# N5391A

# I²C and SPI Triggering and Decode for Infiniium 8000 and 90000 Oscilloscopes

Data Sheet



## Quickly decode I²C and SPI serial packets

Lower-speed serial bus interfaces are widely used for connecting EEPROMs, DACs, ADCs, and other peripheral ICs to microcontrollers and processors. Because these interfaces are relatively simple to implement and have few wires taking up board space, they are found in a wide array of embedded designs. Two common low-speed serial bus interfaces found pre-packaged on many vendors' ICs are inter-integrated circuit (I²C) and serial peripheral interface (SPI).

The N5391A triggering and decode for I²C and SPI software provides the integration of the Infiniium oscilloscope, a powerful everyday signal integrity test tool, with protocol analysis capabilities. With this integration, you can isolate serial packets to find sources of errors due hardware related problems and software related problems. Quickly pinpoint timing or signal integrity issues such as noise or coupling on your I²C or SPI bus. Easily see the information transfer leading up to or following a particular event or failure.

Effectively troubleshoot an embedded system capturing and decoding I²C or SPI buses, correlating them with other signals in the design, such as digital control signals using a mixed signal oscilloscope (MSO), and analog signals interfacing with the real world.

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## Easy-to-Setup Dialog Box

The N5391A triggering and decode application extends Infiniium 8000 and 90000 Series oscilloscopes ease-of-use advantages to serial data analysis. A dialog box makes it easy to set up the process to perform serial decode. The figures on this page show the dialog box selections for setting up the serial decode for I2C and SPI. Note that SPI comes in a 2-wire version (without a chip select signal) or 3-wire (with a chip select signal and single bidirectional data line) or four-wire version (with a chip select signal and two unidirectional data lines). The software supports the 3 versions. Any combination of analog and digital input channels can be used as the data, clock, and chip select sources.

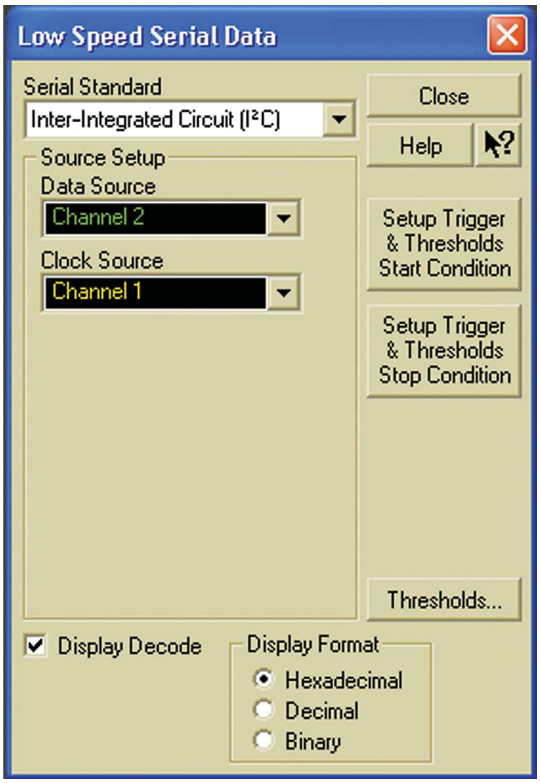


*Figure 1: Setup dialog box for $I^2C$*

The application provides a simple one-button start-of-frame trigger or end-of-frame trigger that automatically sets your Infiniium scope to trigger on a generic $I^2C$ or SPI serial packet. This button also automatically scales Infiniium's measurement thresholds corresponding to the voltage levels of your $I^2C$ or SPI signal.

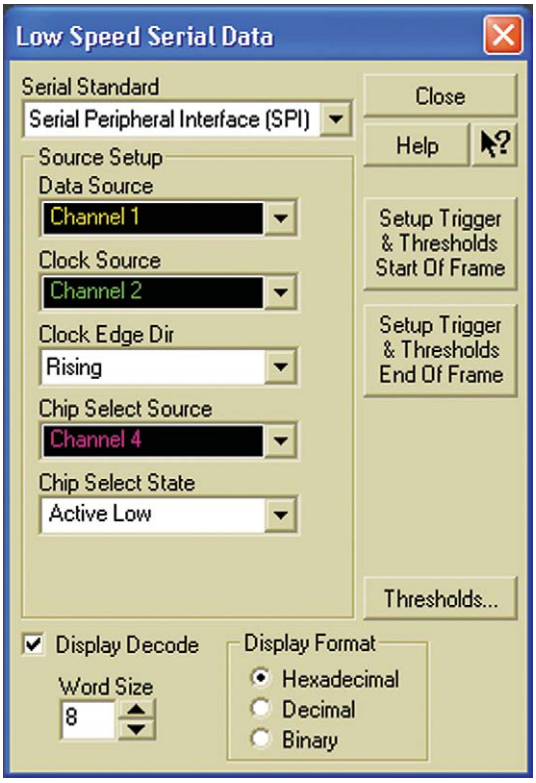


*Figure 2: Setup dialog box for SPI*

## On-Screen Serial Decode

Once the application has been set up and turned on, the numerical decode is automatically displayed below the data signal's waveform. In the setup dialog box, you can vary the display format between hexadecimal, decimal, and binary. The numerical decode values are displayed along with minor and major tick marks. The minor tick marks indicate clock transitions for both $I^2C$ and SPI. The major tick marks for $I^2C$ indicate sections of the serial packet, such as the address, acknowledge, and data. The major tick marks for SPI indicate the beginning and end of each data word in the serial packet. You can click on the decode values and tick marks with the Infiniium scope's mouse and drag them vertically anywhere on the scope display.

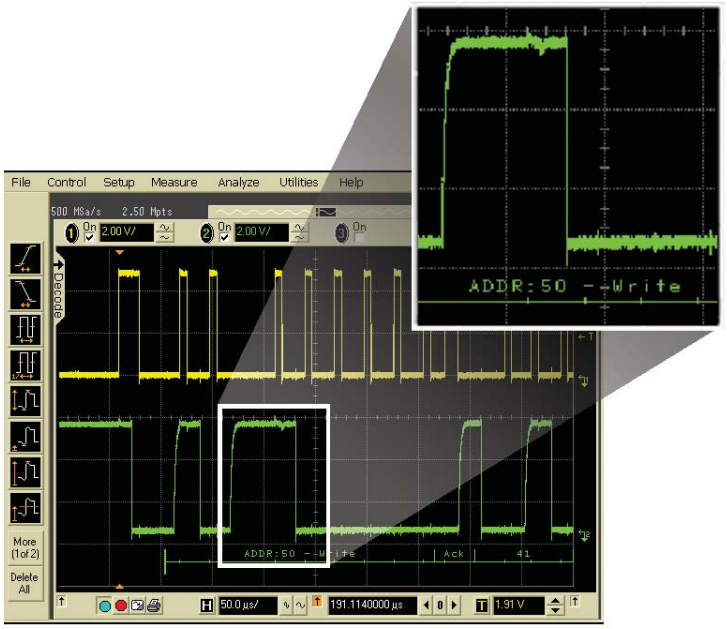


*Figure 3: On-screen serial decode of an $I^2C$ packet on an Infiniium 8000 Series.*

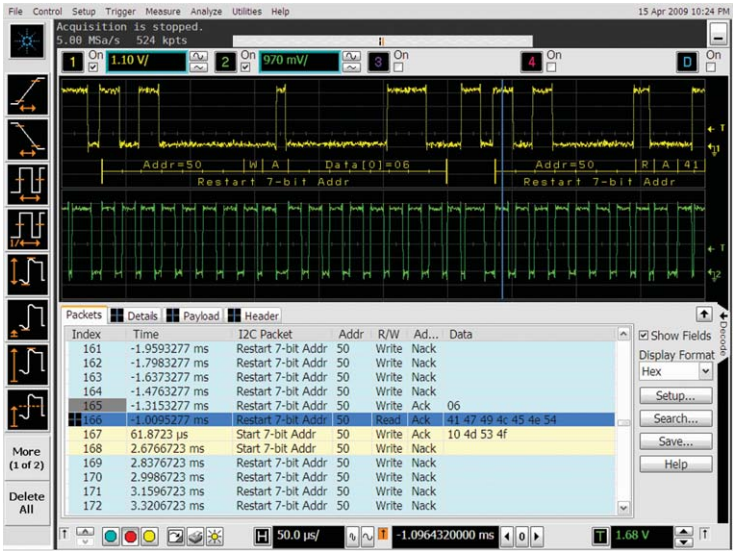


*Figure 3B. Quickly move between physical and $I^2C$ protocol layer information using the time-correlated tracing marker. Display protocol content using embedded decode in the waveform area. Or, see protocol events in a compact listing format using the industry's first scope-based multi-tab protocol viewer.*

# On-Screen Serial Decode (continued)

With deep memory the application becomes particularly valuable. You can capture, decode, and search through many packets of $I^2C$ or SPI transmission over a relatively long period of time, maintaining an appropriate sample rate to digitize all the signal details. You can analyze a series of serial packets that lead up to or follow a particular event of interest or failure in the system. You can use additional channels (up to 20 channels in the MSO models) to probe other test points in the system to correlate traffic on the serial bus to other causes and effects in the system.

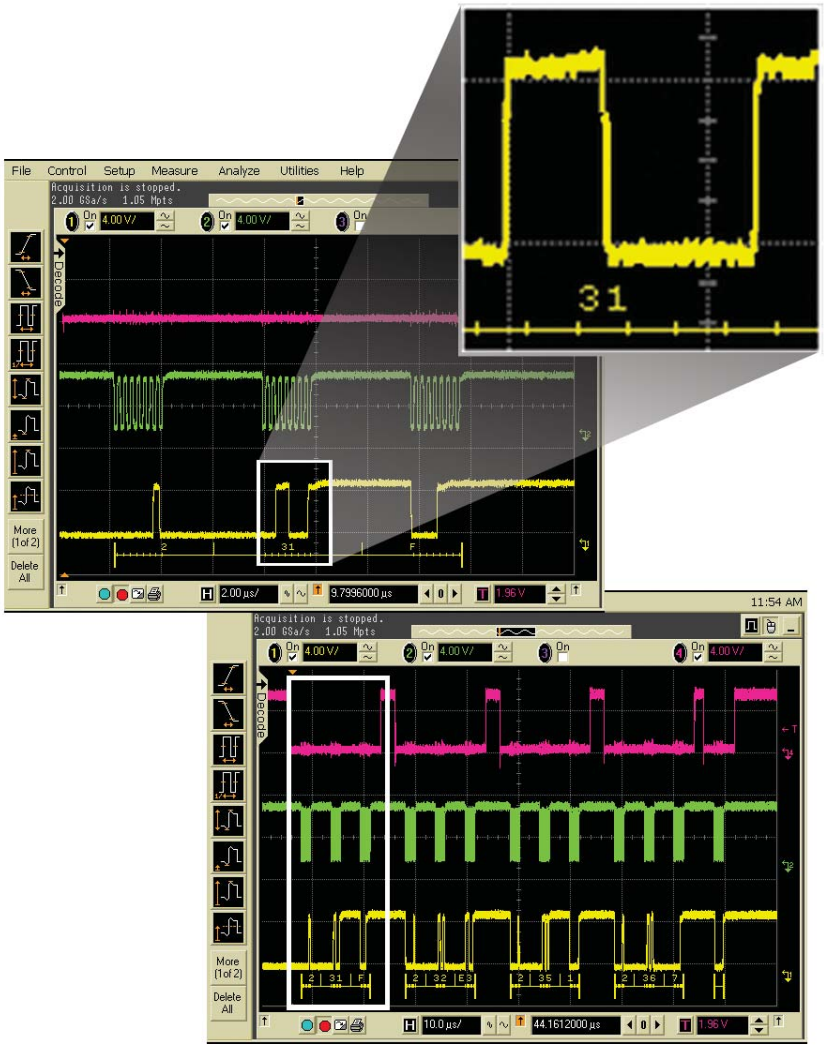


*Figure 4: On-screen serial decode of a SPI packet.*

# Listing Window with Automatic Click and Zoom

This application also offers a listing window view with automatic click and zoom capability. When the application has been set up and turned on, a sliding tab is available to either show or hide a protocol decode list of all $I^2C$ or SPI packets that have been captured in an acquisition. The listing window shows the index number, time stamp value, and data content of each serial packet in the list. With the listing window, you can easily scroll through all decoded serial packets in an acquisition to find particular events of interest or errors in the transmission. The listing window can be shown in full screen to see more decoded packets at one time, or in half screen to see the listing window along with the captured waveforms. The data in the listing window can be saved to a .csv or .txt file for off-line analysis or documentation purposes.

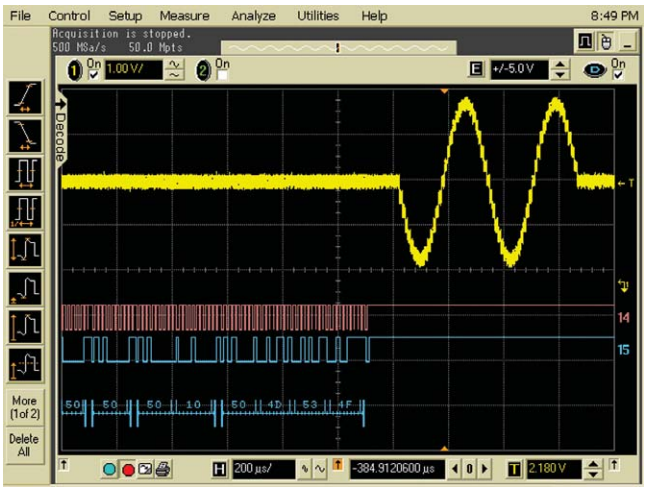


*Figure 5: Listing window hidden with sliding tab available to expand.*

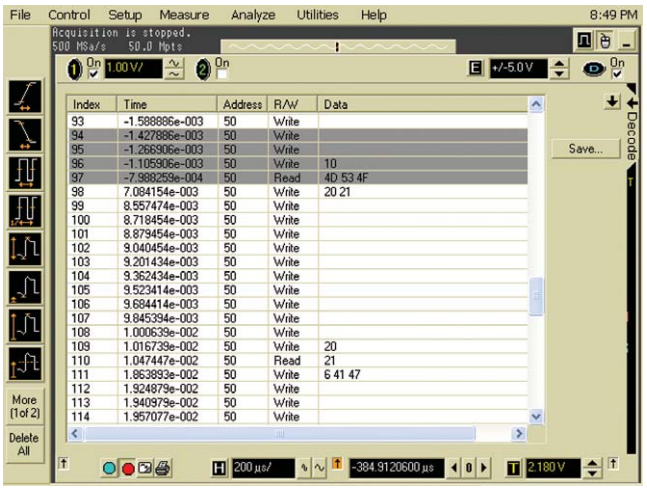


*Figure 6: Full screen listing window of an $I^2C$ capture*

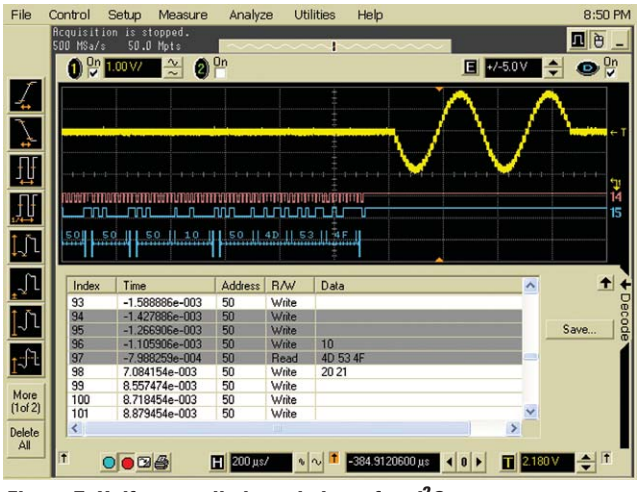


*Figure 7: Half screen listing window of an $I^2C$ capture.*

# Listing Window with Automatic Click and Zoom (continued)

To enable easy correlation between the listing window and the captured waveform, the listing window highlights those serial packets that are currently being viewed in the waveform display. For instance, if you are viewing five serial packets in the waveform display, the listing window will highlight those five serial packet items in the list. This listing window features a click and zoom capability so that once a particular packet of interest is found in the list, you can click on it to have the scope automatically zoom into that packet for more detailed analysis.

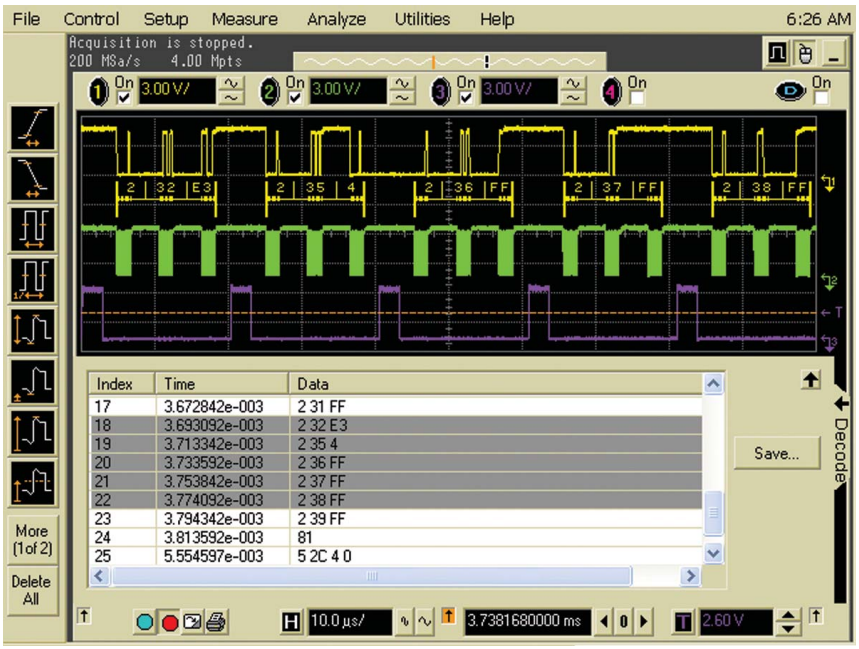


*Figure 8: SPI capture with five packets being viewed in the waveform display, highlighting those five packets in the listing window.*

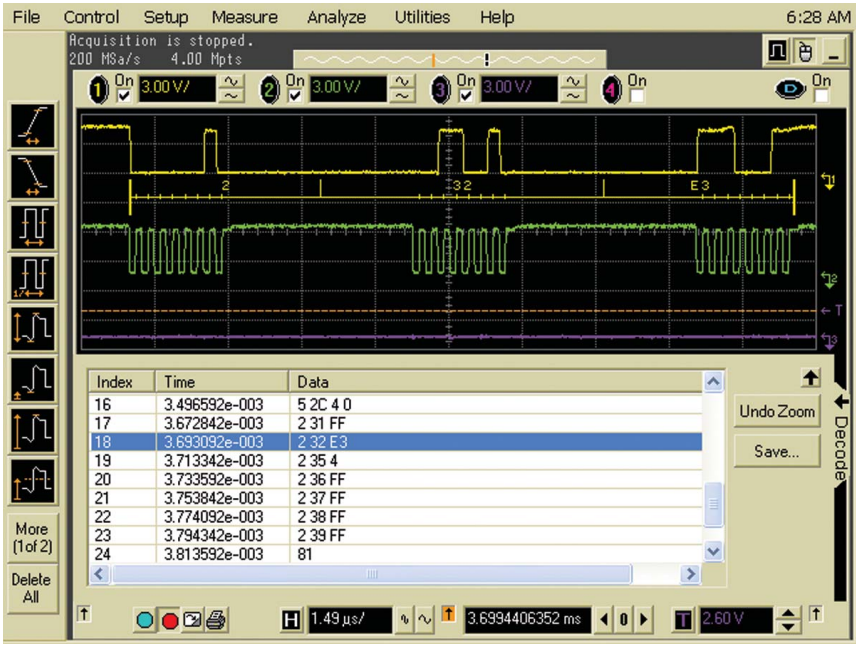


*Figure 9: Listing window of a SPI capture, demonstrating the automatic click and zoom capability. The item in the listing window that was clicked on becomes highlighted in blue. After clicking on an item, the Undo Zoom button becomes available in the listing window.*

## Oscilloscope Compatibility

You can upgrade existing Infiniium oscilloscopes with earlier software revisions using free upgrade software available for order on CD from **http://www.agilent.com/find/infiniium_software** and downloadable from **http://www.agilent.com/find/infiniium_sw_download.**

| Oscilloscope | Operating System | Software Revision |
|---|---|---|
| 8000 Series | Windows XP Pro | A.04.90 or higher |
| 90000 Series | Windows XP Pro | A.01.00 or higher |

## Ordering Information

To order the $I^2C$/SPI application software with an oscilloscopes, please order the option indicated in the table.

| Oscilloscope | Option Number | Description |
|---|---|---|
| 8000 Series | 007 | Factory-installed license for $I^2C$ and SPI triggering and decode application |
| 90000 Series | 007 | Factory-installed license for $I^2C$ and SPI triggering and decode application |

| Option | Description |
|---|---|
| N5391A | User-installed license for $I^2C$ and SPI triggering and decode application |

## Related Literature

| Publication Title | Publication Type | Publication Number |
|---|---|---|
| *Infiniium 8000 Series Oscilloscopes* | Data Sheet | 5989-4271EN |
| *Infiniium 90000 Series oscilloscopes* | Data Sheet | 5989-7819EN |

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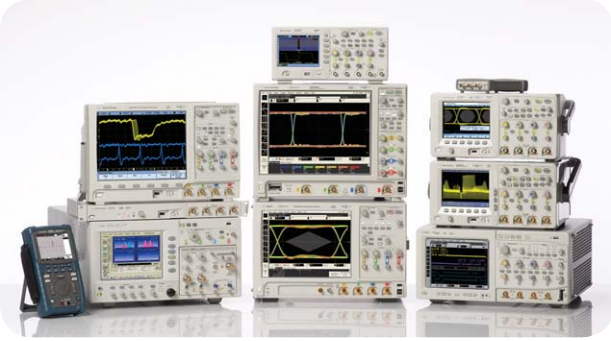

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