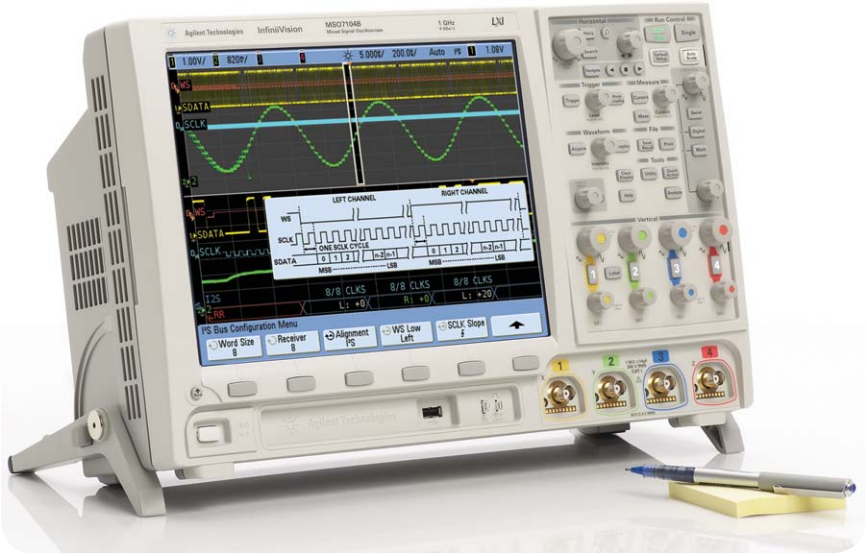
# I²S Triggering and Hardware-based Decode (Option SND) for Agilent InfiniiVision Oscilloscopes

## Data Sheet

### Find and debug intermittent errors and signal integrity problems faster

**Features:**

- I²S serial bus triggering
- I²S hardware-based protocol decoding
- User-selectable signal alignment selections
- Multiple triggering selections



I²S (Inter-IC Sound, or Integrated Interchip Sound), is an electrical serial bus interface standard used for connecting digital audio devices together, such as compact disc, digital audio tape, digital sound processors, and digital TV sound. Traditional methods of debugging serial busses such as I²S includes manual bit counting. But this visual technique of counting "1's" and "0's" can be tedious and prone to errors, especially since I²S is typically formatted in a 2's complement format.

Agilent Technologies' serial bus options for the InfiniiVision oscilloscopes not only offers powerful triggering, but also provides unique hardware-accelerated decoding to help you debug audio designs with the I²S bus faster. With the industry's fastest serial decode update rates, you can more easily find and debug random and intermittent errors and signal integrity problems that you could easily miss using other serial bus decode tools.

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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.

Figure 1 shows an example of decoding a stream of 2 channels of transmitted 8-bit audio data based on standard WS/SCLK timing alignment. The trigger condition for this example was set to synchronize on an "increasing" data value generated by the left channel of digital transmission captured on channel-1 of the oscilloscope (yellow trace).

In addition to viewing the $I^2S$ decoded strings time-correlated to the captured waveforms, you can also select to view multiple packets in a tabular format using the scope's protocol lister display mode. And with Agilent's 7000B Series oscilloscopes, you can also easily search and navigate within the lister to find and mark particular events of interest with direct time-correlation to the waveform display. In the example shown in Figure 2, an "error" search condition was setup. In this case, the scope found three words that contain errors over a 25 ms time span.

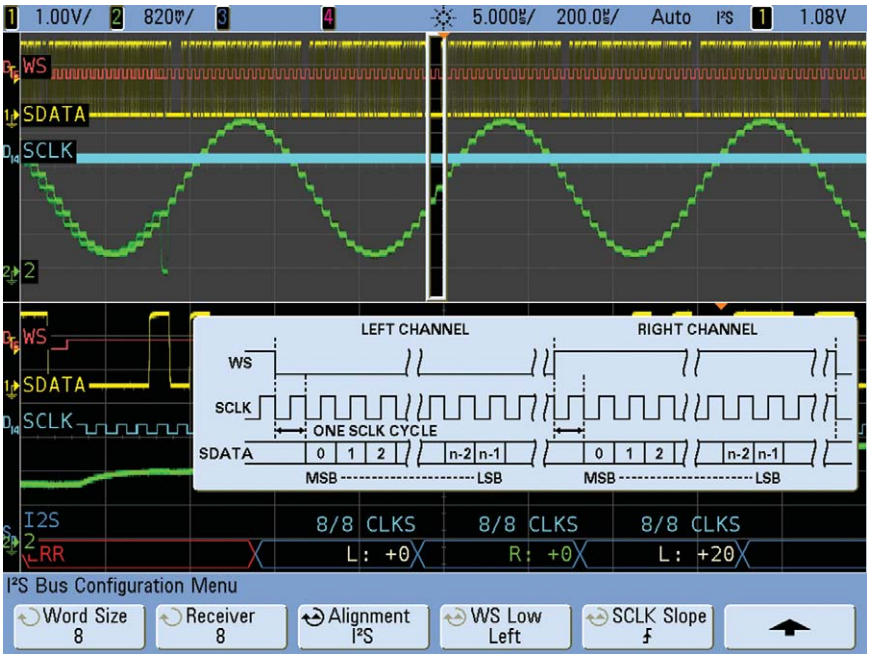



*Figure 1: An InfiniiVision series oscilloscope capturing and decoding 2 channels of $I^2S$ audio data.*


*Figure 2. Viewing $I^2S$ decoded words in the protocol lister display along with automatic search and navigation.*

**Segmented Memory acquisition captures and stores serial bus data packets**

The Segmented Memory acquisition option (Option LMT) for Agilent's InfiniiVision Series oscilloscopes can optimize your scope's acquisition memory, allowing you to capture more $I^2S$ packets of data while using less memory. Segmented memory acquisition optimizes the number of serial packets that can be captured consecutively by selectively ignoring (not digitizing) unimportant idle time or unimportant packets of data. And with a minimum 250 picoseconds time-tagging resolution, you will know the precise time between each captured word.

Figure 3 shows an example of capturing consecutive occurrences of a "left" channel word with a decimal value of +39 using a specific $I^2S$ trigger setup to capture this condition. The scope easily captures 2000 consecutive occurrences of this word for a total acquisition time of over 600 ms. After acquiring these 2000 $I^2S$ words, we can then scroll through all words individually to look for any anomalies or errors.

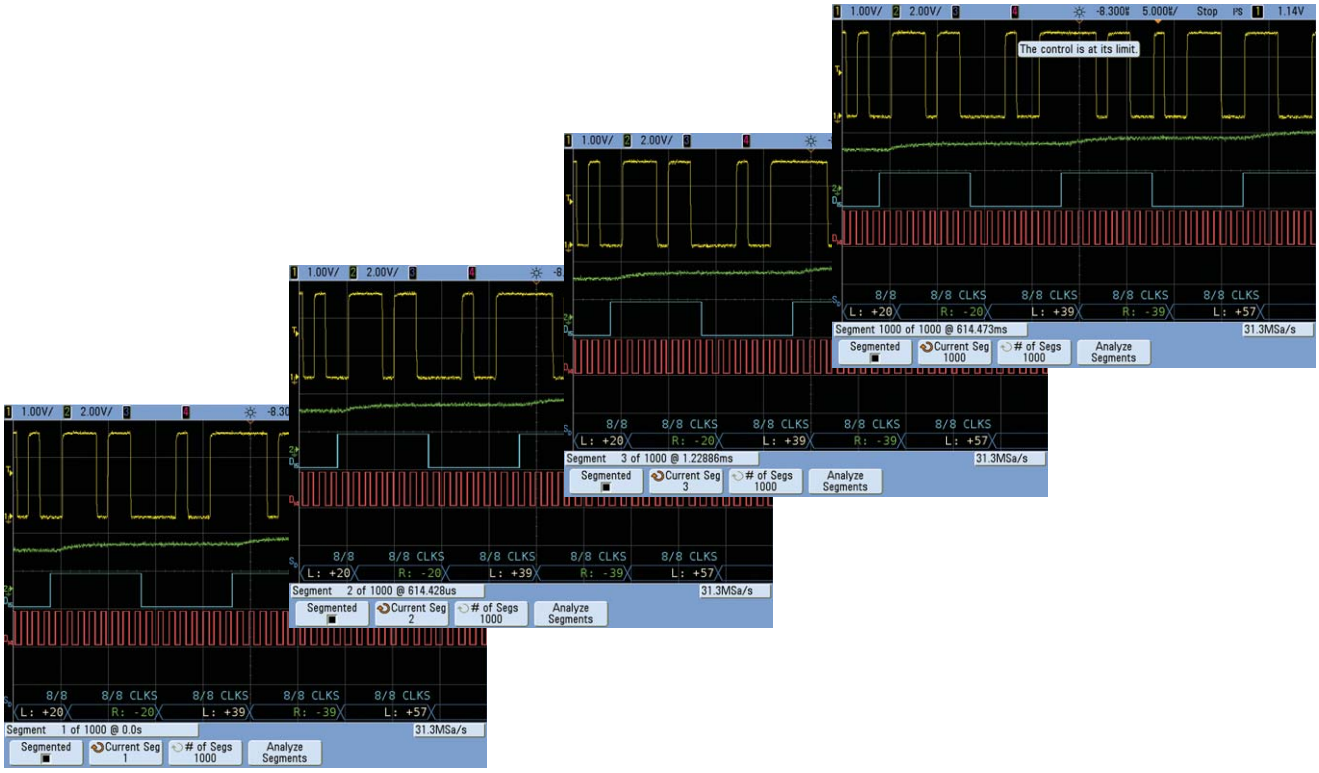



***Figure 3. Segmented Memory acquisition captures up to 2000 consecutive packets of data with precise time-tagging.***

# Agilent InfiniiVision Portfolio

**Agilent's InfiniiVision lineup includes 5000, 6000 and 7000 Series oscilloscopes. These share a number of advanced hardware and software technology blocks. Use the following selection guide to determine which best matches your specific needs.**

**Largest display, shallow depth**

**Optional battery, 100 MHz MSO**

**Ideal for ATE rackmount applications**

**Smallest form factor, lowest price**

| Bandwidth | 7000 Series | 6000A Series | 6000L Series | 5000 Series |
|---|---|---|---|---|
| 100 MHz Bandwidth | ● | ● | ● | ● |
| 300/350 MHz Bandwidth | ● | ● | ● | ● |
| 500 MHz Bandwidth | ● | ● | ● | ● |
| 1 GHz Bandwidth | ● | ● | ● | |
| MSO Models | ● | ● | ● | |
| GPIB Connectivity | | ● | ● | ● |
| Rackmount height | 7U | 5U | 1U | 5U |
| Battery option | | ● | | |
| Display size | 12.1″ | 6.3″ | | 6.3″ |
| Footprint (WxHxD) | 17.9″x 10.9″x 6.8″ | 15.7″x 7.4″x 11.1″ | 17.1″x 1.7″x 10.6″ | 15.2″x 7.4″x 6.9″ |

**Agilent's InfiniiVision oscilloscope portfolio offers:**

- A variety of form factors to fit your environment
- Insightful application software
- Responsive controls and best signal visibility
- Responsive deep memory with Mega*Zoom* III

## Performance characteristics

| Performance characteristics | |
|---|---|
| SCLK, WS, and SDATA source | Analog channels 1, 2, 3, or 4<br>Digital channels D0 – D15 (on MSO models) |
| Bus Configuration: | |
| Transmitted Word Size | 4 to 32 (user selectable) |
| Decoded/Receiver Word Size | 4 to 32 (user selectable) |
| Alignment | Standard, Left-justified, or Right-justified |
| Word Select - Low | Left-channel or Right-channel |
| SCLK Slope | Rising edge or Falling edge |
| Decoded Base | Hex (2's complement) or Signed Decimal |
| Triggering: | |
| Audio Channel | Audio Left, Audio Right, or Either |
| Trigger Modes | = (Equal to entered data value)<br>≠ (Not equal to entered data value)<br>< (Less than entered data value)<br>> (Greater than entered data value)<br>>< (Within range of entered data values)<br><> (Out of range of entered data values)<br>Increasing value that crosses armed (<=) and trigger (>=) entered data values<br>Decreasing value that crosses armed (>=) and trigger (<=) entered data values |
| Color-coded decode: | |
| Left Channel | R: "decoded value" in green |
| Right Channel | L: "decoded value" in white |
| Error | ERR in red (mismatch between transmitted and received word size, or invalid input signaling) |
| Word Size Indicator | "# of TX / # of RX" CLKS in blue displayed above each decoded word |

## Ordering Information

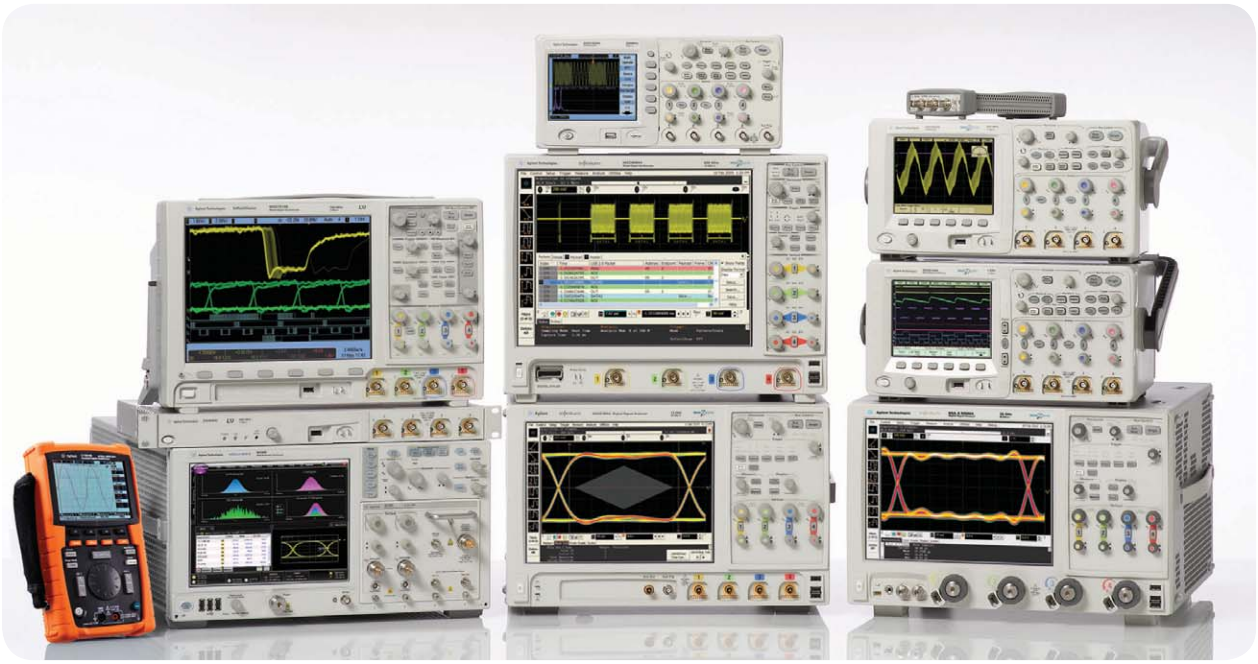
The $I^2S$ trigger and decode option is compatible with all 4-channel and 4+16 channel Agilent InfiniiVision Series oscilloscopes (5000, 6000, and 7000 series scopes). This option is available as a factory-installed option if ordered as Option-SND along with a specific oscilloscope model, or existing InfiniiVision Series oscilloscope users can order this option as an after-purchase product upgrade (N5468A).

| Model number user installed | Option number factory installed | Description |
|---|---|---|
| N5468A | SND | $I^2S$ triggering and decode (4 and 4+16 channel models only) |
| N5457A | 232 | RS232/UART triggering and decode (4 and 4+16 channel models only) |
| N5423A | LSS | $I^2C$/SPI serial decode option (4 and 4+16 channel models only) |
| N5424A | AMS | CAN/LIN automotive triggering and decode (4 and 4+16 channel models only) |
| N5454A | 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 Agilent literature

| Publication title | Publication type | Publication number |
|---|---|---|
| *Agilent 7000 Series InfiniiVision Oscilloscopes* | Data sheet | 5990-4769EN |
| *Agilent 6000 Series InfiniiVision Oscilloscopes* | Data sheet | 5989-2000EN |
| *Agilent 5000 Series InfiniiVision Oscilloscopes* | Data sheet | 5989-6110EN |
| *Agilent InfiniiVision Series Oscilloscope Probes and Accessories* | Data sheet | 5968-8153EN |
| *Segmented Memory Acquisition (5454A) for Agilent InfiniiVision Series Oscilloscopes* | Data sheet | 5989-7833EN |
| *RS-232/UART Triggering and hardware-based decode (N5457A for Agilent InfiniiVision Series Oscilloscopes* | Data sheet | 5989-7832EN |
| *I2C and SPI triggering and hardware-based decode (N5423A) for Agilent InfiniiVision Series Oscilloscopes* | Data sheet | 5989-5126EN |
| *CAN/LIN (N5424A) decode and triggering option for Agilent InfiniiVision Series Oscilloscopes* | Data sheet | 5989-6220EN |
| *Evaluating Oscilloscopes for Best Waveform Update Rates* | Application note | 5989-7885EN |
| *Evaluating Oscilloscopes to Debug Mixed-Signal Designs* | Application note | 5989-3702EN |
| *Using an Agilent InfiniiVision MSO to Debug an Automotive CAN Bus* | Application note | 5989-5049EN |
| *Evaluating Oscilloscope Bandwidths for your Applications* | Application note | 5989-5733EN |
| *Evaluating Oscilloscope Sample Rates vs. Sampling Fidelity* | Application note | 5989-5732EN |
| *Evaluating Oscilloscope Vertical Noise Characteristics* | Application note | 5989-3020EN |
| *Evaluating Oscilloscope Segmented Memory for Serial Bus Applications* | Application note | 5990-5817EN |



# Agilent Technologies Oscilloscopes

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

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Product specifications and descriptions in this document subject to change without notice.


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