D9010USBP USB 2.0, eUSB2, USB 3.x, USB4 Protocol Trigger and Decode

For Infiniium Oscilloscopes

The D9010USBP software package for Infiniium oscilloscopes gives you the ability to trigger and decode on all speeds of USB signals: USB 2.0, eUSB2, USB 3.x and USB4. Support for future specifications will be added for those with an active support subscription.

KEYSIGHT TECHNOLOGIES

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Product Overview

This document is designed to help you understand what is available in D9010USBP. For assistance in using the software, please reference the latest user's guide, programmer's guides, and online help for Infiniium available on Keysight.com.

This application makes it easy to debug and test designs that include USB protocols using Infiniium oscilloscopes. Get access to a rich set of integrated protocol level triggers specific to each serial bus. When serial triggering is selected, the application enables special real-time triggering hardware inside the scope.

Hardware-based triggering ensures that the scope never misses a trigger event when armed. This hardware takes signals acquired using either scope or digital channels and reconstructs protocol frames. It then inspects these protocol frames against specified protocol-level trigger conditions and triggers when the condition is met.
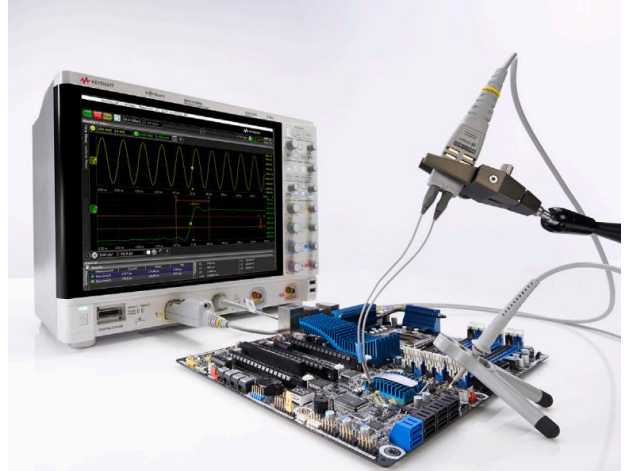
- Easy access to setup with a dedicated Serial Decode front panel key.
- Setup your scope to show protocol decode in less than 30 seconds with an auto setup key for every protocol that sets threshold levels, baud rates, sample rate, memory depth and more.
- Save time and eliminate errors by viewing packets at the protocol level on the physical waveform, or in tabular or graphical format.
- Easy to use search and navigate tools allow you to search through long sets of data and find specific packets of interest on the serial bus.
- Segmented memory allows you to capture seconds to days' worth of serial protocol traffic. The scope fills memory in segments as each acquisition sees a trigger condition, using time tags to track time between segments.
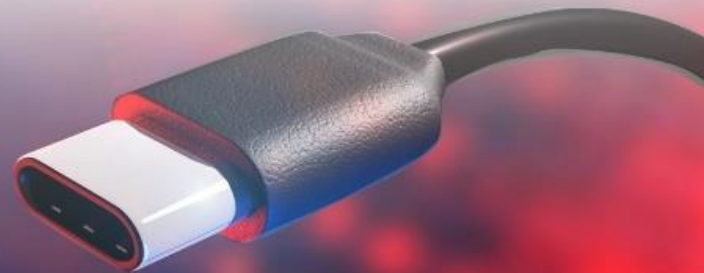
USB 2.0 / eUSB2
Low-speed and full-speed

USB 1.x runs at 1.5 Mbps (low-speed) and 12 Mpbs (full-speed). Decoding for USB 1.x is located in the Protocol Decode menu under USB 2.0, as the 1.x standards were absorbed into USB 2.0 upon its release. Analog and digital channels, as well as waveform memory and math, can be selected as sources for D+ and D-. Single-ended probes must be used for 1.x trigger and decode on analog channels. Users have access to an auto-setup key that will configure the oscilloscope for decoding and triggering. D9010USBP provides not only decode, but also listing window view, software searching, and trigger on search.
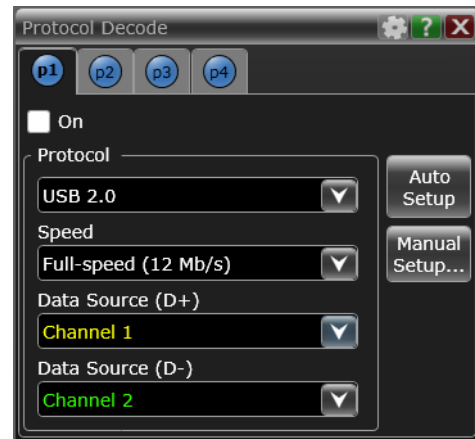

Figure 1. USB full-speed protocol decode setup window.

High-speed

USB 2.0 runs at 480 Mbps. Analog and digital channels, as well as waveform memory and math, can be selected as sources for D+ and D-. Differential probes must be used for 2.0 trigger and decode on analog channels, and oscilloscopes with 2.5 GHz or greater bandwidth are recommended. Users have access to an auto-setup key that will configure the oscilloscope for decoding and triggering. D9010USBP provides not only decode, but also listing window view, software searching, and trigger on search.

Figure 2. USB high-speed trigger and decode, with protocol lister and detailed packet view.

USB 2.0 and eUSB2 specifications and characteristics

Data sources (D+ and D-)	Any analog channel Any digital channel (MSO only) Any waveform memory Any waveform math
Supported speeds	Low-speed (1.5 Mbps) Full-speed (12 Mbps) High-speed (480 Mbps)
Auto setup	Automatically configures trigger levels, decode thresholds, sample rate, memory depth, holdoff, and trigger
Oscilloscope requirements	Keysight recommends an oscilloscope and probe of 2.5 GHz or faster for accurate measurements of the USB 2.0 bus.
Probing requirements	Low- and full-speed: single-ended required High-speed: differential required*, for eUSB2 single-ended required
Trigger options	USB 2.0: Tokens: OUT, IN, SOF, SETUP Data: DATA0, DATA1, DATA2, MDATA Handshake: ACK, NAK, NYET, STALL Special: RESERVED, SPLIT, PING, PRE/ERR Errors: Any error, PID error, Bad 5- or 16-bit CRC, Glitch (double transition) eUSB2 add-on: SOP Any Packet Control Messages: CM.FS/CM.L1, CM.L2, CM.Reset, CM.Test, CM.RAP Events: Suspend, Resume, Port Rest, Port Configuration, Remote Wake SYNC: No. of Sync Bits Errors: No ACK in CM, CM Parity Error

USB 3.x

The specifications for USB 3.x are moving fast, having already progressed to a second generation of USB 3.2. D9010USBP supports trigger, decode, and search for USB 3.0, 3.1 generations 1 and 2, and 3.2 generations 1 and 2. Along with traditional triggering and decoding on the host of commands, packets and payloads, D9010USBP also allows you to decode the low-level handshakes that negotiate data rates between devices.

Figure 3. USB 3.2 SuperSpeed+ trigger and decode, with protocol lister and detailed packet view.

Figure 4: On the left is a comprehensive search system with a hex payload editor. On the right is the setup window.

USB 3.x Specifications and characteristics

Data sources (1 through 4)	Any analog channel Any waveform memory Any waveform math
Supported protocols / speeds	USB 3.0 [5 Gbps] USB 3.1 (gen 1 or 2) [5, 10 Gbps] USB 3.2 (gen 1 or 2) [5, 10, 20 Gbps]
Auto setup	Automatically configures trigger levels, decode thresholds, sample rate, memory depth, holdoff, and trigger
Oscilloscope requirements	Contact Keysight
Probing requirements	Direct cable connection (e.g. SMA) Differential probe22
Decode options	Symbol display format: K/D codes, 8-bit or 10-bit representation, or labels Descrambling Multilane decoding Removal of electrical IDLEs Low level LFPS/LBPS handshaking
Trigger options	USB 3.0, 3.1: Please contact Keysight if you have questions about available trigger search conditions. USB 3.2: LFPS, ordered sets, link commands, header packets, link management header packets, transaction header packets, data packet payloads, symbol sequences, errors

USB4

D9010USBP application includes a suite of configurable protocol-level searches and software-based triggering specific to all USB standards including the latest released USB4. The application is used in conjunction with the N7019A Active Link Fixture to decode USB4 Low-Speed SBU and USB4 High-Speed signals.

Using cross-triggering, it easily correlates the USB4 Link transitions with sideband transitions and helps in observing the behavior of the USB4 link when the

- DUT is plugged-in
- DUT goes from CLd state to Training.LOCK1 sub-state
- DUT is in Training.LOCK1 State (TxFFE negotiation)
- DUT is transiting from two single-lane Links to dual-Lane Link (i.e. Lane bonding)

With an active support subscription, you will be the first to receive future generations of USB trigger and decode on Infiniium oscilloscopes.
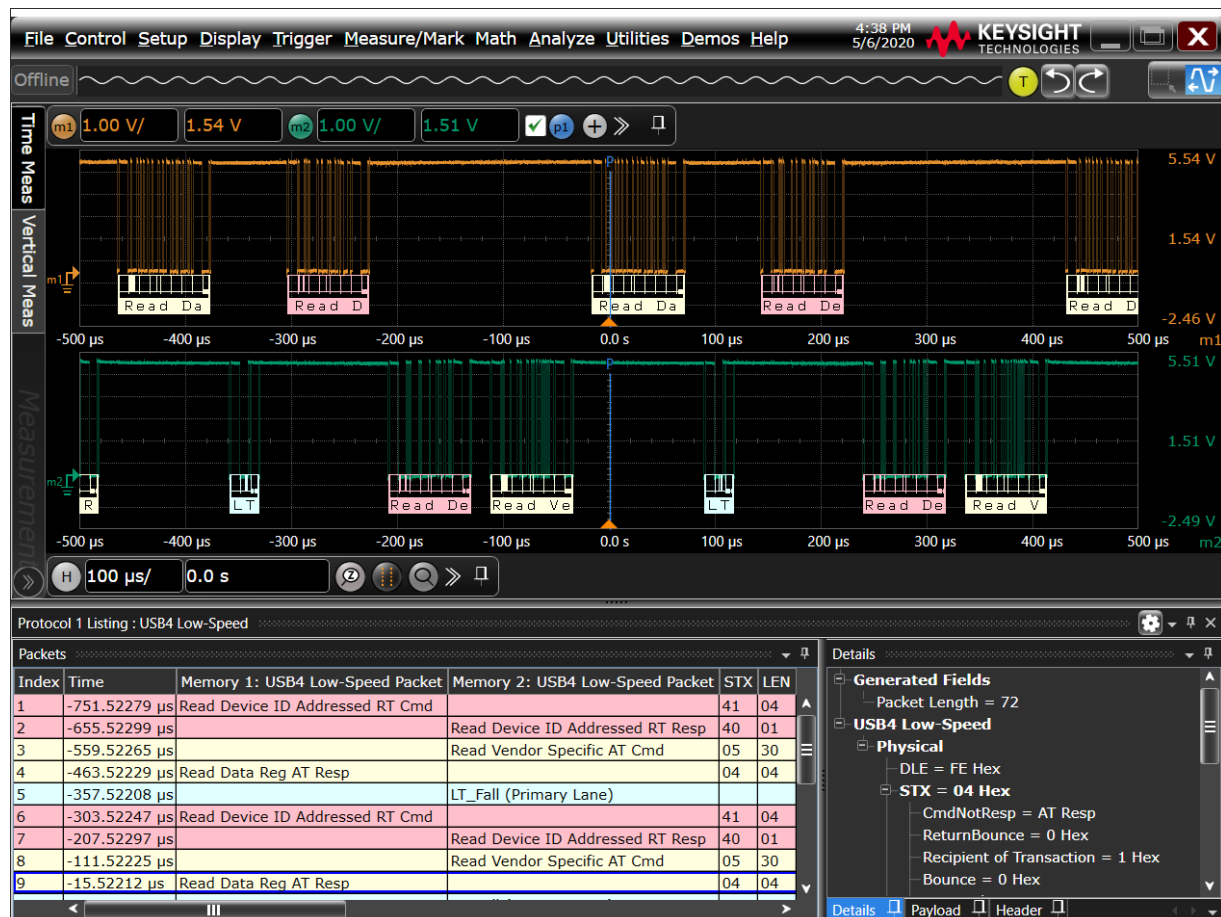

Figure 5. USB4 Low-Speed trigger and decode, with protocol lister and detailed packet view.
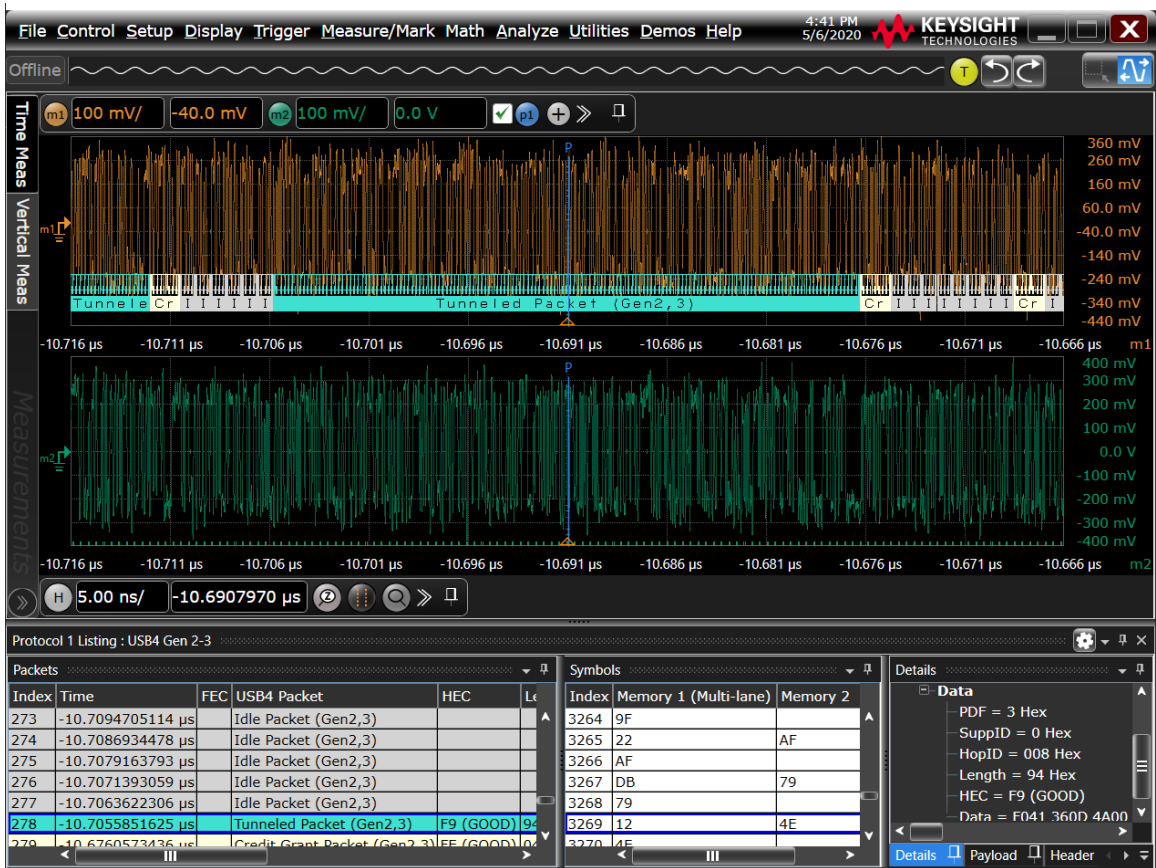
Figure 6. USB4 High-Speed trigger and decode, with protocol lister and detailed packet view.

USB4 Specifications and characteristics

Data sources	Any analog channel Any waveform memory Any waveform math
Supported protocols / speeds	Gen3 128b/132b (20, 40 Gbps) Gen3 FEC (20, 40 Gbps) Gen2 64b/ 66b (10, 20 Gbps) Gen2 FEC (10, 20 Gbps) Low Speed SB Decode
Auto setup	Automatically configures trigger levels, decode thresholds, sample rate, memory depth and trigger
Oscilloscope requirements	Contact Keysight
Probing requirements	Direct cable connection (e.g. SMA)
Decode options	Symbol display format: Labels Descrambling Multilane decoding
Trigger options	USB4 LS: any packet, LT transaction, any AT cmd, AT cmd Write, AT cmd read, any AT resp, AT resp write, AT resp read, broadcast RT transaction, any addressed RT cmd, addressed RT cmd write, addressed RT cmd read, any addressed RT resp, addressed RT resp write, addressed RT resp read, errors USB4 Gen2/ Gen3: ordered sets, control packets, link management packets, time sync packets, tunneled packet, FEC invalid block, symbol sequence, errors

Ordering Information

This option is offered as perpetual or time-based (subscription) license, as described in the tables and examples below. A valid support contract is included in the pricing for the term of any time-based licenses. For perpetual license holders, a separate support contract is required to access Keysight technical support and receive software updates.

Types	Description	Pricing Formula
Node-Locked	Allows you to use the license on one specified instrument/computer	
Transportable	Allows you to use the license on one instrument or computer at a time. This license may be transferred to another instrument or computer using Keysight's online tool.	130% of node-locked
USB Portable	Allows you to move the license from one instrument/computer to another by end-user only with a certified USB dongle, which is purchased separately.	130% of node-locked
Floating	Allows you to access the license on networked instruments / computers from a server, one at a time. For concurrent access, multiple licenses may be purchased.	140% of node-locked
Perpetual	Software license can be used in perpetuity.	
Time-Based	Software license is time limited to a defined period, such as 12 months.	38% of a perpetual for a 12-month license
Support contract (for perpetual licenses)	Allows license holder access to Keysight technical support and all software upgrades.	15% of perpetual for 12 months of support

Software license and support subscription contract model number format:

R-B	\<Term / Service\>	P -	\<License Type\> -	\<License / Support Contract Term\>
	4 = Time Based License 5 = Perpetual 6 = Subscription		001 = Node-Locked 002 = Floating 004 = Transportable 005 = USB Portable	A = Fixed B = Floating (Single Site) D = Floating (Transportable Perpetual) E = USB F = 6 Month Term L = 12 Month Term X = 24 Month Term Y = 36 Month Term Z = 60 Month Term

Examples

Software License and Support Configuration Examples	Model Number	Perpetual License	Support Contract
Node-locked perpetual license and 12-month renewable support contract (most common)	D9010USBP	R-B5P-001-A	R-B6P-001-L
Floating 24-month license subscription	D9010USBP	N/A	R-6BP-002-X

Benefits of flexible license types (transportable, floating, USB portable)

- Maximize the flexibility of your test assets by sharing measurement applications between your Infiniium oscilloscopes
- Save money and increase your return on test asset investments as project needs change by purchasing fewer applications per instrument
- Save time by transporting the licenses to the test bench nearest you, instead of physically moving the test equipment or DUT
- Use the same application in different time zones, departments, and/or test benches
- Keep up with your changing project needs by transporting measurement application
- licenses; use a simple Keysight server connection with an instrument or a PC to check-in/out licenses

Related literature

Type	Description / URL
Webpage	USB Design, Simulation, and Test Solutions
Webpage	USB Type-C Cable and Connector Testing
App Note	Characterizing High-Speed USB 2.0 in Embedded Designs
Datasheet	Infiniium V-Series Oscilloscopes
Datasheet	Infiniium Z-Series Oscilloscopes
Datasheet	Infiniium UXR Oscilloscopes

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