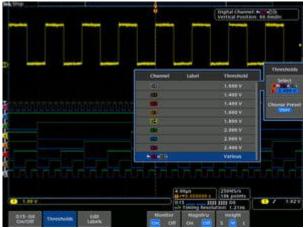
The MSO Series provide 16 integrated digital channels enabling you to view and analyze timecorrelated analog and digital signals.

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.

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.

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

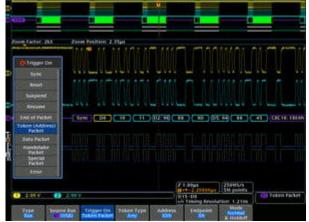
This unique probe design offers two eight-channel pods. Each channel ends with a probe tip featuring a recessed ground for simplified connection to the device under test. The coax on the first channel of each pod is colored blue making it easy to identify. The common ground uses an automotive-style connector 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 k Ω 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. The optional serial protocol triggering and analysis functionality is offered free for a 30-day trial period. This free trial period starts automatically when the instrument is powered on for the first time.



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.

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 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 (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 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.

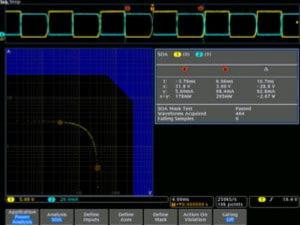
Technology		Trigger, Decode, Search	Order product	
Embedded	l ² C	Yes	DPO4EMBD	
LINDedded	SPI	Yes	DPO4EMBD	
Computer	RS232/422/485, UART	Yes	DPO4COMP	
USB	USB LS, FS, HS	Yes	DPO4USB	
Ethernet	10Base-T, 100Base-TX	Yes	DPO4ENET	
	CAN	Yes	DPO4AUTO or DPO4AUTOMAX	
Automotive	LIN	Yes	DPO4AUTO or DPO4AUTOMAX	
	FlexRay	Yes	DPO4AUTOMAX	
Military and Aerospace	MIL-STD-1553	Yes	DPO4AERO	
	l ² S	Yes	DPO4AUDIO	
Audio	LJ, RJ	Yes	DPO4AUDIO	
	TDM	Yes	DPO4AUDIO	

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 (\leftarrow) and Next (\rightarrow) buttons on the front panel.

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. The optional power analysis functionality is offered free for a 30-day trial period. This free trial period starts automatically when the instrument is powered on for the first time.



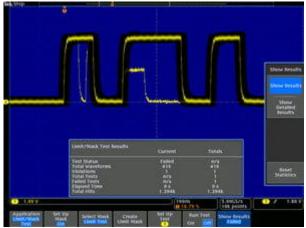
Safe operating area measurement. Automated power measurements enable quick and accurate analysis of common power parameters.

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

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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. The optional limit/mask test functionality is offered free for a 30-day trial period. This free trial period starts automatically when the instrument is powered on for the first time.



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, as well as a video picture mode enabling you to see the picture of the video signal you are viewing - for NTSC and PAL signals. The optional video analysis functionality is offered free for a 30- day trial period. This free trial period starts automatically when the instrument is powered on for the first time.



Viewing an NTSC video image. Video picture mode contains automatic contrast and brightness settings as well as manual controls.



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.

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.

Connectivity

The MSO/DPO4000B contains a number of ports which can be used to connect the instrument to a network, directly to a PC, or other test equipment.

• Two USB host ports on the front and two USB host ports on the rear enable easy transfer of screen shots, instrument settings, and waveform data to a USB mass storage device. A USB keyboard can also be attached to a USB host port for data entry.

- Rear USB device port is useful for controlling the oscilloscope remotely from a PC or for printing directly to a PictBridge®-compatible printer.
- The standard 10/100/1000BASE-T Ethernet port on the rear of the instrument enables easy connection to networks, provides network and e-mail printing, and provides LXI Class-C compatibility. The instrument can also mount network drives for easy storage of screen images, setup files, or data files.
- A video out port on the rear of the instrument allows the display to be exported to an external monitor or projector.

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. The instrument provides up to 50 W of power to the front panel TekVPI connectors from the internal power supply, giving you the confidence that it can meet any demanding probing requirements you have.

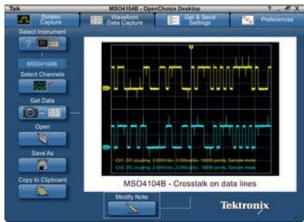


TekVPI probe interface simplifies connecting your probes to the oscilloscope.

Remote connectivity and instrument control

Exporting data and measurements is as simple as connecting a USB cable from the oscilloscope to your PC. Key software applications – 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.

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 embedded e*Scope® capability enables fast 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. Transfer and save settings, waveforms, measurements, and screen images or make live control changes to settings on the oscilloscope directly from the web browser.

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, 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.

3GW-20156-24



(m) 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.

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