Keysight Technologies
USB and HSIC Protocol Triggering and Decode
For Infiniium 9000 and S-Series Oscilloscopes

Data Sheet

This application is available in the following license variations.

- Fixed to an oscilloscope
- Floating license
  - Server-based license
  - Transportable license

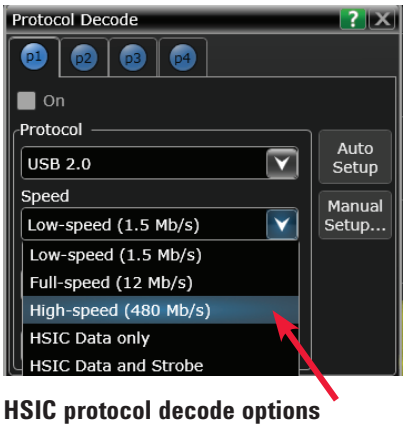
KEYSIGHT TECHNOLOGIES

Easily debug and test designs that include USB protocols using your Infiniium 9000 and S-Series oscilloscope

Serial bus interfaces such as USB (universal serial bus) interfaces are widely used today in electronic designs. In many designs, USB buses can provide a content-rich point for debug and test. However, since USB protocols transfer bits serially, using a traditional oscilloscope has limitations. Manually converting captured 1's and 0's to protocol requires significant effort, can't be done in real-time, and includes potential for human error. In addition, traditional scope triggers are not sufficient for specifying protocol-level conditions.

Extend your scope capability with the Keysight Technologies, Inc. USB triggering and decode application. This application makes it easy to debug and test designs that include low, full, or high-speed USB protocols using your Infiniium Series oscilloscope.

- Set up your scope to show USB protocol decode in less than 30 seconds.
- Get access to a rich set of integrated protocol-level triggers.
- Save time and eliminate errors by viewing packets at the protocol level.
- Use time-correlated views to quickly troubleshoot serial protocol problems back to their timing or signal integrity root cause.

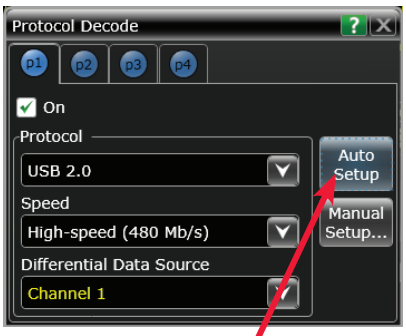


HSIC protocol decode options

Support for High-Speed Inter-Chip (HSIC) is included in the USB protocol triggering and decode software. Acquire both data and strobe or just data to view HSIC decode on the display. If both data and strobe are selected the decode will be based on the strobe timing relative to the data logic levels.

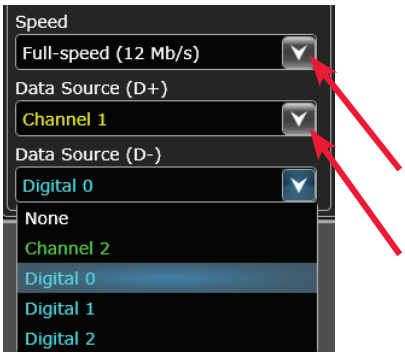
Easy to find

Turn decode on/off via the "Serial Decode" button on the front of the instrument or in the "Setup" menu. View decode embedded on the waveform display or in the protocol viewer listing window. (See pages 4-5).



30 Second USB Setup

Configure your oscilloscope to display protocol decode in under 30 seconds. Use "Auto Setup" to automatically configure sample rate, memory depth and threshold and trigger levels.



Support for both analog and digital channels

Acquire low and full-speed USB signals using any combination of scope or digital channels. Using digital channels on MSO models preserves analog channels for viewing other time-correlated signals. Analog differential channels provide robust signal integrity for high-speed USB protocol analysis.

USB protocol triggering and searching

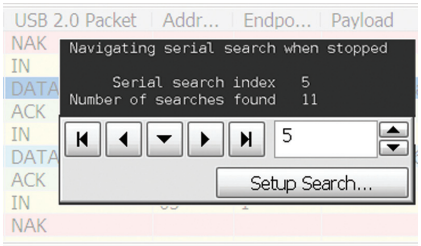
Get access to a rich set of integrated protocol level triggers. The application includes a suite of configurable protocol-level trigger conditions specific to USB. When serial triggering is selected, the application enables special real-time triggering hardware inside the scope.

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.

USB Trigger Setup
Choose triggers from a broad range of USB protocol, including token, data, handshakes, special and error types.

Payload editor

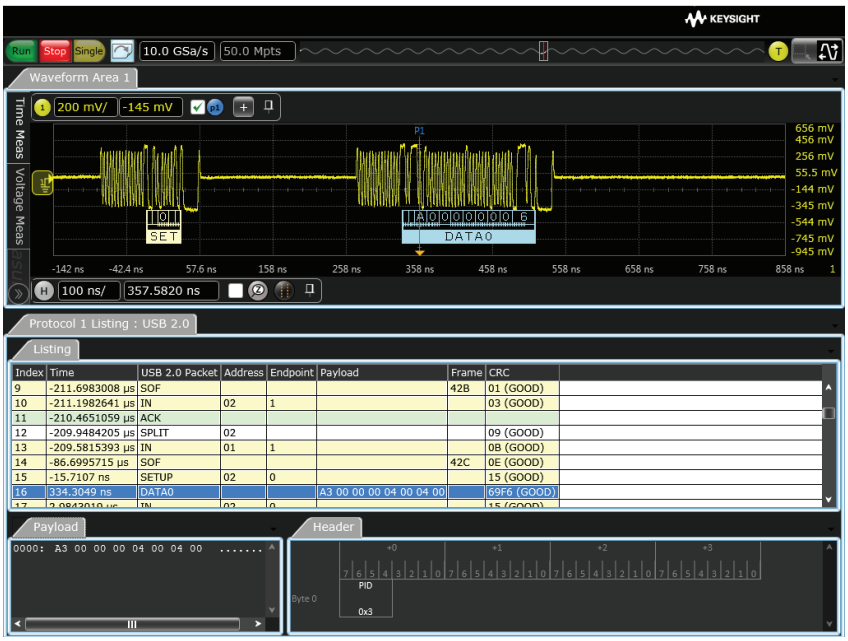
Use the payload editor to specify data values word by word.



Quickly find occurrences

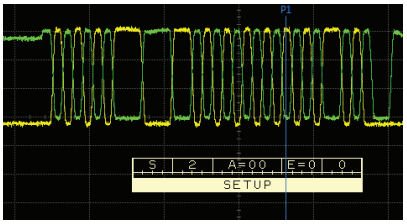
Quickly move to next occurrence of a specified event.

USB low- and full-speed protocol decode



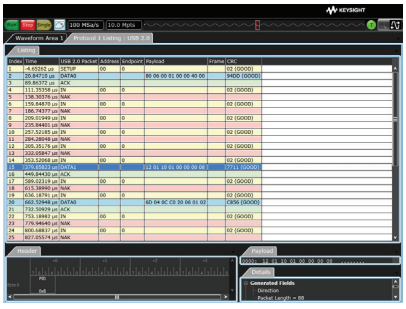
USB full-speed protocol decode with precise time-correlation between waveforms and listing

Keysight's multi-tab protocol viewer includes correlation between the waveforms and the selected packet. The selected packet, highlighted blue row in the listing, is time-correlated with the blue line in the waveform display. Move the blue tracking marker in time through waveforms and the blue bar will automatically track in the packets window. Or, scroll through the packet viewer and highlight a specific packet. The time-correlation tracking marker will move to the associated point in the waveform.



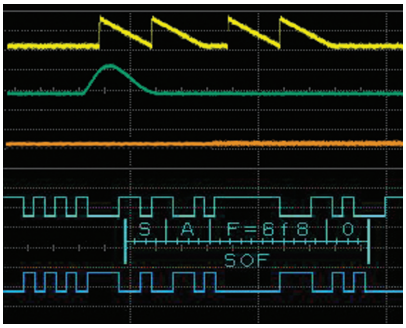
USB decode embedded in waveform area

Utilize the oscilloscope waveform area to display decode information. For USB, minor ticks indicate clock transitions and major ticks show the beginning and end of each word in the serial packet.



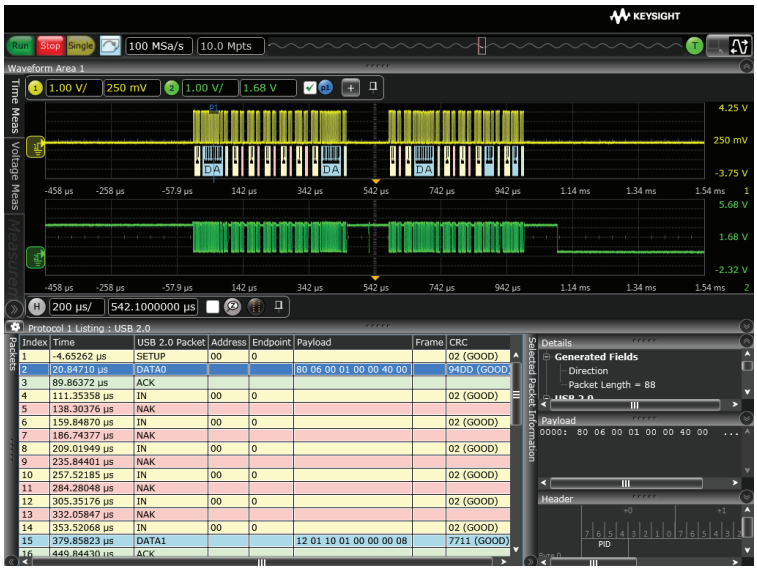
Full screen USB listing

Fill the entire display with compact protocol information using the full screen listing. The protocol viewer window shows the index number, time stamp value, and data content for each serial packet in the list. Scroll though all decoded serial packets to find events of interest or errors in the transmission. Data in the listing window can be saved to a .csv or .txt file for off-line analysis or documentation.

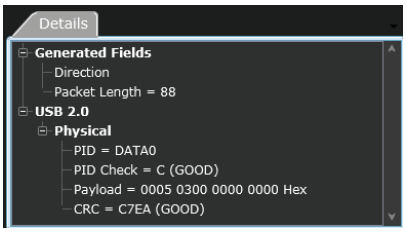


Use digital MSO channels for USB low- or full-speed to preserve analog channels for other system activity.

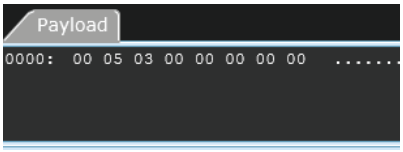
USB high-speed protocol decode



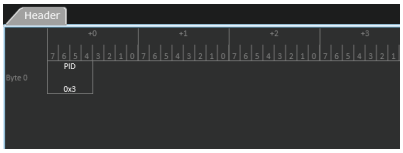
Quickly move between physical and USB high-speed protocol layer information using the time-correlated tracing marker. Display protocol content using embedded decode in the waveform area. Or, see protocol events in a compact listing format using the industry's first scope based multi-tab protocol viewer. For minor tick marks indicate clock transitions. Major tick markets indicate sections of the USB serial packet.



Details area breaks the packets into easy-to-read textual fields. Hovering shows additional detail.

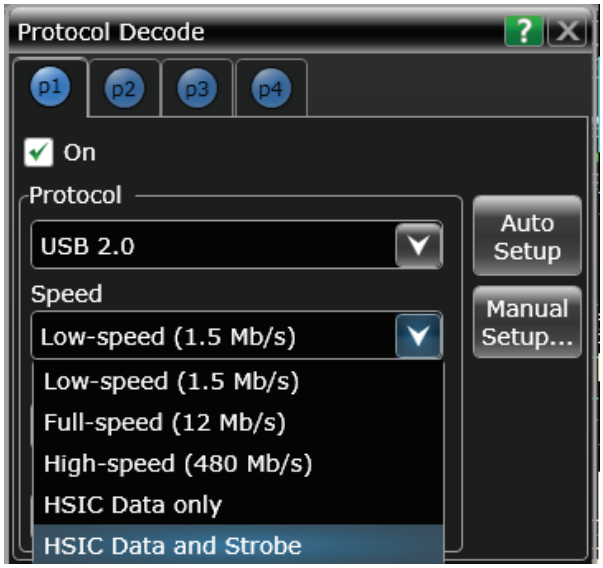


Payload area shows data carried by the packet in byte-by-byte HEX and ASCII.



Header area shows packets in a data book format. Hovering at any field reveals additional detail.

High-Speed Inter-Chip (HSIC) protocol decode



HSIC Data and Strobe protocol decode with Strobe used for packet decode

The HSIC decode allows user to decode data by itself or relative to the strobe signal. Data only decode uses the same clock recover method as standard High-Speed USB packets. In both cases all the features and capabilities of the USB protocol decode software, like packet search and viewing tabs, are available.

USB specifications and characteristics

USB 2.0 supported speeds	Low-speed (1.5 Mb/s) requires single-ended probing, supported by all 9000 Series bandwidth Full-speed (12 Mb/s) requires single-ended probing, supported by all 9000 Series bandwidth High-speed (480 Mb/s) (requires differential probing), recommended 2.5 GHz bandwidth or greater models HSIC data only (480 Mb/s) HSIC data and strobe
Probing	Single-ended required for USB low- and full-speed Differential required for USB high-speed (recommended 1.5-GHz 1130A or higher bandwidth) High resistance (1MΩ) required for HSIC strobe (ex: N2796A)
D+ and D- data sources	Analog channels 1, 2, 3, or 4 Any waveform memory For low- or full-speed USB protocol, MSO models can additionally use digital channels D0 to D15
Auto Setup	Automatically configures trigger levels, measurement thresholds, Volts/div, vertical offset, memory depth, sample rate, trigger and holdoff for proper decode and triggering
Probing location requirements	General recommendation: keep cable lengths as short as possible. High-speed (480 Mb/s) differential probing, recommend using cable lengths as short as possible Full-speed (12 Mb/s) single ended probing, must probe signals to be analyzed near the receiver of the transaction (far-end location) HSIC Data (480 Mb/s), must probe signals near the receiver of the transaction (far-end location). Probe impedance is not critical HSIC Strobe (480 Mb/s), must probe signals near the receiver of the transaction (far-end location) and should be probed in same location as HSIC Data. Probe must be high impedance (ex: N2796A) due to weak pull-up on Strobe during electrical idle
Trigger types	Token selections: Any token, OUT, IN, SOF, or SETUP AND-ing of user defined value for up to three of the following PID check, address, endpoint, or CRC Data selections: DATA0, DATA1, DATA2, MDATA AND-ing for user defined value for PID check, payload, and CRC values Handshake selections: Any handshake, ACK, NAK, NYET, STALL User selectable PID check value for handshakes Special selections Any special Reserved with user selectable PID check value Split with AND-ing of three of the following – PID check with user selectable value – Address with user selectable value – C with choice of SSPLIT or CSPLIT – Port with user define d value – S with choice of full speed or low speed – ET with choice of isochronous, bulk, or interrupt – CRC with user defined value PING: AND-ing of user defined values for three of the following PID check, address, endpoint, CRC PRE/ERR with user defined PID check value Error selections Any error, PID error, bad 5-bit CRC, bad 16-bit CRC.

Ordering information

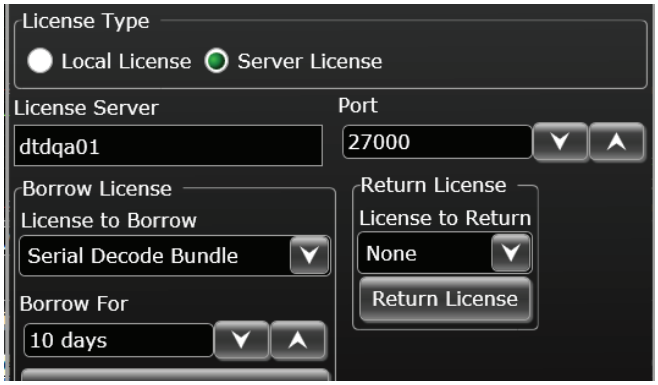
This application is compatible with all 9000 and S-Series oscilloscope models.

Application software			9000 Series	S-Series
USB 2.0 protocol decode and triggering	Fixed	Factory-installed	Option 005	N5464B-1FP
		User-installed	N5464B-1NL/1FP*	N5464B-1FP
	Floating	Transportable	N5464B-1TP*	
		Server-based	N5434A-034	

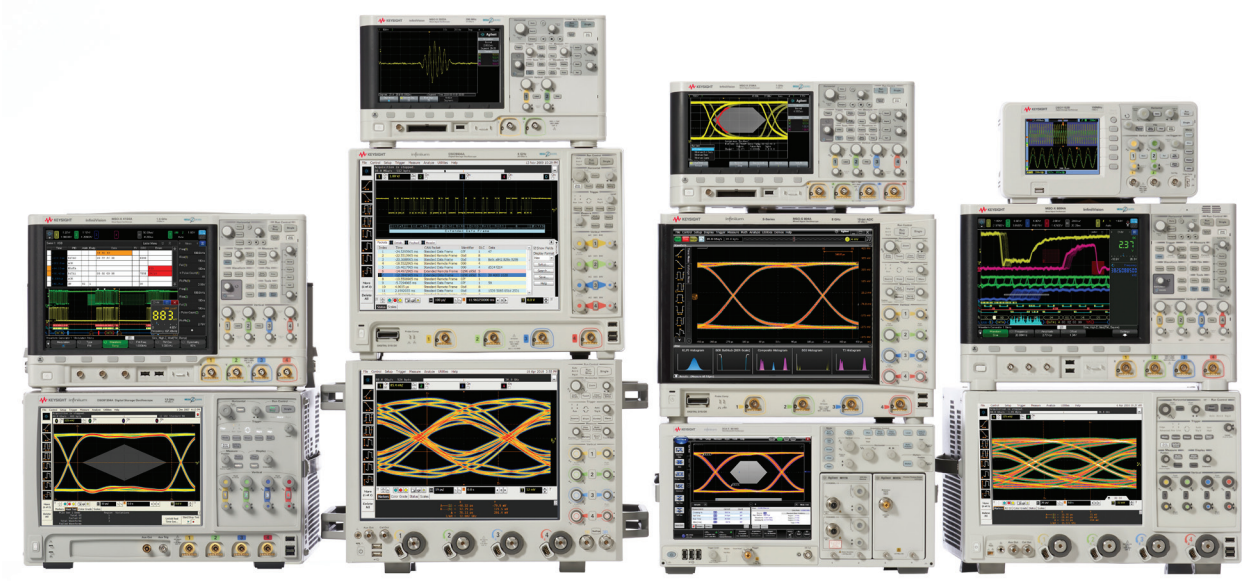
* Requires Infiniium 5.0 or above

Related literature

Publication title	Publication type	Publication number
Infiniium S-Series Oscilloscopes	Data Sheet	5991-3904EN
Infiniium 9000 Series Oscilloscopes	Data Sheet	5990-3746EN
Infiniium 9000 H-Series Oscilloscopes	Data Sheet	5991-1520EN
USB Test Compliance for Infiniium Oscilloscopes	Data Sheet	5989-4044EN
U7248A High-Speed Inter-Chip (HSIC) Electrical Test Software for Infiniium Oscilloscopes	Data Sheet	5990-9246EN



Sharing the application across multiple instruments? Server-based licensing allows users to borrow and application license for a specified period of time.



Keysight Technologies Oscilloscopes

Multiple form factors from 20 MHz to > 90 GHz | Industry leading specs | Powerful applications

myKeysight

myKeysight

www.keysight.com/find/mykeysight
A personalized view into the information most relevant to you.

www.axiestandard.org
AdvancedTCA® Extensions for Instrumentation and Test (AXIe) is an open standard that extends the AdvancedTCA for general purpose and semiconductor test. Keysight is a founding member of the AXIe consortium. ATCA®, AdvancedTCA®, and the ATCA logo are registered US trademarks of the PCI Industrial Computer Manufacturers Group.

www.lxistandard.org
LAN eXtensions for Instruments puts the power of Ethernet and the Web inside your test systems. Keysight is a founding member of the LXI consortium.

Three-Year Warranty
www.keysight.com/find/ThreeYearWarranty
Keysight's commitment to superior product quality and lower total cost of ownership. The only test and measurement company with three-year warranty standard on all instruments, worldwide.

Keysight Assurance Plans
www.keysight.com/find/AssurancePlans
Up to five years of protection and no budgetary surprises to ensure your instruments are operating to specification so you can rely on accurate measurements.

www.keysight.com/quality
Keysight Technologies, Inc.
DEKRA Certified ISO 9001:2008
Quality Management System

Keysight Channel Partners
www.keysight.com/find/channelpartners
Get the best of both worlds: Keysight's measurement expertise and product breadth, combined with channel partner convenience.

www.keysight.com/find/9000_usb

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at:
www.keysight.com/find/contactus

Americas

Canada	(877) 894 4414
Brazil	55 11 3351 7010
Mexico	001 800 254 2440
United States	(800) 829 4444

Asia Pacific

Australia	1 800 629 485
China	800 810 0189
Hong Kong	800 938 693
India	1 800 112 929
Japan	0120 (421) 345
Korea	080 769 0800
Malaysia	1 800 888 848
Singapore	1 800 375 8100
Taiwan	0800 047 866
Other AP Countries	(65) 6375 8100

Europe & Middle East

Austria	0800 001122
Belgium	0800 58580
Finland	0800 523252
France	0805 980333
Germany	0800 6270999
Ireland	1800 832700
Israel	1 809 343051
Italy	800 599100
Luxembourg	+32 800 58580
Netherlands	0800 0233200
Russia	8800 5009286
Spain	0800 000154
Sweden	0200 882255
Switzerland	0800 805353 Opt. 1 (DE) Opt. 2 (FR) Opt. 3 (IT)
United Kingdom	0800 0260637

For other unlisted countries:
www.keysight.com/find/contactus
(BP-07-10-14)

KEYSIGHT TECHNOLOGIES

Published in USA, August 4, 2014
5990-3922EN
www.keysight.com