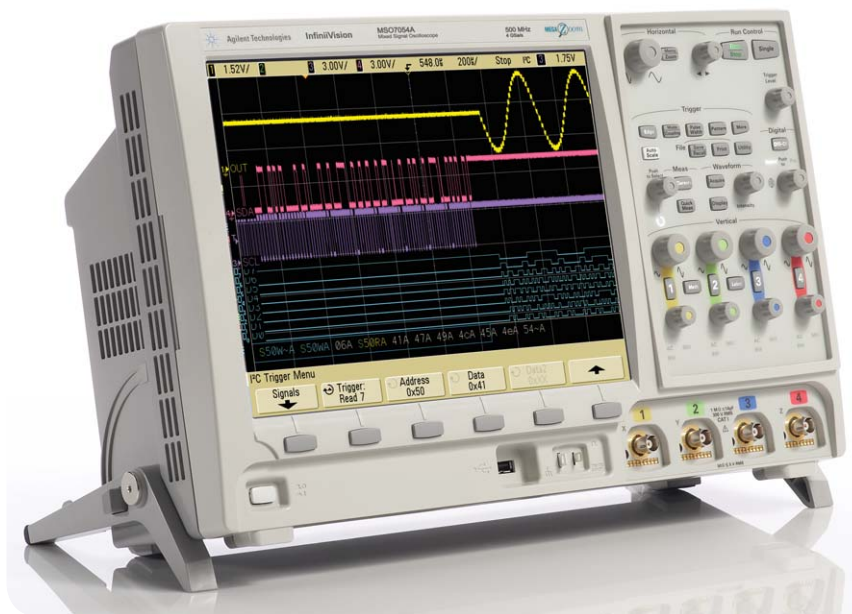


I²C and SPI Triggering and Hardware-based Decode for Agilent InfiniiVision Series Oscilloscopes (N5423A)

Data Sheet



Find and debug intermittent serial bus errors and signal integrity problems faster

Agilent Technologies' triggering and decode options for the InfiniiVision Series oscilloscopes (5000, 6000, and 7000 series) offer hardware-accelerated decode to help you debug embedded designs with I²C and SPI serial buses hardware-based decoding provides the fastest decode update rates in the industry.

Lower-speed serial bus interfaces such as I²C (inter-integrated circuit) and SPI (serial peripheral interface) are widely used today in mixed-signal embedded designs for chip-to-chip communication between EEPROMs, DACs, ADCs, and other peripheral ICs to microcontrollers, microprocessors, and DSPs. Since these protocols transfer many bits of data serially, it can be very difficult to unravel what's happening in an

embedded system with conventional scope triggering.

The Agilent InfiniiVision Series oscilloscopes offer integrated serial triggering and hardware-accelerated protocol decoding solutions that give you the tools you need to efficiently and effectively debug your embedded system designs that have serial buses.



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Other oscilloscope solutions with serial bus triggering and protocol decode typically use software post-processing techniques to decode serial packets/frames. Using these software techniques, waveform- and decode-update rates tend to be slow (sometimes seconds per update), especially when you use deep memory, which is often required to capture multiple packetized serial signals. Faster decode update rates enhance the scope's probability of capturing infrequent serial communication errors.

Agilent's InfiniiVision Series mixed signal oscilloscopes (MSOs) are a perfect fit for verifying and debugging embedded designs that include a combination of analog signals, serial traffic, and higher-speed digital control signals found in today's embedded designs. MSOs provide an integrated way to capture and time-correlate multiple analog, serial and digital signals of various speeds with deep memory. Agilent offers MSOs with optional serial bus capabilities in various bandwidth models ranging from 100-MHz up to 1-GHz.

Using an MSO with the N5423A I²C/SPI option, you can capture and decode I²C or SPI data packets and correlate them with other signals in mixed-signal designs, such as digital control signals and analog signals, as shown in Figure-1.

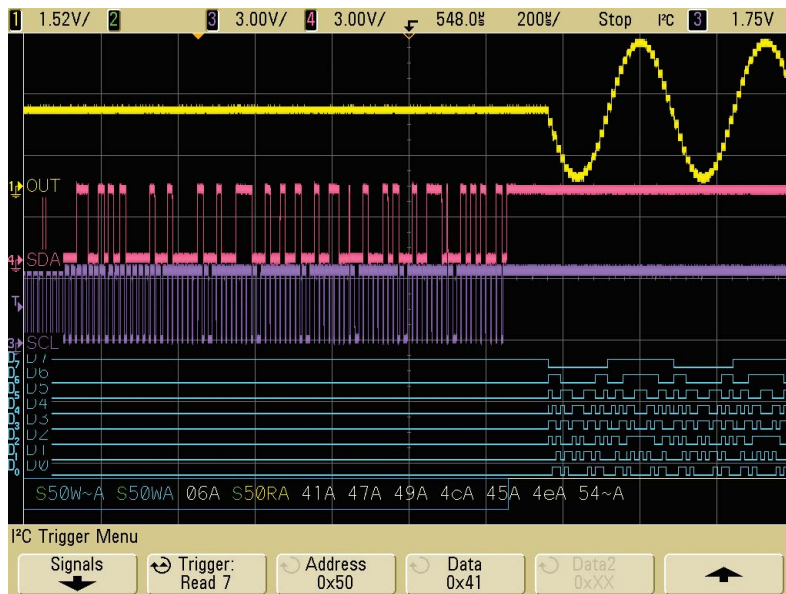


Figure 1. On-screen serial decode of I²C data packet shown with time-correlated analog and digital waveforms captured by an MSO

I²C Specifications/Characteristics (N5423A or Option LSS)

I ² C source (clock and data)	Analog channels 1, 2, 3, or 4 Digital channels D0 to D15
Max clock/data rate	Up to 3.4 Mbps (automatic)
Triggering ¹	Start condition Stop condition Missing acknowledge Address with no acknowledge Restart EEPROM data read Frame (Start:Addr7:Read:Ack:Data) Frame (Start:Addr7:Write:Ack:Data) Frame (Start:Addr7:Read:Ack:Data:Ack:Data2) Frame (Start:Addr7:Write:Ack:Data:Ack:Data2) 10-bit write
Color-coded, hardware-accelerated decode ²	Data (HEX digits in white) Read address (HEX digits in yellow) Write address (HEX digits in light-blue) Restart addresses (prefixed with "S" in green) Acknowledges (suffixes "A" or "~A" in the same color as the data or address preceding it) Idle bus (high bus trace in white) Active bus (bi-level bus trace in dark-blue) Unknown/error bus (bi-level bus trace in red)

1 Standard I²C triggering in all Agilent 6000 Series oscilloscopes

2 Optional I²C decoding in all 4-channel and 4+16-channel 6000 Series oscilloscopes

SPI Specifications/Characteristics (N5423A or Option LSS)

SPI source (clock, data, chip select)	Analog channels 1, 2, 3, or 4 Digital channels D0 to D15
Max clock/data rate	Up to 25 Mbps (automatic)
Triggering ¹	4- to 32-bit data pattern during a user-specified framing period Framing period can be a positive or negative chip select (CS or ~CS) or clock idle time (timeout)
Color-coded, hardware-accelerated decode ²	Data (hex digital in white) Unknown/error bus (bi-level bus trace in red) Number of clocks/packet ("XX CLKS" in light-blue) Idle bus (outside of a packet = white) Active bus (bi-level bus trace in dark-blue)

1 Standard SPI triggering in all Agilent 6000 Series oscilloscopes

2 Optional SPI decoding in all 4-channel and 4+16-channel 6000 series oscilloscopes

Ordering information

The N5423A (I²C and SPI) is compatible with Agilent's InfiniiVision Series' 4-channel DSO and 4+16 channels MSO models, including the 5000, 6000, and 7000 Series scopes. This option is available as a factory-installed option

if ordered as Option-LSS along with a specific oscilloscope model, or existing InfiniiVision Series oscilloscope users can order this option as an after-purchase product upgrade (N5423A).

Model	Description
N5423A (or Option LSS)	I ² C/SPI serial decode option (4 and 4+16 channel models only)
N5457A (or Option 232)	RS-232/UART triggering and decode (4 and 4+16 channel models only)
N5424A (or Option AMS)	CAN/LIN automotive triggering and decode (4 and 4+16 channel models only)
N5454A (or option SGM)	Segmented Memory

Note that additional options and accessories are available for Agilent InfiniiVision Series oscilloscopes. Refer to the appropriate 5000, 6000, or 7000 Series data sheet for ordering information about these additional options and accessories, as well as ordering information for specific oscilloscope models.

Related Literature

Publication Title	Publication Type	Publication Number
<i>Agilent Technologies Oscilloscope Family Brochure</i>	Brochure	5989-7650EN
<i>Agilent 7000 Series InfiniiVision Oscilloscopes</i>	Data sheet	5968-7736EN
<i>Agilent 6000 Series InfiniiVision Oscilloscopes</i>	Data sheet	5989-2000EN
<i>Agilent 5000 Series InfiniiVision Oscilloscopes</i>	Data sheet	5989-6110EN
<i>Agilent InfiniiVision Series Oscilloscope Probes and Accessories</i>	Data sheet	5989-8153EN
<i>RS-232/UART triggering and hardware-based decode for Agilent Agilent InfiniiVision Series Oscilloscopes (N5457A)</i>	Data sheet	5989-7832EN
<i>Segmented Memory Acquisition for Agilent InfiniiVision Oscilloscopes (N5454A)</i>	Data sheet	5989-7833EN
<i>Using an Agilent InfiniiVision MSO to Debug an Automotive CAN Bus</i>	Application note	5989-5049EN
<i>Evaluating Oscilloscopes for Best Signal Visibility</i>	Application note	5989-7885EN
<i>Debugging Embedded Mixed-Signal Designs Using Mixed Signal Oscilloscopes</i>	Application note	5989-3702EN
<i>Choosing an Oscilloscope with the Right Bandwidth for your Applications</i>	Application note	5989-5733EN
<i>Evaluating Oscilloscope Sample Rates vs. Sampling Fidelity</i>	Application note	5989-5732EN
<i>Evaluating Oscilloscope Vertical Noise Characteristics</i>	Application note	5989-3020EN

To download these documents, insert the publication number in the URL: <http://cp.literature.agilent.com/litweb/pdf/xxxx-xxxxEN.pdf>

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