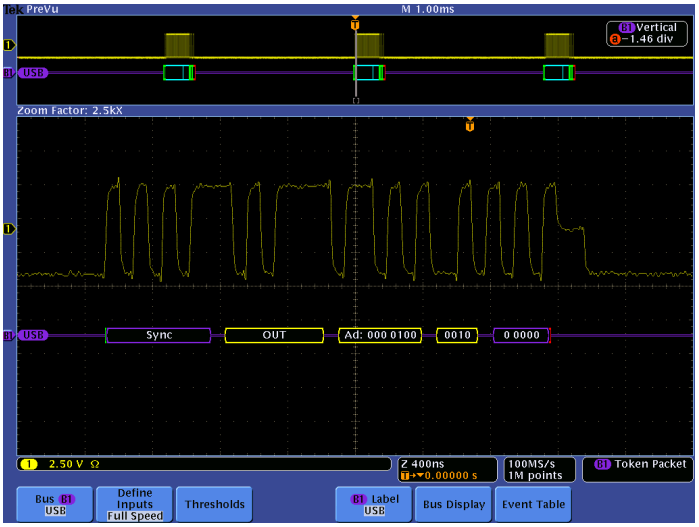
USB 2.0 Application Software

USB, SR-USB, DPO4USB, and MDO3USB Datasheet



Tektronix provides comprehensive, integrated tool sets to serve the needs of engineers designing USB-based embedded systems as well as those validating the physical-layer compliance of USB 2.0 serial devices to the USB 2.0 standards.

Features and Benefits

- USB USB 2.0 Compliance Testing
  - Automated Compliance Testing for USB 2.0 Verification
  - Designed for use with MSO/DPO5000, DPO7000, and DPO/DSA/MSO70000 Series Oscilloscopes
- SR-USB USB 2.0 Triggering and Analysis
  - Automated Trigger and Decode for USB 2.0
  - Designed for use with MSO/DPO5000, DPO7000C, and DPO/DSA/MSO70000C/D/DX Series Oscilloscopes
- DPO4USB USB 2.0 Triggering and Analysis
  - Automated Trigger, Decode, and Search for USB 2.0
  - Designed for use with MDO4000, MSO4000, and DPO4000 Series Oscilloscopes
- MDO3USB USB 2.0 Triggering and Analysis
  - Automated Trigger, Decode, and Search for USB 2.0
  - Designed for use with MDO3000 Series Oscilloscopes

Applications

- Low-speed USB 2.0
- Full-speed USB 2.0
- High-speed USB 2.0

Product description

The Tektronix USB 2.0 compliance test application (Opt. USB) and selected Tektronix oscilloscopes provide one-button compliance testing for USB 2.0 devices as specified by the USB-IF. The USB software automates the compliance testing and allows engineers to perform the required tests efficiently and reliably right on their bench.

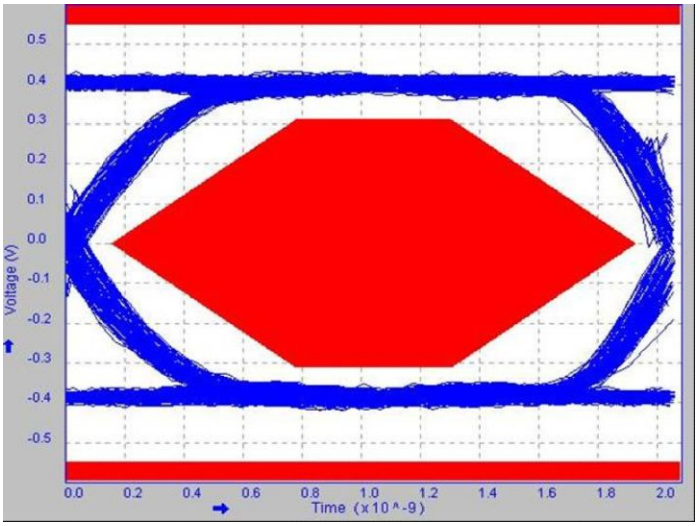
The Tektronix MDO/MSO/DPO4000 Series oscilloscopes with the DPO4USB Serial Application Module, MDO3000 Series oscilloscopes with the MDO3USB Serial Application Module, and MSO/DPO5000, DPO7000C, and DPO/DSA/MSO70000C/D/DX Series oscilloscopes with the SR-USB application simplify analysis of USB 2.0 waveforms when validating and debugging USB-based embedded systems. MDO3USB offers automated decode and search for low-speed, full-speed, and high-speed USB buses, as well as triggering on low-speed and full-speed buses. DPO4USB offers automated trigger, decode, and search for low-speed, full-speed, and high-speed USB buses, enabling fast and efficient validation and debug.

USB – Automated USB 2.0 Physical Layer compliance testing

USB compliance testing has some unique measurement challenges:

- Designers must quickly and accurately perform all compliance tests recommended by the USB Implementers Forum, Inc. (USB-IF) before they can use the “certified” USB-IF logo on their packaging
- Characterization of these electrical signals includes mask testing and parametric testing, for low-speed, full-speed, and high-speed hosts, devices, and hubs
- Signal speeds range from 1.5 Mb/s (low-speed) to 480 Mb/s (high-speed)

USB compliance test results



USB automated USB eye diagram analysis

The USB application software provides automated compliance testing for USB 2.0 serial bus verification, including:

- Fully compliant with USB-IF tests for USB 2.0 compliance testing
- Automated eye diagram analysis verifies signal quality
- Automated oscilloscope setups for various tests eliminate time-consuming manual setups
- Comprehensive test fixture enables quick setup and signal access for a wide range of tests
- High-speed tests: Signal Quality, Receiver Sensitivity, Chirp, Reset, Resume, Suspend, Packet Parameter, and Monotonicity tests
- Automatic rise and fall time measurements simplify tests
- Automatic deskew for accurate measurements
- Online help fully documents test procedures
- User-configurable report formats for customization
- User-configurable measurement limits for tolerance testing

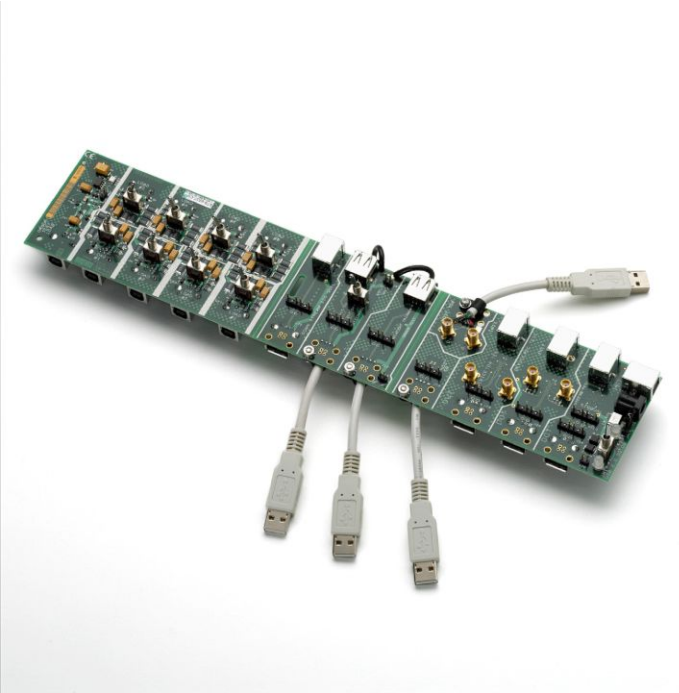
Measurement Select menu for the Signal Integrity test

Quick Pass/Fail tests substantiated with results make the USB application the preferred solution for USB 2.0 physical-layer validation. In-depth analysis is possible with the statistical information about the tests performed. The user-defined measurement limits also help to perform tolerance testing on a design.

USB can be downloaded from www.tektronix.com and with the option license you can easily install the software on your oscilloscope. After installation, the application is accessible from the menu bar of the Tektronix Windows oscilloscopes. The user manual and other documents are copied at the application installation location on the oscilloscope's hard drive.

USB2 compliance test fixtures

A comprehensive compliance test fixture provides a probing solution for the Signal Quality, Inrush Current, Drop and Droop, Receiver Sensitivity, and Impedance Measurement test. The test fixture (TDSUSBF) is ordered separately. The USB-IF logo-tagged 6 in. AB cable is shipped along with the test fixture



TDSUSBF USB 2.0 test fixture

SR-USB USB 2.0 triggering and analysis

Debugging USB-based embedded systems designs provides some complex measurement and analysis challenges:

- Capturing specific USB addresses and data
- Displaying the elements of the USB message in an understandable format, in a variety of formats, for a wide variety of engineers and technicians
- Time-correlating USB messages with analog and digital signals in the embedded system
- Capture long time windows of USB traffic and then find specific events within the acquired data

The optional SR-USB application software, installed in an MSO/DPO5000, DPO7000C, or DPO/DSA/MSO70000C/D/DX Series oscilloscope, provides a robust set of tools for debugging embedded systems with USB 2.0 serial buses, including:

- Automated serial triggering and decode for low-speed, full-speed, and high-speed USB 2.0 signals
- Trigger on all the critical elements of a USB bus such as address, data, etc.
- Decode all the critical elements of each USB message. No more counting 1s and 0s!
- Search through long acquisitions using user-defined criteria to find specific messages
- Event table shows decoded serial bus activity in a tabular, time-stamped format for quick summary of system activity

USB serial triggering

Trigger on packet content such as sync, reset, suspend/resume, token (address) packets with specific address and endpoint, specific data content, handshake packets, special packets, and errors.

Triggering on a specific PID on a USB full-speed bus. A complete set of triggers, including triggers for specific token (address) and data packet content, ensures you quickly capture your event of interest.

USB serial decode

The SR-USB application provides a higher-level, combined view of the individual signals that make up the USB bus, making it easy to identify where packets begin and end and identify subpacket components such as sync, PID, data, CRC, errors, etc.

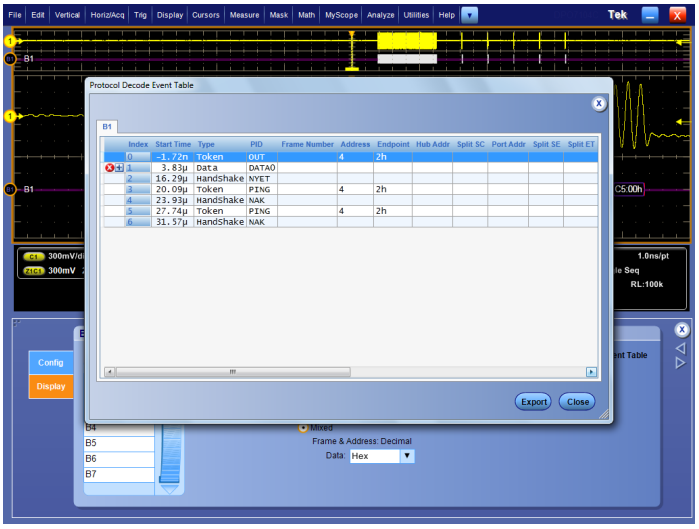
Color-coded decoded display of low-speed USB bus, showing Sync, PID, CRC, and Stop components of the serial signal

High-speed USB decoded display, automatically displaying bus content in any of several digital formats

Are you wasting time manually decoding the waveform? 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 with the SR-USB application do it for you! Once you've set up a USB bus, the MSO/DPO5000, DPO7000C, or DPO/DSA/MSO70000C/D/DX Series will decode each packet on the bus, and display the value in Hex, Binary, or ASCII in the bus waveform.

USB 2.0 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 (Time, PID, Address, Payload, and Errors).



USB decoded Event table showing all packet information with time-stamp information

USB 2.0 search

USB packet content triggering is very useful for isolating the event of interest, but once you've captured it and need to analyze the surrounding data, what do you do? In the past, users had to manually scroll through the waveform counting and converting bits and looking for what caused the event. With the SR-USB application installed, you can enable the oscilloscope to 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 oscilloscope front panel.

DPO4USB/MDO3USB - USB 2.0 triggering and analysis

Debugging USB-based embedded system designs provides some complex measurement and analysis challenges:

- Capturing specific USB addresses and data
- Displaying the elements of the USB message in an understandable format, in a variety of formats, for a wide variety of engineers and technicians
- Time-correlating USB messages with analog and digital signals in the embedded system
- Capture long time windows of USB traffic and then find specific events within the acquired data

The optional DPO4USB application module, installed in an MDO4000, MSO/DPO4000, or MSO/DPO4000B Series oscilloscope, or the optional MDO3USB application module, installed in an MDO3000 Series oscilloscope, provides a robust set of tools for debugging embedded systems with USB 2.0 serial buses, including:

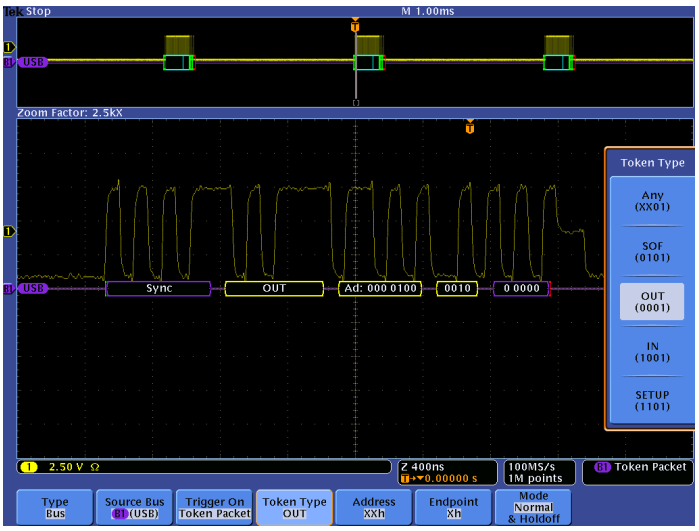
- Automated serial triggering and decode for low-speed, full-speed, and high-speed (DPO4USB only) USB 2.0 signals
- Trigger on all the critical elements of a USB bus such as address, data, etc.
- Decode all the critical elements of each USB message. No more counting 1s and 0s!
- Search through long acquisitions using user-defined criteria to find specific messages
- Event table shows decoded serial bus activity in a tabular, time-stamped format for quick summary of system activity

USB 2.0 serial triggering

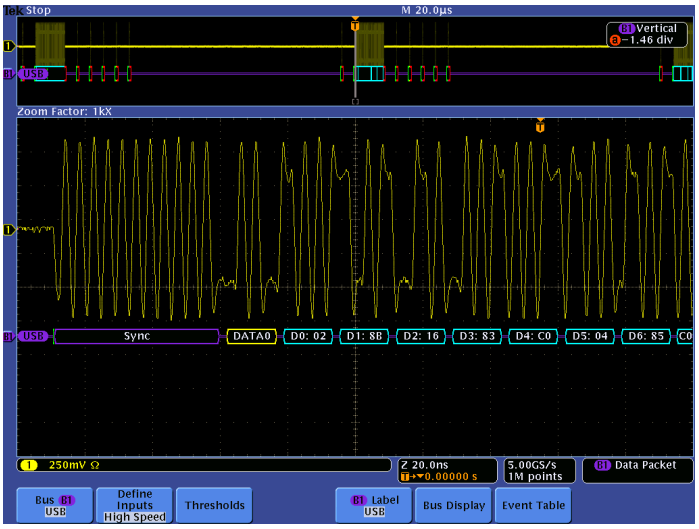
Trigger on packet content such as sync, reset, suspend/resume, token (address) packets with specific address and endpoint, specific data content, handshake packets, special packets, and errors.

USB 2.0 decode

The DPO4USB/MDO3USB USB Serial Application Module provides a higher-level, combined view of the individual signals that make up the USB bus, making it easy to identify where packets begin and end and identifying subpacket components such as sync, PID, data, CRC, errors, etc.



Triggering on a specific PID on an USB FS bus. A complete set of triggers, including triggers for specific Token (address) and data packet content, ensures you quickly capture your event of interest.

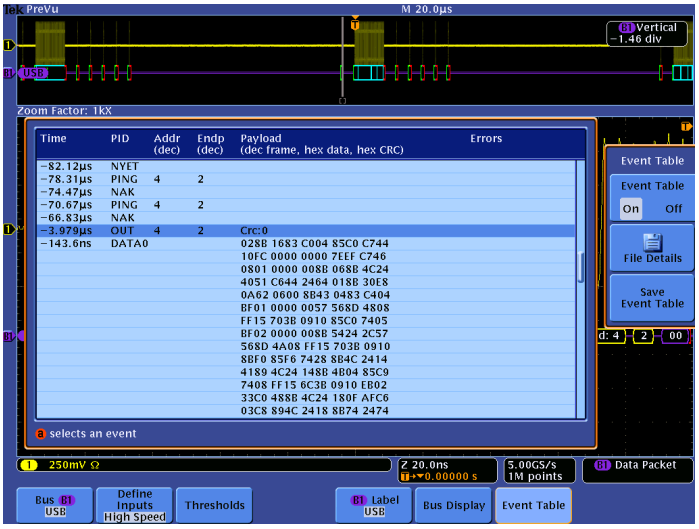


High-speed USB decoded display, automatically displaying bus content in any of several digital formats

Are you wasting time manually decoding the waveform? 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 with a USB Triggering and Analysis Application module do it for you! Once you've set up a USB bus, the MDO/MSO/DPO4000 or MDO3000 Series will decode each packet on the bus, and display the value in Hex, Binary, or ASCII in the bus waveform.

USB 2.0 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 (Time, PID, Address, Payload, and Errors).



USB decoded Event table showing all packet information with time-stamp information

USB 2.0 search

USB packet content triggering is very useful for isolating the event of interest, but once you've captured it and need to analyze the surrounding data, what do you do? In the past, users had to manually scroll through the waveform counting and converting bits and looking for what caused the event. With a USB Serial Application Module, you can enable the oscilloscope to 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 oscilloscope front panel.

Specifications

USB

Instrument compatibility

Oscilloscope	Description
MSO5034/B DPO5034/B MSO5054/B DPO5054/B MSO5104/B DPO5104/B DPO7054/C DPO7104/C	USB 2.0 Compliance: Low-speed and Full-speed USB
MSO5204/B DPO5204/B DPO7254/C DPO7354/C All DPO/DSA/MSO70000 models	USB 2.0 Compliance: Low-speed, Full-speed, and High-speed USB

Testing options

USB tests	Host, hubs, and devices
Signal Quality tests	Eye Diagram Test, Jitter (JK, KJ, and consecutive), Crossover Voltage Range, Signal Rate, End-of-Packet Width, Rising-edge Rate, Falling-edge Rate
High-speed tests	Receiver Sensitivity, Chirp, Reset, Resume, Suspend, Packet Parameter, and Monotonicity test
Inrush Current check	Data-sufficiency readout. Coulombs and capacitance listed across inrush regions
Droop test	Volts readout
Speed selection	Low-speed (LS), Full-speed (FS), and High-speed (HS)
Signal direction	Upstream and downstream
Test Point selection	Near End and Far End
Report Generation format	Plug-fest, user-specific, and Tektronix format

SR-USB

Instrument compatibility

Oscilloscope	Description
MSO5034/B DPO5034/B MSO5054/B DPO5054/B DPO7054C	Trigger and Decode: Low-speed and Full-speed USB
MSO5104/B DPO5104/B MSO5204/B DPO5204/B	Trigger and Decode: Low-speed, Full-speed, and High-speed USB
DPO7104C DPO7254C DPO7354C All DPO/DSA/MSO70000C/D/DX models	Decode: Low-speed, Full-speed, and High-speed USB Trigger: Low-speed and Full-speed USB

Bus Setup options

USB 2.0 compatibility	Low-speed and Full-speed: All MSO/DPO5000, DPO7000C, and DPO/DSA/MSO70000C/D/DX Series models High-speed: MSO/DPO5204/B, MSO/DPO5104/B, DPO7354C, DPO7254C, DPO7104C, and DPO/DSA/MSO70000C/D/DX models only
Sources	
Single-ended	Analog channels 1-4 Math channels 1-4 Digital channels D0-D15 (MSO5000 and MSO70000C/DX Series only)
Differential	Analog channels 1-4 Math channels 1-4
Recommended probing	Low-speed and Full-speed: Single-ended or differential High-speed: Differential

Bus Setup options

Address/Data formats available	Hex, Binary, Decimal Decimal: Frame and Address Hex or ASCII: Data
Display modes	
Bus	Bus only
Bus and waveforms	Simultaneous display of bus and digital waveforms
Event table	Decoded packet data in a tabular view

Bus Trigger options

Trigger and/or search on

Low-speed

Trigger/Search on Sync, Reset, Suspend, Resume, End of Packet, Token (Address) Packet, Data Packet, Handshake Packet, Special Packet, Error

Packet type	Description
Token packet	Any token type, SOF, OUT, IN, SETUP; 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	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	Any handshake type, ACK, NAK, STALL
Special packet	Any special type, Reserved
Error	PID Check, CRC5, CRC16, Bit Stuffing

Full-speed

Trigger/Search on Sync, Reset, Suspend, Resume, End of Packet, Token (Address) Packet, Data Packet, Handshake Packet, Special Packet, Error

Packet type	Description
Token packet	Any token type, SOF, OUT, IN, SETUP; 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	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	Any handshake type, ACK, NAK, STALL
Special packet	Any special type, PRE, Reserved.
Error	PID Check, CRC5, CRC16, Bit Stuffing

High-speed

Trigger/Search on Sync, Reset, Suspend, Resume, End of Packet, Token (Address) Packet, Data Packet, Handshake Packet, Special Packet, Error

Packet type	Description
Token packet	Any token type, SOF, OUT, IN, SETUP; 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	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	Any handshake type, ACK, NAK, STALL, NYET
Special packet	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	PID Check, CRC5, CRC16, Any

Bus decode

USB 2.0 Data rates

Low-speed: 1.5 Mb/s

Full-speed: 12 Mb/s

High-speed: 480 Mb/s

Decode display

Start (green bar)

PID (yellow packet)

Data (cyan packet)

CRC (purple packet)

Stop (red bar)

DPO4USB

Instrument compatibility

Oscilloscope	Description
All 100 MHz, 350 MHz, 500 MHz MDO4000/B, MSO4000/B, and DPO4000 [1]/B Series	Trigger and Decode: Low-speed and Full-speed
MSO4104	Trigger: Low-speed and Full-speed
DPO4104 [1]	Decode: Low-speed, Full-speed, and High-speed
All 1 GHz models of MSO/DPO4000B and MDO4000/B Series	Trigger and Decode: Low Speed, Full Speed, and High Speed

Bus Setup options

USB 2.0 compatibility

Low-speed and Full-speed: All MDO/MSO/DPO4000 Series models

High-speed: Models with 1 GHz analog channel bandwidth

Sources

Single-ended

Analog channels 1-4

Digital channels D0-D15 (MDO and MSO Series only)

Differential

Analog channels 1-4

Math channel

Reference channels 1-4

Recommended probing

Low-speed and Full-speed: Single-ended or differential

High-speed: Differential

Threshold presets

Low-speed and Full-speed: Single-ended (D+: 1.4 V; D-: -1.4 V), Differential (High: 1.4 V; Low: -1.4 V)

High-speed: Differential (High: 100 mV; Low: -100 mV)

Address/Data formats available

Hex, Binary, Decimal

Decimal: Frame and Address

Hex or ASCII: Data

1 For DPO4000 (non-B) Series products with serial numbers lower than C020000 and no serial triggering hardware update installed, USB triggering is not supported.

Bus Setup options

Display modes

Bus	Bus only
Bus and waveforms	Simultaneous display of bus and digital waveforms
Event table	Decoded packet data in a tabular view

Bus Trigger options

Trigger and/or search on .

Low-speed Trigger/Search on Sync, Reset, Suspend, Resume, End of Packet, Token (Address) Packet, Data Packet, Handshake Packet, Special Packet, Error

Packet type	Description
Token packet	Any token type, SOF, OUT, IN, SETUP; 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	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	Any handshake type, ACK, NAK, STALL
Special packet	Any special type, Reserved
Error	PID Check, CRC5, CRC16, Bit Stuffing

Full-speed Trigger/Search on Sync, Reset, Suspend, Resume, End of Packet, Token (Address) Packet, Data Packet, Handshake Packet, Special Packet, Error

Packet type	Description
Token packet	Any token type, SOF, OUT, IN, SETUP; 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	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	Any handshake type, ACK, NAK, STALL
Special packet	Any special type, PRE, Reserved.
Error	PID Check, CRC5, CRC16, Bit Stuffing

High-speed Trigger/Search on Sync, Reset, Suspend, Resume, End of Packet, Token (Address) Packet, Data Packet, Handshake Packet, Special Packet, Error

Packet type	Description
Token packet	Any token type, SOF, OUT, IN, SETUP; 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	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	Any handshake type, ACK, NAK, STALL, NYET
Special packet	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	PID Check, CRC5, CRC16

Bus decode

USB 2.0 Data rates

Low-speed: 1.5 Mb/s

Full-speed: 12 Mb/s

High-speed: 480 Mb/s

Decode display

Start (green bar)

PID (yellow packet)

Data (cyan packet)

CRC (purple packet)

Stop (red bar)

MDO3USB

Instrument compatibility

Oscilloscope	Description
All 100 MHz, 200 MHz, 350 MHz, 500 MHz MDO3000 Series	Trigger and Decode: Low-speed and Full-speed
All 1 GHz MDO3000 Series	Trigger: Low-speed and Full-speed Decode: Low-speed, Full-speed, and High-speed

Bus Setup options

USB 2.0 compatibility

Low-speed and Full-speed: All MDO3000 Series models

High-speed: Models with 1 GHz analog channel bandwidth

Sources

Single-ended

Analog channels 1-4

Digital channels D0-D15 (models with MSO options only)

Differential

Analog channels 1-4

Math channel

Reference channels 1-4

Recommended probing

Low-speed and Full-speed: Single-ended or differential

High-speed: Differential

Threshold presets

Low-speed and Full-speed: Single-ended (D+: 1.4 V; D-: -1.4 V), Differential (High: 1.4 V; Low: -1.4 V)

High-speed: Differential (High: 100 mV; Low: -100 mV)

Address/Data formats available

Hex, Binary, Decimal

Decimal: Frame and Address

Hex or ASCII: Data

Display modes

Bus Bus only

Bus and waveforms Simultaneous display of bus and digital waveforms

Event table Decoded packet data in a tabular view

Bus Trigger options

Trigger and/or search on .

Low-speed Trigger/Search on Sync, Reset, Suspend, Resume, End of Packet, Token (Address) Packet, Data Packet, Handshake Packet, Special Packet, Error

Packet type	Description
Token packet	Any token type, SOF, OUT, IN, SETUP; 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	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	Any handshake type, ACK, NAK, STALL
Special packet	Any special type, Reserved
Error	PID Check, CRC5, CRC16, Bit Stuffing

Full-speed Trigger/Search on Sync, Reset, Suspend, Resume, End of Packet, Token (Address) Packet, Data Packet, Handshake Packet, Special Packet, Error

Packet type	Description
Token packet	Any token type, SOF, OUT, IN, SETUP; 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	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	Any handshake type, ACK, NAK, STALL
Special packet	Any special type, PRE, Reserved.
Error	PID Check, CRC5, CRC16, Bit Stuffing

High-speed Trigger/Search on Sync, Reset, Suspend, Resume, End of Packet, Token (Address) Packet, Data Packet, Handshake Packet, Special Packet, Error

Packet type	Description
Token packet	Any token type, SOF, OUT, IN, SETUP; 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	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	Any handshake type, ACK, NAK, STALL, NYET
Special packet	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	PID Check, CRC5, CRC16

Bus decode

USB 2.0 Data rates	Low-speed: 1.5 Mb/s Full-speed: 12 Mb/s High-speed: 480 Mb/s
Decode display	Start (green bar) PID (yellow packet) Data (cyan packet) CRC (purple packet) Stop (red bar)

Ordering information

USB

USB 2.0 Physical-layer Compliance Test Application

Model	New instrument orders	Product upgrades	Floating licenses
MSO/DPO5000 Series	Opt. USB	DPO-UP, Opt. USB	DPOFL-USB
DPO7000 Series	Opt. USB	DPO-UP, Opt. USB	DPOFL-USB
DPO/DSA/MSO70000 Series	Opt. USB	DPO-UP, Opt. USB	DPOFL-USB

SR-USB

USB 2.0 Triggering and Analysis Application

Model	New instrument orders	Product upgrades	Floating licenses
MSO/DPO5000 Series	Opt. SR-USB	DPO-UP, Opt. SR-USB	DPOFL-SR-USB
DPO7000C Series	Opt. SR-USB	DPO-UP, Opt. SR-USB	DPOFL-SR-USB
DPO/DSA/MSO70000C/D/DX Series	Opt. SR-USB	DPO-UP, Opt. SR-USB	DPOFL-SR-USB

DPO4USB

USB 2.0 Triggering and Analysis Application

Model	New instrument orders	Product upgrades	Floating licenses
MDO/MSO/DPO4000 Series	DPO4USB	DPO4USB	-

MDO3USB

USB 2.0 Triggering and Analysis Application

Model	New instrument orders	Product upgraded	Floating licenses
MDO3000 Series	MDO3USB	MDO3USB	-

Recommended accessories

The P6248, P6330, TDP1500, and TDP3500 probes are approved for compliance testing.

Higher-performance active or differential probes may be used for design applications. It is recommended to use a probe with 1X attenuation for best results.

Please refer to www.tektronix.com/probes for further information on the recommended models of probes and any necessary probe adapters.

Accessories

TDSUSBF	USB 2.0 test fixture
AWG5000C or AWG7000C series	Arbitrary waveform generator, signal source for receiver sensitivity tests. 5X attenuators are required

SR-USB

Please refer to www.tektronix.com/probes for further information on the recommended models of probes and any necessary probe adapters.

DPO4USB

Please refer to www.tektronix.com/probes for further information on the recommended models of probes and any necessary probe adapters.

MDO3USB

Please refer to www.tektronix.com/probes for further information on the recommended models of probes and any necessary probe adapters.

Additional information

Tektronix offers a range of solutions for USB testing, including HSIC (High Speed Inter Connect) and USB 3.0. To see a comprehensive listing, and download the latest resources, visit www.tektronix.com/USB.

USB solution updates and up-to-date instrument software upgrades are available at www.tektronix.com/downloads.

CE

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

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

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