Keysight Technologies
I²C and SPI Protocol Triggering and Decode

For Infiniium 9000 and S-Series Oscilloscopes

Data Sheet

KEYSIGHT
TECHNOLOGIES

This application is available in the following license variations.

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

Easily debug and test designs that include I2C or SPI protocols using your Infiniium oscilloscopes

Lower-speed serial bus interfaces such as I^2C (inter-integrated circuit) and SPI (serial peripheral interface) are widely used today in electronic designs for chip-to-chip communication. In many designs these serial buses tend to provide content-rich points for debug and test. However, since these 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 I^2C and SPI Triggering and Decode application. This application makes it easy to debug and test designs that include I^2C or SPI protocols using your Infiniium oscilloscopes.

- Set up your scope to show I2C or SPI 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.


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)
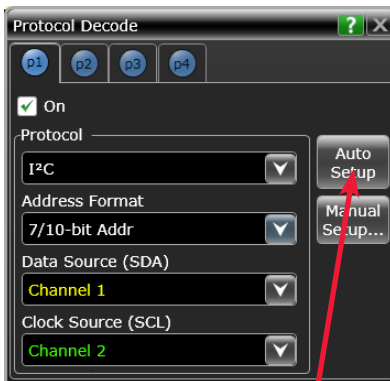
30 Second SPI or I²C Setup
Configure your oscilloscope to display protocol decode in under 30 seconds. Use "Auto Setup" to automatically configure sample rate, memory depth and threshold and trigger levels.
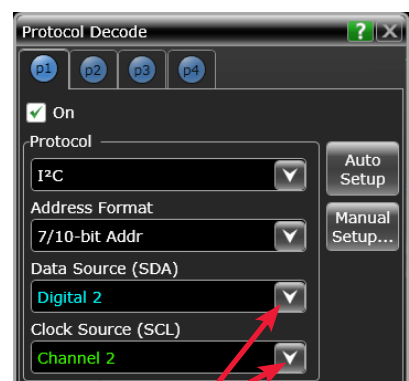
Support for both
analog and digital channels
Acquire serial buses using any combination of scope or digital channels. Using digital channels on MSO models preserves analog channels for viewing other time-correlated signals.

I^{2}C and SPI 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 I^{2}C and SPI. 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.
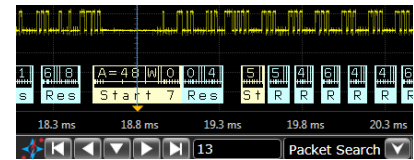
SPI Trigger Setup
Quickly access protocol triggering via the scope's trigger menu. Specify SPI trigger in HEX, binary, or decimal up to 200 bits.

I^{2}C Trigger Setup
Choose a combination of address, read/write, address acknowledge and data values for I2C triggers.

Quickly find occurrences
Quickly move to next occurrence of a specified event. Jump to the next or previous occurrence of the specified event.
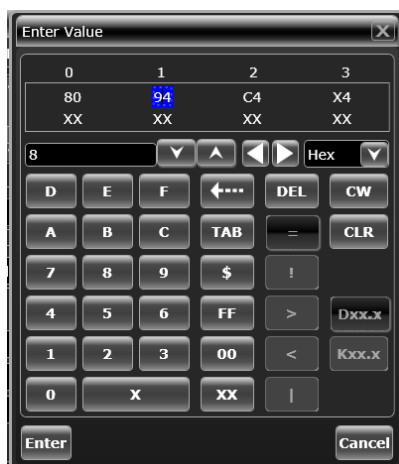
Payload editor
Use the payload editor to specify data values word by word. Operators give additional triggering flexibility.
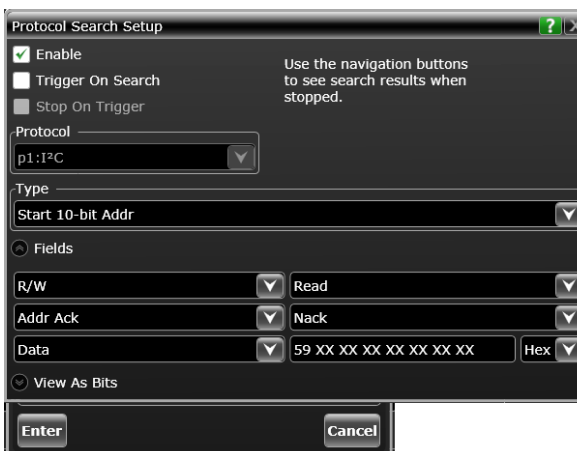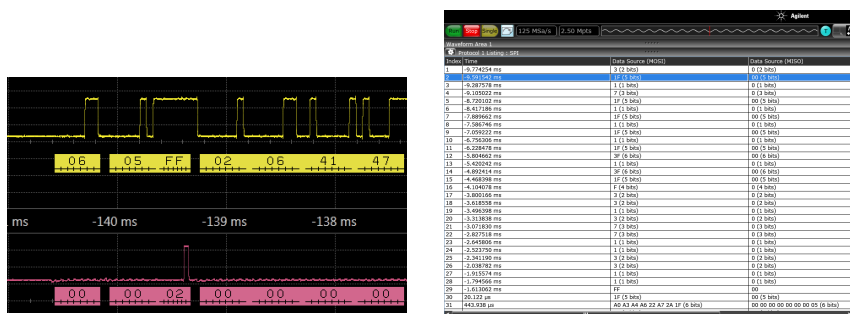
Post-acquisition searching
Search acquired protocol listing using a menu that is identical to the trigger menu.

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SPI protocol decode

SPI protocol decode with precise time-correlation between waveforms and listing

The Keysight Technologies, Inc. SPI 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.

Support for 2, 3, and 4-Wire SPI
The application supports 2-, 3-, and 4-wire SPI. Use digital channels on MSO models to preserve analog channels for simultaneously viewing other signals.

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

Full screen SPI 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.


Long Time Captures using Segmented Memory
Capture seconds to days of serial protocol. The scope fills memory as each acquisition sees its trigger condition.

Segmented memory uses time tags to track time between segment acquisitions.

I²C protocol decode

Quickly move between physical and I2C 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 I2C minor tick marks indicate clock transitions. Major tick marks indicate sections of the serial packet such as address, acknowledge, and data.
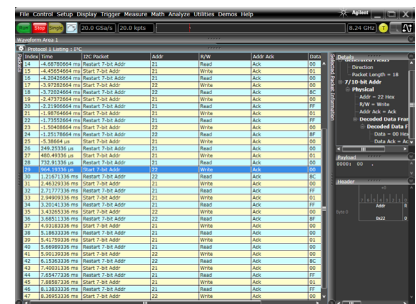
Fill the entire display with compact protocol information. The protocol viewer shows index number, time stamp, and data content for each serial packet. Listing content can be saved to a .csv or .txt file for off-line analysis or documentation. Use search capability to quick navigate through an acquisition.
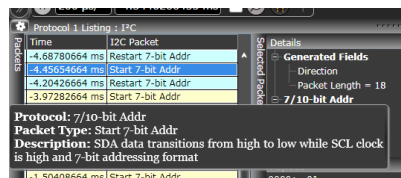
Details tab breaks the packets into easy-to-read textual fields. Hovering shows additional detail.
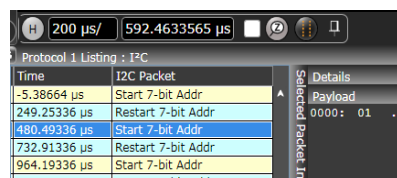
Payload tab shows data carried by the packet in byte-by-byte HEX and ASCI.

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

I²C specifications and characteristics

I²C source (clock and data)	Analog channels 1, 2, 3, or 4 MSO models can additionally use digital channels D0 to D15 any waveform memory
Max clock/data rate	Any waveform memory up to 3.4 Mbps (automatic)
Auto Setup	Automatically configures scope settings for proper I²C decode and protocol triggering

Triggering	Start and re-start 7-bit address
	Start and re-start 8-bit address
	Start and re-start 10-bit address
	Start and re-start 11-bit address
	Specify value for 3 fields choosing between the following
	    Read or write
	    Address (value in HEX or binary)
	    Address acknowledge
	    Data (up to 20 bytes (specify in HEX, binary, ASCII, or decimal)
	        Operators include: = on 8-bit word boundaries.

SPI specifications and characteristics

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SPI protocols supported	2-wire SPI signals:
	    data source and clock source
	3-wire SPI signals:
	    data source, clock source, and chip select source
	4-wire SPI signals: data source (MOSI), clock source, chip select source,
	    data source (MISO)

SPI source (all signals)	Analog channels 1, 2, 3, or 4 MSO models can additionally use digital channels D0 to D15
Max clock/data rate	Up to 50 Mbps (automatic)
Autoset	Automatically configures scope settings for proper SPI decode and protocol triggering
Decode word size	User-selectable from 4 to 32 bits
Decode bit order	User-selectable LSB or MSB

Triggering	Data length up to 200 bits
	    Number of words * word size ＜ 200 bits
	        Number of words selectable up to 50
	        Word size selectable from 4 to 32 bits
	Data operators include: =, OR

Ordering information

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

Application software			9000 Series	S-Series
I²C/SPI triggering and decode	Fixed	Factory-installed	Option 007	N5391B-1FP
		User-installed	N5391B-1NL N5391B-1FP*	N5391B-1FP
	Floating	Transportable	N5391B-1TP*	
		Server-based	N5435A-006	
I²C/SPI, RS-232/UART triggering and decode bundle	Fixed	Factory-installed	Option 018	N8800B-1FP
		User-installed	N8800B-1NL N8800B-1FP*	N8800B-1FP
	Floating	Transportable	N8800B-1TP*	
		Server-based		

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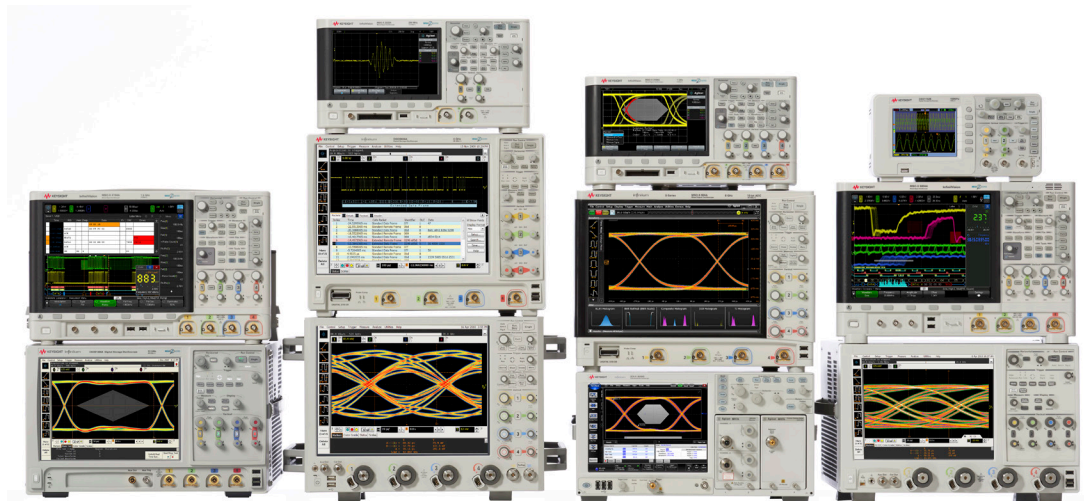
Keysight Technologies Oscilloscopes
Multiple form factors from 20 MHz to > 90 GHz | Industry leading specs | Powerful applications

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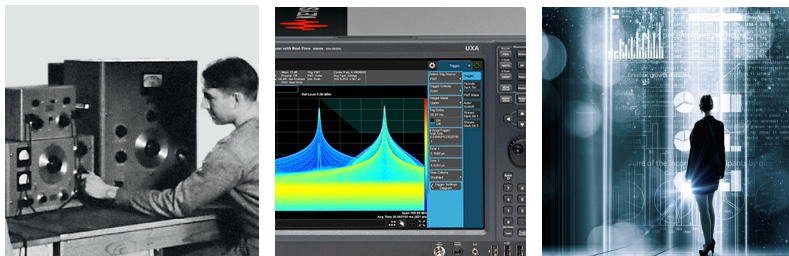
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www.keysight.com/find/9000_I2C-SPI

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