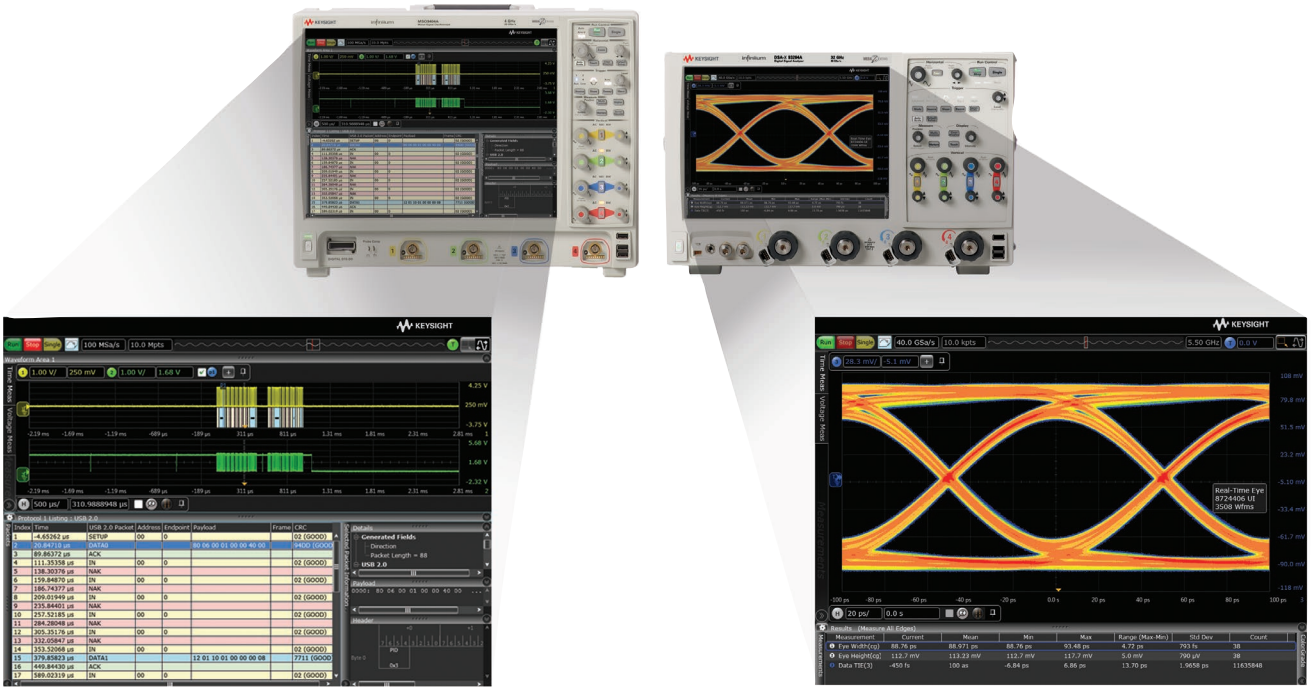
Keysight E2688A, N5384A

High-Speed Serial Data Analysis and Clock Recovery Software

For Infiniium Oscilloscopes

Data Sheet



KEYSIGHT TECHNOLOGIES

Unlocking Measurement Insights

The Keysight Technologies, Inc. High-Speed Serial Data Analysis (SDA) software provides you with a fast and easy way to pinpoint signal integrity problems and validate performance for serial interface designs. Perform mask testing, characterize serial data streams that employ embedded clocks, and decode 8b/10b data.

SDA software enables engineers to verify compliance to computer, communication, and data communications standards such as PCI Express®, Serial ATA, Serial Attached SCSI (SAS), Fibre Channel, XAUI and Gigabit Ethernet.

The BER contour feature provides data valid window measurement capability with components of noise and jitter. This allows designers such as memory DDR4 and LPDDR4 to make JEDEC compliance measurements.

SDA software and the Infiniium oscilloscopes offer several features to simplify the validation of serial interface designs:

Real-time eye display with Mask unfolding

The real-time eye display is reconstructed from all unit intervals in the oscilloscope memory aligned by the recovered clock. In this display mode the center screen (or zero in the time base) corresponds to the active edge of the recovered clock. Each signal including channels and functions can be displayed as a real-time eye.

With the High-Speed SDA software, once you identify a failure of the eye mask, you can unfold the eye diagram to show the specific unit interval that caused the failure. When used with the 8b/10b decoding feature you can identify data dependent errors that result in eye mask violations caused by Inter-Symbol Interference (ISI).

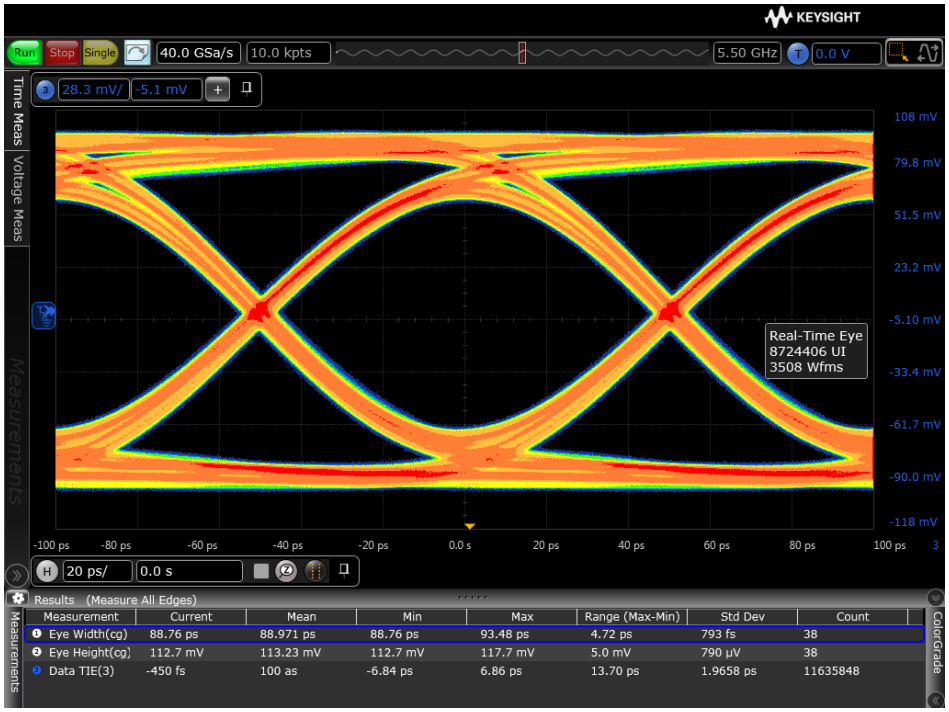


Figure 1. A real-time eye display is reconstructed from all unit intervals in the memory aligned by a recovered clock.

8b/10b decoding

When used with the Infiniium Series oscilloscopes, you can perform 8b/10b decoding with the analog view of a serial data stream. You can use your oscilloscope to assist you with debugging during the link bring-up phase of development. In addition you can use the 8b/10b decode feature to help solve disparity error problems or bit error rate performance problems resulting from ISI.

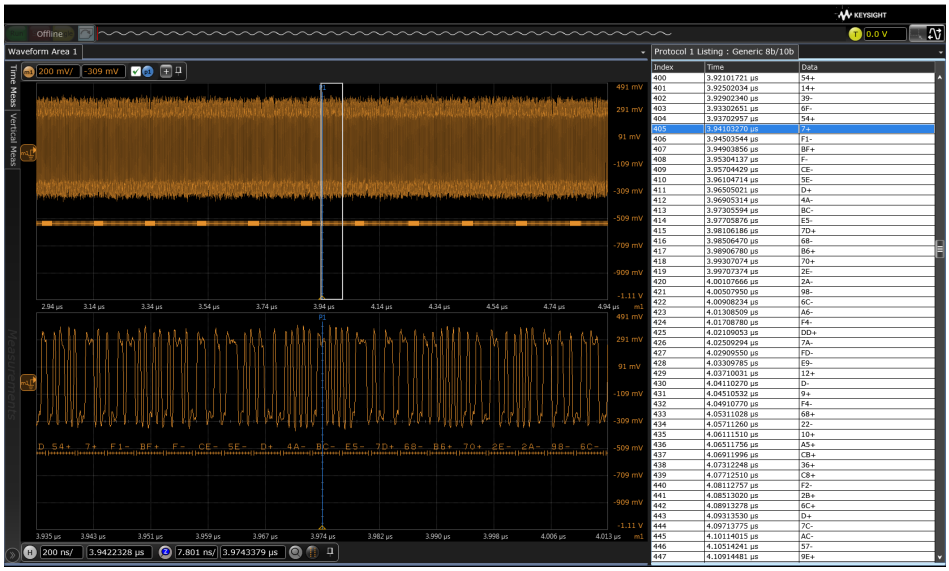


Figure 2. The 8b/10b decoded symbol information below the appropriate portion of a PCI Express signal.

BER contour analysis and measurement setup

You can perform BER contour analysis to make accurate data valid window measurements. The BER contour is computed statistically from jitter and noise components of the signal. The timing parameters specific to the BER contour in accordance to the DDR4 and LPDDR4 JEDEC specification are timing data input valid window (TdiVW) and voltage data input valid window (VdiVW).



Figure 3. The BER contour is computed statistically from jitter and noise components.

Mask testing

When used with the Keysight Infiniium oscilloscopes, masks are provided for the following standards:

- PCI Express (2.5 Gb/s)
- Fibre Channel Electrical (1.0625, 2.125 and 4.25 Gb/s)
- Serial ATA
- Serial Attached SCSI (SAS)
- XAUI
- FlexRay

When performing a mask test, the High-Speed SDA software indicates the number of waveforms (acquisitions) and unit intervals tested, and the number waveforms and unit intervals that failed. This information helps determine your level of confidence in meeting a given target bit error ratio.

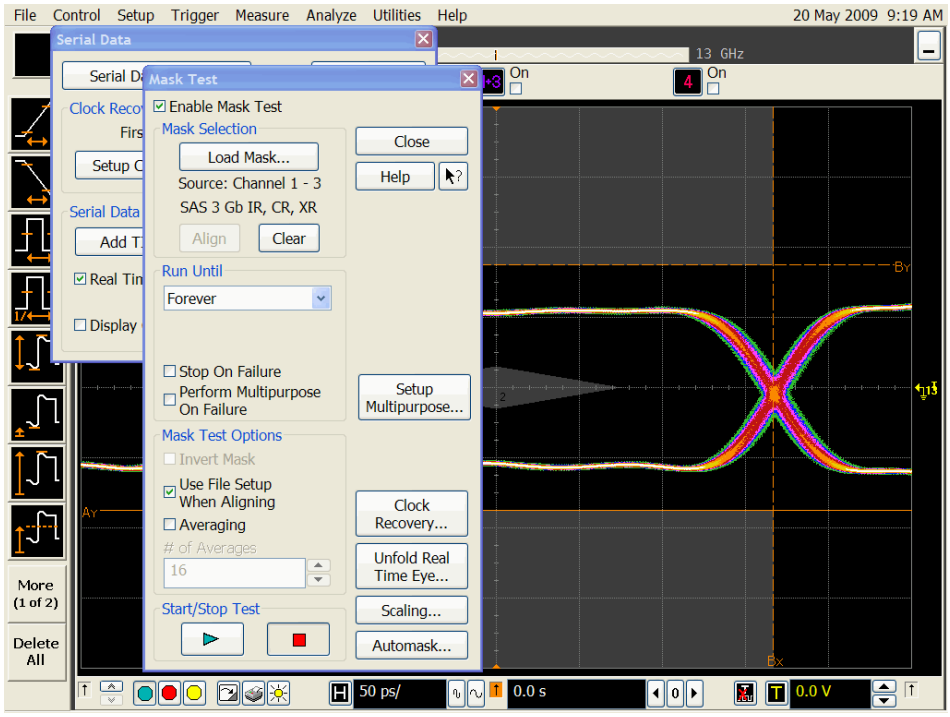


Figure 4. An example of leading a mask through SDA software.

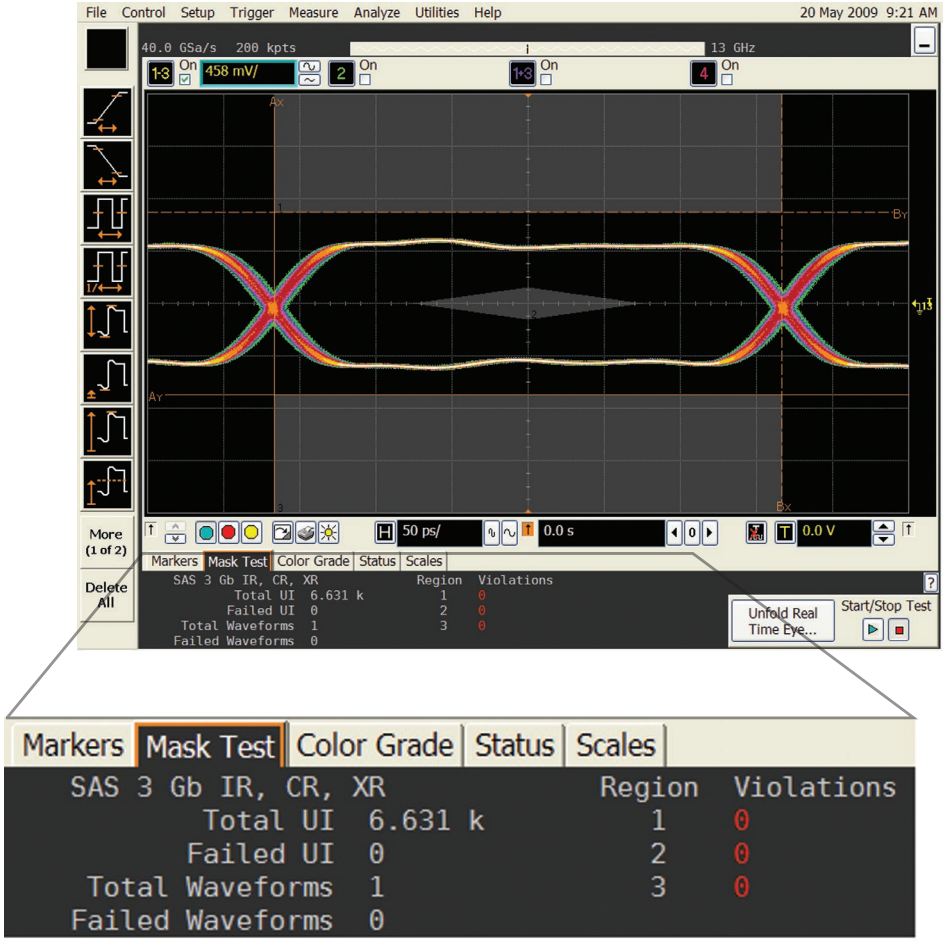


Figure 5. An example of a mask test on a failing Serial ATA signal. The information below the mask screen helps you determine the level of confidence in meeting your desired bit error rate.

Easy measurement setup

The High-Speed SDA software extends the ease-of-use advantages of Keysight's Infiniium oscilloscopes to the analysis of serial data. A wizard walks you quickly through the steps required to setup and perform a measurement. Intuitive displays and clear labeling of information make it easy to comprehend measurement results.

SDA provides a real-time eye menu. The menu is located in the display menu under color grade view. Use this menu to change scaling, look only at worst case edges, and decide which bits you want to include in your real-time eye.



Figure 6. To set up a measurement, the wizard asks you to identify the signal source and select the clock recovery algorithm.

One-click real-time eye

SDA provides the ability to right-click on a waveform and quickly create a real-time eye.

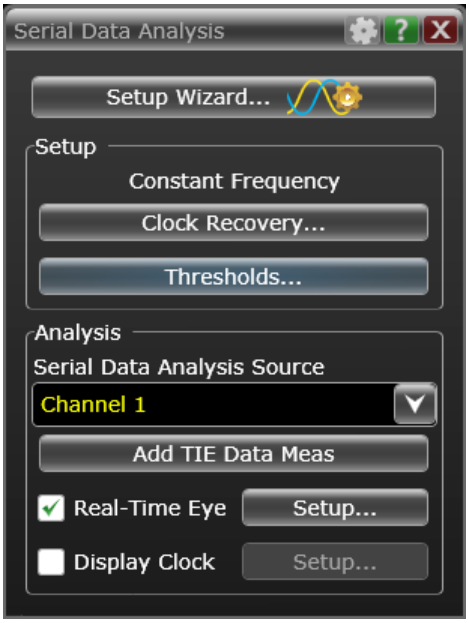


Figure 7. Next, the setup wizard asks you to enter a nominal data rate and a loop bandwidth.



Figure 8. Real-time eyes can be created by a single click of the mouse.

Serial data trigger and search

Powerful software triggering is available for use on Infiniium oscilloscopes when combined with the 8b/10b data decoding function (that continuously scans for the occurrence of up to 4 consecutive symbols).

Setup the trigger based on symbols; specific to a given standard. Invalid codes or hex values. Solve data dependent problems fast by using your oscilloscope to monitor serial traffic and capture error conditions. Unlike any other tool, you can now combine logical errors with the analog signal view of the serial data stream at the time of the error occurrence.

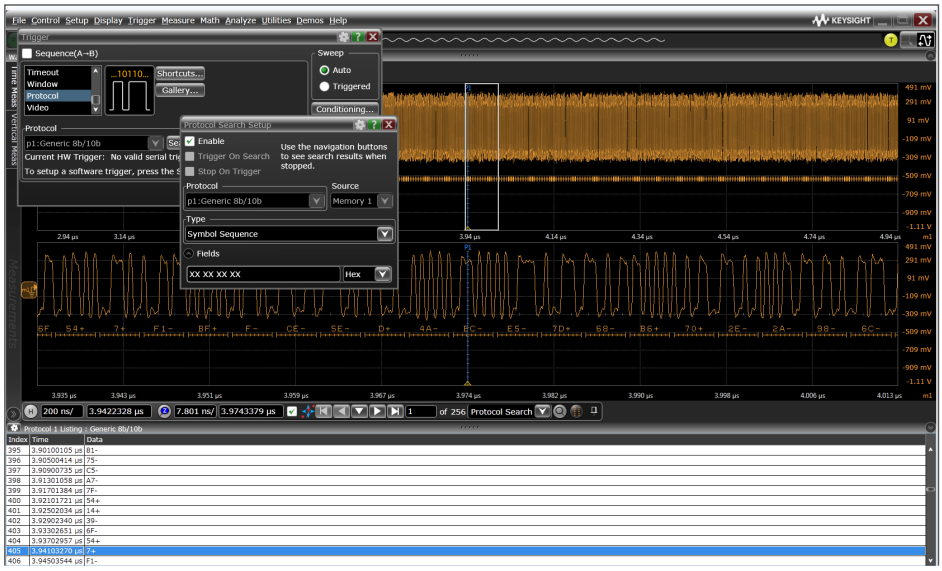


Figure 9. Configuring a serial data trigger in the 8b/10b protocol.

Flexible clock recovery

You can choose constant-frequency, first-order phase-locked loop (PLL), or second-order PLL clock recovery. You can adjust the center frequency and bandwidth, and in the case of second-order PLL, the damping factor. For PCI Express, the clock recovery algorithm specified by the PCI-SIG® is provided. A specific clock recovery algorithm is also available for SATA, HDMI, MHL, DisplayPort, USB, PCI Express, CEI, Fibre Channel, FlexRay, and MIPI® technologies. When you choose PLL clock recovery, the clock recovery algorithm requires some time at the start of each record to lock to the data. This interval cannot be viewed or analyzed. The serial data wizard will indicate the required time period for the clock recovery algorithm to lock.

The first-order PLL selection emulates a first-order PLL

You enter the nominal data rate and loop bandwidth for the clock recovery PLL

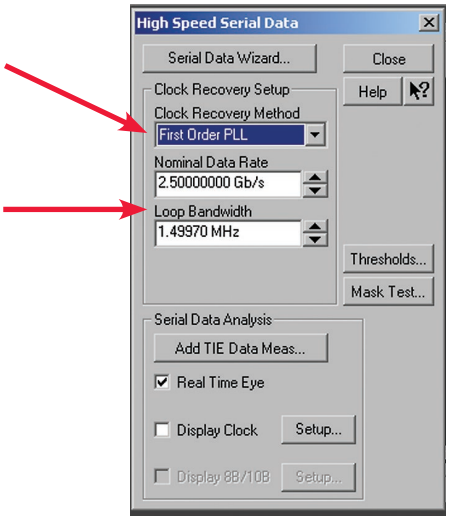
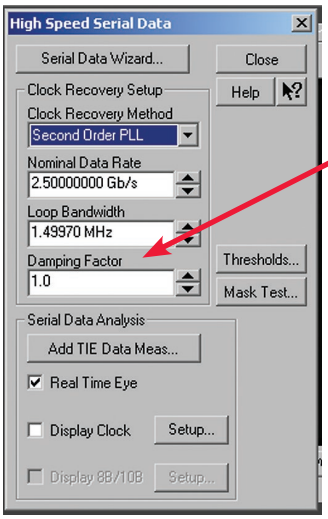


Figure 10. First-order PLL selections.



When you select second-order PLL, you can enter a damping factor in addition to nominal data rate and loop bandwidth. You can also choose between OJTF and JTF

Figure 11. Second-order PLL selections.

Clock display mode

You can view the data signal superimposed with the recovered clock. This provides a display of the measured data relative to the active edge of the recovered clock.

External clock

You can choose to use an external clock as your clock reference by applying the signal to any of the oscilloscope channels. This allows you to provide your own explicit clock that can be then used for jitter analysis and to generate eye diagrams.

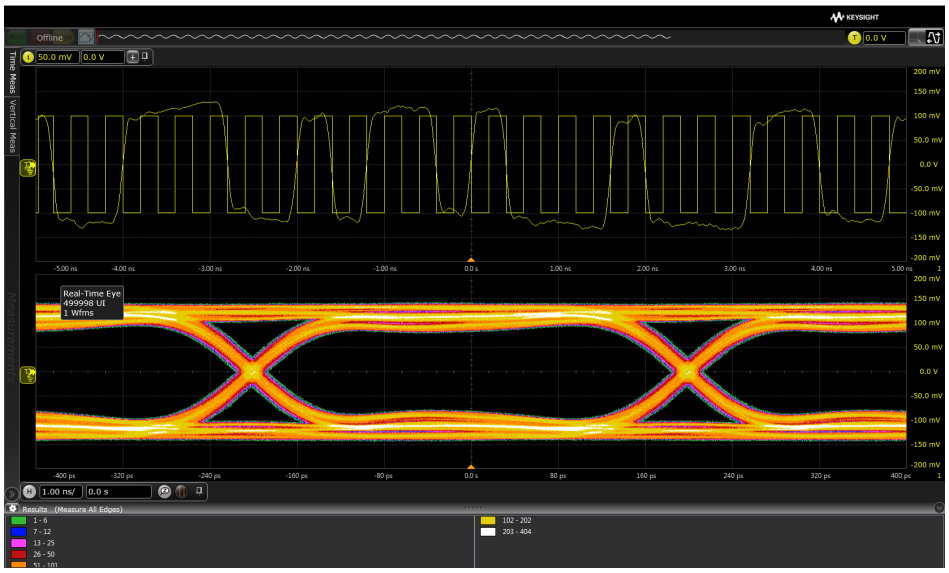


Figure 12. The display shows a data signal superimposed with a recovered clock.

Deep memory for deeper insight

At a sampling rate of 20-GSa/s and an incoming data rate of 2.5-Gb/s, 1Mpts memory allows you to capture an entire 2^{16} pseudorandom bit sequence (PRBS) on each acquisition. The Infiniium Series oscilloscopes, both with up to 1 Gpts of memory, are currently the only real-time oscilloscopes that will allow you to capture and analyze data for patterns as large as PRBS^{23}. Usable deep memory is extremely important for capturing longer sequences of serial data for analysis at the maximum 40 GSa/s sampling rate.

Multiple real-time eyes

SDA provides real-time eye views on each signal. With this capability, combined with waveform areas, you can look at dozens of real-time eyes at once. Each real-time eye can have its own timebase.

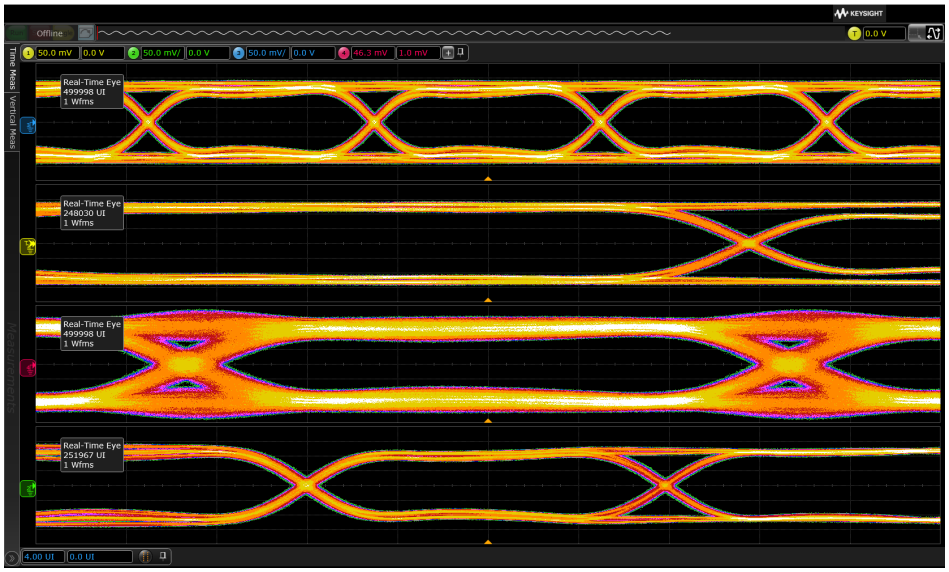


Figure 13. SDA lets you look at many real-time eyes at once.

Oscilloscope compatibility

For oscilloscopes with earlier software revisions, free upgrade software is available at **http://www.keysight.com/find/infiniium_software**

Oscilloscope	Operating system	Software revision
9000A and 90000 Series	Windows XP Pro	A.02.10 or higher
90000 X-Series	Windows XP Pro	A.03.00 or higher
9000 H-Series	Windows 7	A.04.20 or higher
Z-Series	–	–
S-Series	–	–

Ordering information

To purchase the High-Speed SDA software with a new Infiniium oscilloscope, please order the option indicated in the table:

Oscilloscope	Option number	Description
9000A, 9000 H-, 90000, 90000 X Series	003	High-Speed SDA software (Installed at the factory)
Z-Series	E2688A-1FP	High-Speed SDA software
S-Series	N5384A-1FP	High-Speed SDA software

To enable BER contour feature, please order the option in the table in addition to the high-speed SDA software:

Model number	Description
N8823B-1FP [1]	Fixed perpetual EZJIT Complete software for Infiniium 9000A, 9000H and S-Series
N8823A-1FP [1]	Fixed perpetual EZJIT Complete software for Infiniium 90000A, V-Series and Z-Series

1. BER contour feature requires N8823A EZJIT Complete software in addition to E2688A SDA software.

To add the High-Speed SDA software to an existing Infiniium oscilloscope, please order the following:

Model number	Description
N5384A-1FP	Fixed perpetual High-Speed SDA software for Infiniium 9000A, 9000 H-, and S-Series
E2688A-1FP	Fixed perpetual High-Speed SDA software for Infiniium 90000A, 90000 X-, and Z-Series

Related literature

Publication title	Publication numbers
Infiniium 90000 Series Oscilloscopes - Data Sheet	5989-7819EN
Infiniium 9000 Series Oscilloscopes - Data Sheet	5990-3746EN
Infiniium 90000 X-Series Oscilloscopes - Data Sheet	5990-5271EN
Infiniium 9000 H-Series High-Definition Oscilloscopes - Data Sheet	5991-1520EN
Infiniium Z-Series Oscilloscopes - Data Sheet	5991-3868EN
Infiniium S-Series High-Definition Oscilloscopes - Data Sheet	5991-3904EN

www.axiestandard.org

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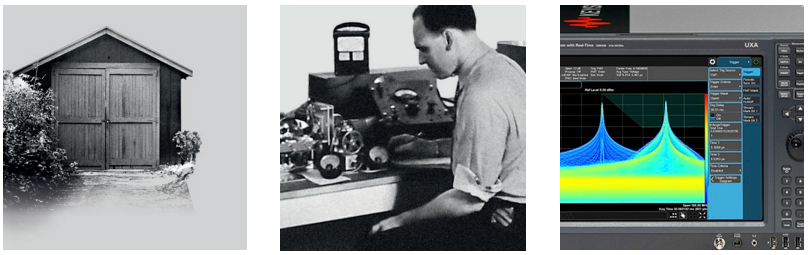


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