

D9110USBP USB 2.0, eUSB2, USB 3.x, USB4, DisplayPort 2.1 AUX Protocol Trigger and Decode

for Infiniium Oscilloscopes

Introduction

The D9110USBP 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, USB4, and DisplayPort 2.1 AUX Channel. Support for future specifications will be added for those with an active support subscription.



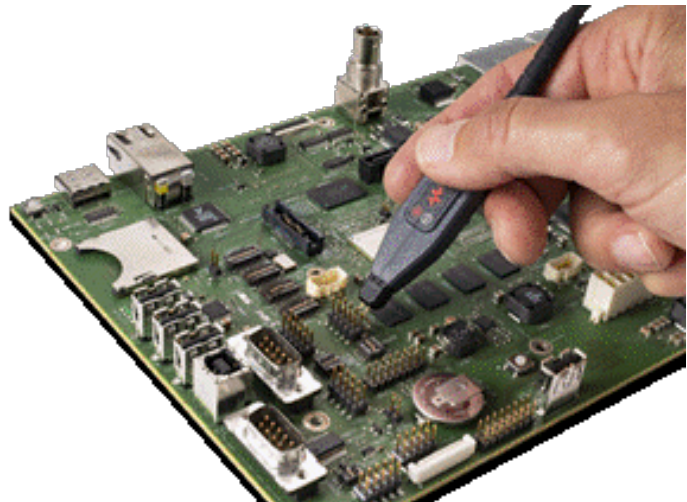
Product Overview

This document is designed to help you understand what is available in D9110USBP. 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 and DisplayPort 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 Mbps (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. D9110USBP provides not only decode, but also listing window view, software searching, and trigger on search.

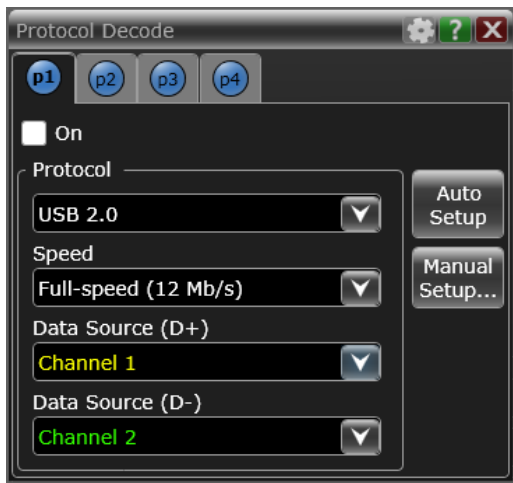


Figure 1. USB full-speed protocol decode setup window.



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

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. D9110USBP provides not only decode, but also listing window view, software searching, and trigger on search.

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. D9110USBP 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, D9110USBP also allows you to decode the low-level handshakes that negotiate data rates between devices.

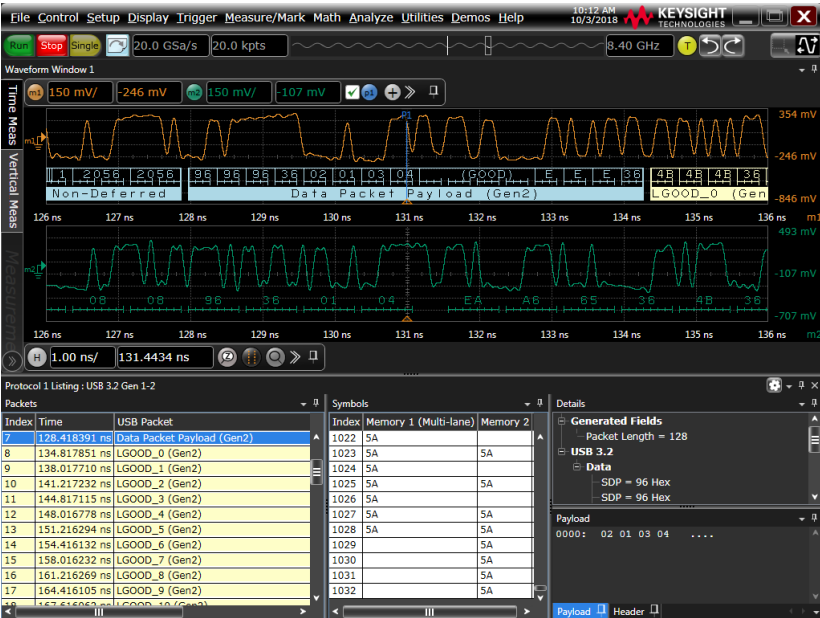


Figure 3. USB 3.2 SuperSpeed+ trigger and decode, with protocol list and detailed packet view.



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

D9110USBP 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.

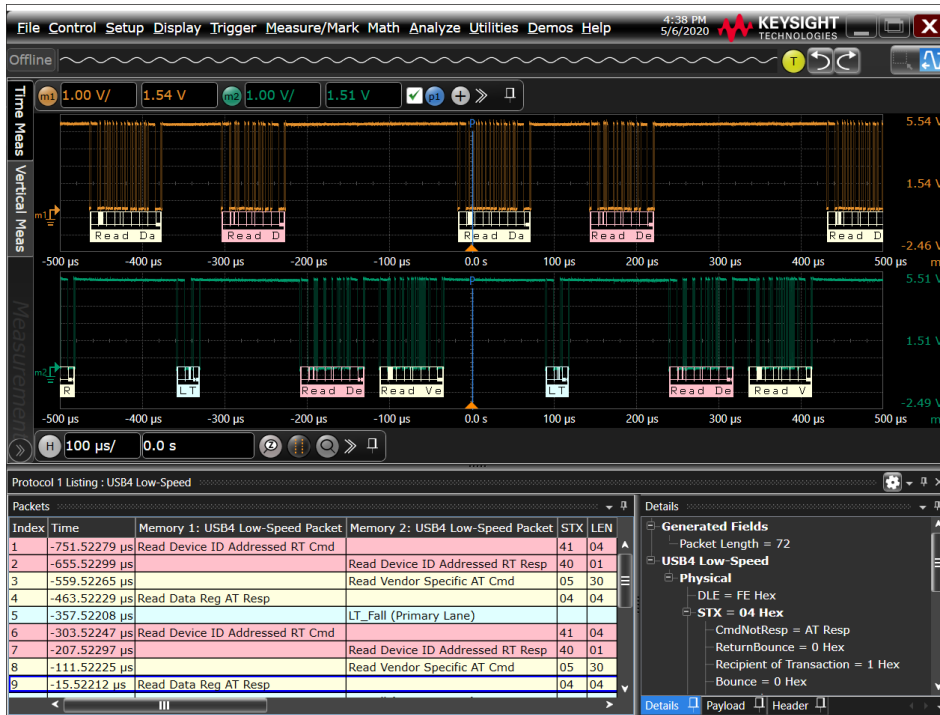


Figure 5. USB4 Low-Speed trigger and decode, with protocol lister and detailed packet view.

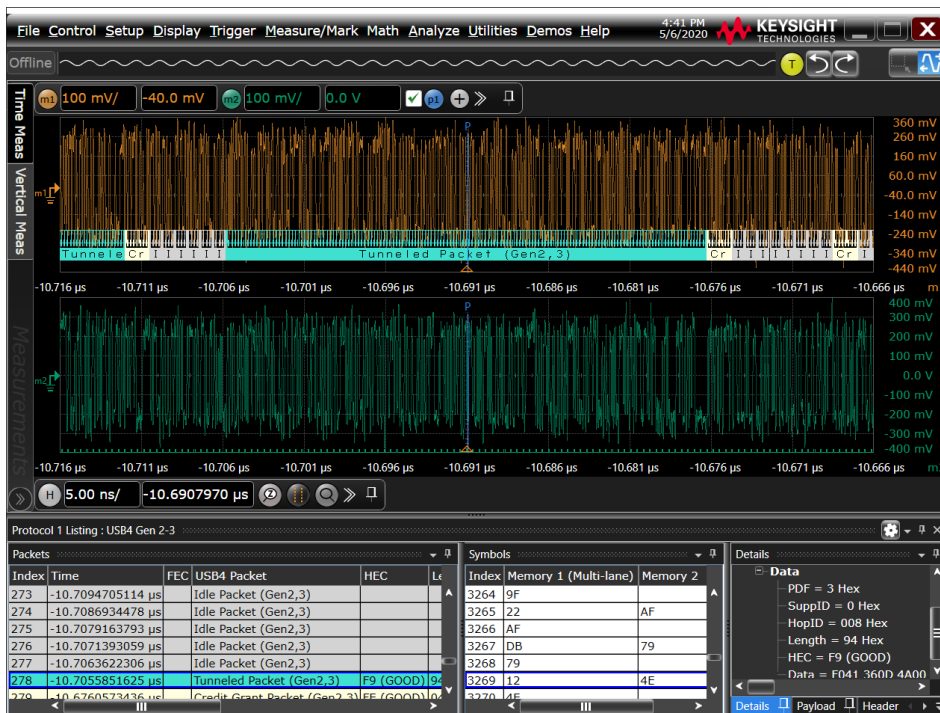


Figure 6. USB4 High-Speed trigger and decode, with protocol lister and detailed packet view.

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

DisplayPort 2.1

DisplayPort link is composed of three channels.

- Main-Link
The Main-Link is a unidirectional, high-bandwidth, low-latency channel that is used to transport isochronous data streams, such as uncompressed video and audio.
- Aux Channel
The AUX_CH is a half-duplex, bidirectional channel that is used for link and device management.
- Hot Plug Detect (HPD)
The HPD signal also serves as an interrupt request by the DP Sink device. In addition, the DP connector for a box-to-box connection has a power pin that is used for powering a local device

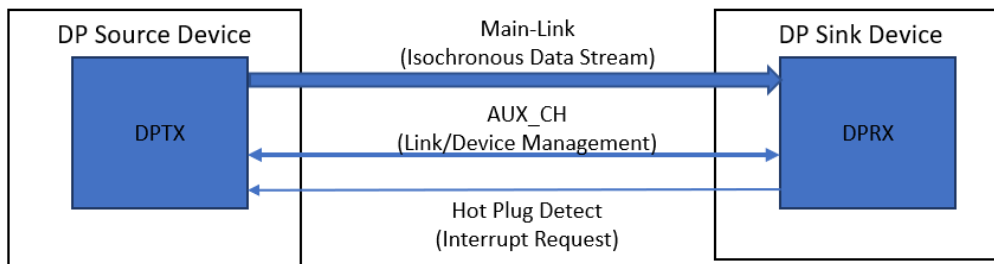
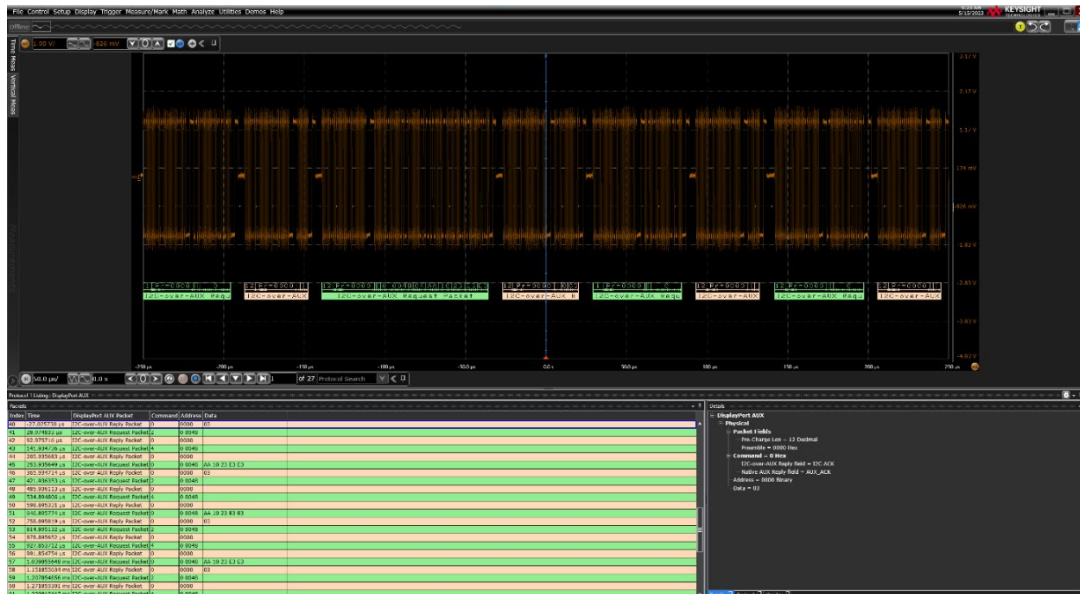


Figure 7. DisplayPort Data Transport Channels.

DisplayPort 2.1 Aux Channel (AUX_CH)

The communication over the Auxiliary Channel (AUX CH) is critical for a successful DisplayPort link bring-up and product interoperability. The DisplayPort physical interface consists of Main Link, up to 4 high-speed differential, unidirectional pairs, Hot-Plug Detect (HPD) — used by the DP Sink to signal its presence to the DP Source — and the AUX CH. The AUX CH uses a modified version of the Manchester-II encoding running at 1 Mbps to establish a bidirectional, request-response communication channel between the DP Source and the DP Sink to advertise capabilities and negotiate the link bandwidth (number of high-speed lanes and data rate) and DP Source drive settings.



DP-AUX Specification and Characteristics

Data sources	Any analog channel Any waveform memory Any waveform math
Probing requirements	Differential
Supported speed	1 Mbps
Auto setup	Automatically configures trigger levels, decode thresholds, sample rate, memory depth, holdoff, and trigger
Trigger options	Any packet, Aux Write/Read Request, I2C Write/Read Request, I2C Write Status Update Request, Aux Write/Read Acknowledged, Aux Write Not-Acknowledged, Aux Deferred, I2C Write/Read Acknowledged, I2C Write/Read Not-Acknowledged, I2C Deferred, errors

DisplayPort Main-Link (UHBR Rates)

Main-Link through which data is transmitted by a DPTX of a DP device (either DP Source device or DP Branch device) is referred to as a “downstream link” of the DP device. The port through which the link is driven is referred to as a “downstream-facing port” (DFP). Main-Link through which data is received by the DPRX of a DP device (either a DP Branch or Sink device) is referred to as an “upstream link” of the DP device. The port through which the link is receiving data is an “upstream-facing port” (UFP).

DisplayPort 2.1 introduces the new 128b/132b channel encoding for the Ultra High Bit Rates (UHBR). The “DisplayPort 2.1 UHBR” protocol decoder can be used to decode the Main-Link 128b/132b packets and the trigger on search is supported. The protocol decoder will auto-detect the presence of RS-FEC block data within the trace captured.



Figure 9. DisplayPort 2.1 UHBR trigger and decode, with protocol lister and detailed packet view.

DP2.1 UHBR Specification and Characteristics

DP2.1 Main-Link	Any analog channel Any waveform memory Any waveform math
Probing requirements	UHBR10: 21 GHz or higher, Differential UHBR13.5: 21 GHz or higher, Differential UHBR20: 25 GHz or higher, Differential
Supported speeds	UHBR10: 10 Gbps/lane UHBR13.5: 13.5 Gbps/lane UHBR20: 20 Gbps/lane
Supported Lanes	1, 2, 3, 4
Auto setup	automatically determine the signal type, mode, speed, thresholds, and trigger

Ordering Information

Recommended oscilloscopes

This protocol decode software is compatible with Keysight's Infiniium V, Z, UXR Series oscilloscopes. To ensure you continue to receive all the latest software updates and enhancements on your UXR-Series scopes, you will need to have a current core software subscription. A node-locked perpetual core software license and a minimum 1-year updates and enhancements subscription is included with new UXR-Series scopes. The subscription can be extended to 3 or 5 years at the time of purchase and can then be renewed later for a fee.

Flexible software licenses

Keysight offers a variety of flexible licensing options to fit your needs and budget. Choose your license term, and license type.

License terms

Perpetual – Perpetual licenses can be used indefinitely.

Subscription – Subscription licenses can be used through the term of the license only (6, 12, 24, or 36 months).

License types

Node-locked – License can be used on one specified instrument/computer.

Transportable – License can be used on one instrument/computer at a time but may be transferred to another using Keysight Software Manager (internet connection required).

USB Portable – License can be used on one instrument/computer at a time but may be transferred to another using a certified USB dongle (available for additional purchase with Keysight part number E8900-D10).

Floating (single site) – Networked instruments/computers can access a license from a server one at a time. Multiple licenses can be purchased for concurrent usage.

Selecting your license

Step 1. Choose your software product (e.g. D9110USBP)

Step 2. Choose your license term: perpetual or time-based.

Step 3. Choose your license type: node-locked, transportable, USB portable, or floating.

To ensure you continue to receive all the latest software updates and enhancements on your MXR and UXR-Series scopes, make sure your core software subscription is current.

Example

If you selected:	Your quote will look like this:	
	Part number	Description
D9110USBP node-locked perpetual license	D9110USBP	USB 2.0, eUSB2, USB 3.x, USB4, DisplayPort 2.1 Protocol Trigger and Decode
	R-B5P-001-A	Node-locked perpetual license
D9110USBP transportable subscription 6-month license	D9110USBP	USB 2.0, eUSB2, USB 3.x, USB4, DisplayPort 2.1 Protocol Trigger and Decode
	R-B7P-004-F	6-months, transportable subscription license

Subscription-based Compliance Test Software Suites

A new ownership model of multiple Compliance Test Software Applications is now available. With this new subscription-based model, the USB software suites bundle the Compliance Test Software Applications under a model number. Using a subscription-based ownership, you can enjoy all the test software features covered under USB across multiple generations and variants.

Software support and continuity

Under the subscription plan, software support is made available with no extra support cost. Ensuring your software always stays up to date with the latest enhancements and measurement standards while having access to our team of technical experts when you need support.

On top of that all upgrades are made available to you as the USB standards progresses with no additional costs.

Subscription-based Compliance Test Software Suites

Each suite comes with a 12, 24, or 36-month software suite subscription.

Suite license	Technology generation and variants coverage (current)
SW02USBH USB High Speed Full TX Test Suite	USB 3.2 TX Test (D9020USBC) USB4 TX Test (D9040USBC) USB4v2 TX Test (D9050USBC) USB 4.0, 3.2, 2.0 Protocol Decode (D9110USBP)

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

To configure your product and request a quote:

<http://www.keysight.com/find/software>

Contact your Keysight representative or authorized partner for more information or to place an order:

www.keysight.com/find/contactus