10 Reasons to Upgrade to a 16800 or 16900 Series Logic Analyzer

Application Note 1597

Overview

Troubleshooting today's sophisticated designs is all about detecting problems quickly, getting to the root cause and working efficiently. Your success starts with having the right debug tools, and a logic analyzer can be one of the most effective ones. Typically, the main reason for upgrading to a new logic analyzer is that your exiting logic analyzer no longer has the measurement capability you need for your next design – whether it is acquisition speed, number of channels, or memory depth. What you may not realize is that Agilent's latest generation of logic analyzers, the 16800 Series portables and 16900 Series modular systems, have evolved to provide new use models traditionally not associated with a logic analyzer.

The purpose of this application note is to make you aware of the recent innovations in Agilent logic analyzers that address industry trends and provide new ways to make measurements. Agilent's logic analyzers deliver the industry-leading accuracy and performance you expect as well as new ways to make measurements on your toughest digital debug problems. New measurement and analysis tools provide you faster insight and increased productivity, allowing you to incorporate the latest technology and get to market faster.

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Agilent Technologies

1 Save days to weeks debugging your FPGA-based designs with unprecedented insight into internal Xilinx and Altera FPGA activity

FPGAs play an increasingly important role in your digital designs. The high level of integration available in today's FPGAs allows you to use them in ways that weren't envisioned just a few years ago. In addition, you are faced with new measurement challenges as you develop and debug your designs.

Since pins on an FPGA are typically an expensive resource, there are a relatively small number available for debug. Signals that were previously available on the board may exist exclusively as nodes inside the FPGA. Getting visibility across critical internal interactions can be time-consuming. This makes integration of the FPGA and the surrounding system challenging.

To address this challenge, Agilent created the FPGA dynamic probe software. The Agilent FPGA dynamic probe used in conjunction with a 16800 or 16900 Series logic analyzer provides unprecedented visibility into your Xilinx and Altera FPGAs, enabling you to debug your FPGAs and the surrounding system faster and more effectively. The FPGA dynamic probe lets you:

- **View internal activity at full speed** – With a logic analyzer, you are normally limited to measuring signals at the periphery of the FPGA. With the FPGA dynamic probe, you can now access signals internal to the FPGA. You can measure up to 256 internal signals for each external pin dedicated to debug, unlocking visibility into your design that you never had before.

- **Make multiple measurements in seconds without design changes** – Moving probe points internal to an FPGA used to be time consuming. Now, in less than a second you can easily measure a different set of internal signals without design changes. FPGA timing stays constant when you select new sets of internal signals for probing.

- **Eliminate unintentional mistakes and save hours of time during measurement setup** – Previously you would manually enter the name of each signal and bus you wanted to measure into the logic analyzer. Now you can leverage the work you did in your design environment by letting the FPGA dynamic probe automatically map the internal signal and bus names from your FPGA design tool to your logic analyzer.

- **Time-correlate internal FPGA and external system activity** – It's important to know not only what's going on inside your FPGA but also how that relates to the activity in the surrounding system in order to solve your toughest debug challenges.

- **Take full advantage of logic analyzer memory depth and triggering resources** – Maximize the amount of internal FPGA activity acquired (up to 256 M for state and 512 M for timing) without using FPGA block RAM for storage. Deep memory is essential for finding the cause of a problem that is widely separated in time from the symptom. Agilent logic analyzers provide up to 16 trigger sequence levels, enabling you to create simple to complex trigger scenarios to help isolate your problem.

Save days to weeks debugging your FPGA-based designs with unprecedented insight into internal Xilinx and Altera FPGA activity

Figure 1. The FPGA dynamic probe enables your logic analyzer with unique productivity enhancements to find problems more quickly.

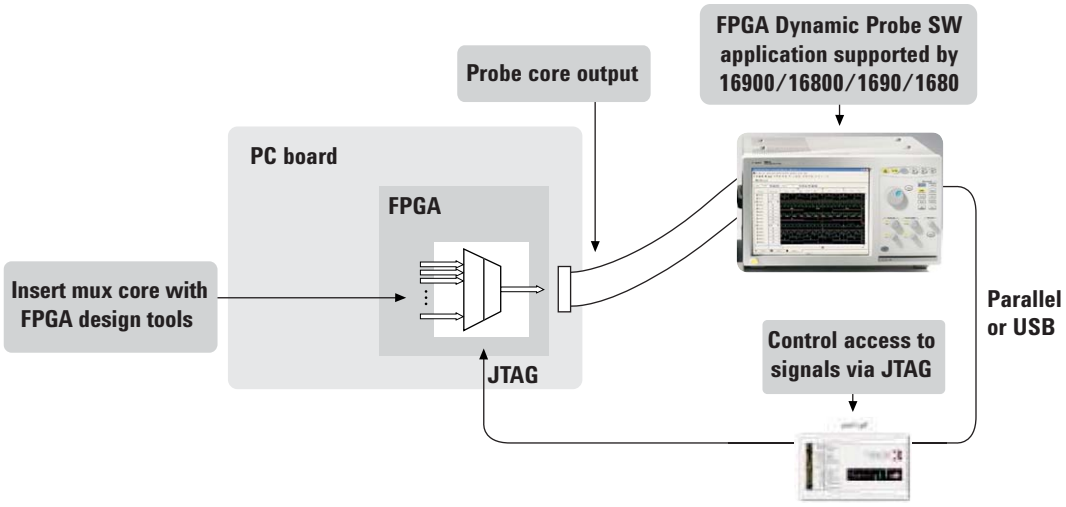


Figure 2. Create a timesaving FPGA measurement system. Insert an ATC2 (Agilent Trace Core) core into your FPGA design. With the application running on your logic analyzer you can control which group of internal signals to measure via JTAG.

For more detailed information on this topic, including videos, data sheets and application notes, go to **www.agilent.com/find/fpga**.

2 Work at the packet level to trigger, view, search and analyze on industry standard or proprietary protocol buses

Your designs often include one or more serial buses. Using Agilent's Packet Viewer, you can view serial data in a protocol-rich format for quick analysis. You gain insight into your system whether you're monitoring industry standard or proprietary protocols. These powerful tools provide non-intrusive probing plus logic analysis triggering and decoding at the packet level. They also enable time-correlated analysis and sequenced event triggering across multiple buses for virtually every type of bus, making it easy to follow transactions, data, and packets as they flow through your system. This allows you to operate at a higher level of abstraction and more quickly resolve protocol issues.

Agilent supports a number of multilane serial buses and continues to add support on a regular basis. The following lists the available protocol support at the time this application note was written.

- PCI Express® (PCIe)
- Advanced Switching Interface (ASI)
- Serial ATA (SATA) and Serial Attached SCSI (SAS)
- Serial RapidIO
- Parallel RapidIO
- SPI 4.2 (System Packet Interface, POS PHY L4)
- InfiniBand
- I^2C
- FlexRay
- SPI (Serial Peripheral Interface)

If you're using PCI-Express 2, the P2L (Protocol to Logic) gateway integrates logic analyzer and protocol analyzer functionality in a single solution. With this connection between a logic analyzer and the E2960B PCI-Express 2 protocol analyzer you can perform time-correlated cross bus measurements and cross triggering. Both the logic analyzer and protocol analyzer can be operated from a single PC.

If you are adding unique extensions to an existing industry standard protocol or using proprietary protocols, Agilent's B4641A Protocol Development Kit enables you to customize a protocol solution that lets you work at the packet level.

Work at the packet level to trigger, view, search and analyze on industry standard or proprietary protocol buses

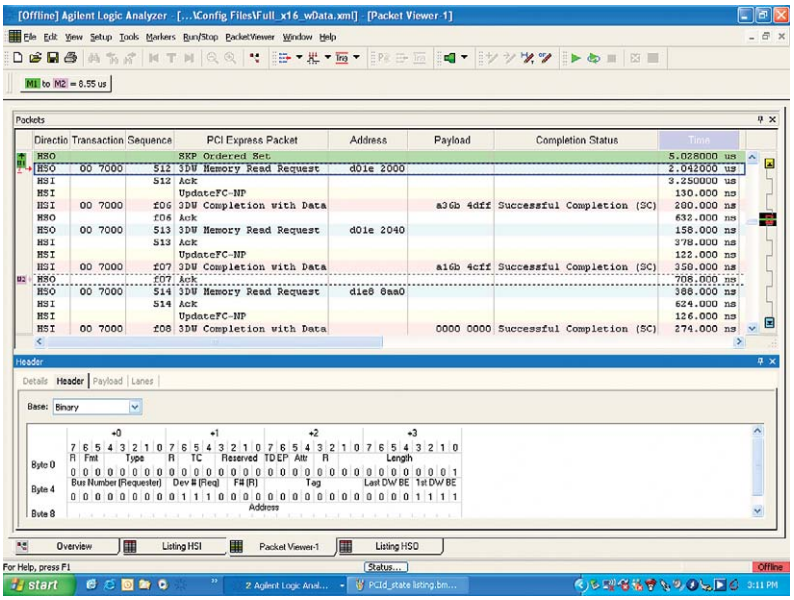


Figure 3. Trigger, search, view and analyze at the packet level in a familiar protocol format, whether you use industry-standard protocols or use Agilent's B4641A protocol development kit to create a solution for your proprietary bus.

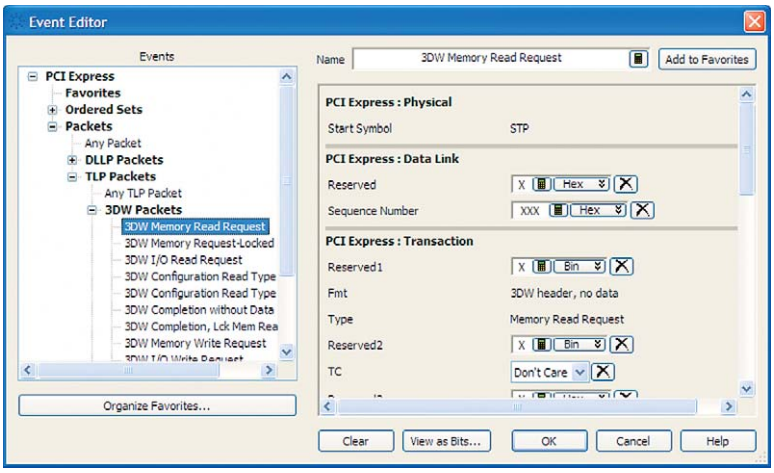


Figure 4. The Event Editor lets you define trigger and search events at the packet level.

3 Verify signal integrity by quickly identifying problem signals

Effectively debugging digital designs often requires both digital and analog views of key signals. In order to effectively track down problems you need test equipment that is time-correlated and works seamlessly together.

How many times have you discovered a problem signal late in product development? With Eye Scan you can quickly identify problem signals early in the debug phase by viewing eye diagrams across all buses and signals simultaneously. For instance, Figure 5 shows a bus that has a potential for threshold violations, a problem that may not have been found until late in the project. By simply expanding the bus we can identify the problem for further parametric analysis with a scope that is seamlessly integrated with the logic analyzer.

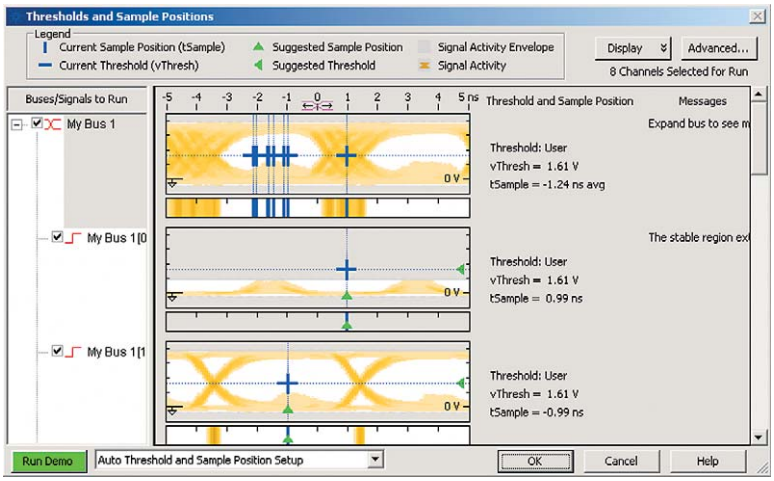


Figure 5. Identify problem signals quickly by viewing eye diagrams across all buses and signals simultaneously.

Verify signal integrity by quickly identifying problem signals

In addition, Agilent offers tight integration between our logic analyzers and scopes to help you quickly track down problems. The View Scope feature, included standard with our logic analyzers, provides seamless integration of time-correlated scope waveforms into the logic analyzer's waveform display to simplify viewing and analysis. The Agilent View Scope application is the industry's only solution that integrates scope and logic analyzer measurements using off-the-shelf BNC and LAN cables.

View Scope allows you to:

- Quickly get to your first measurement regardless of which supported Agilent oscilloscope you connect to.
- Instantly validate the logic and timing relationships between analog and digital views of your design. Oscilloscope and logic analyzer waveforms are integrated into a single logic analyzer waveform display.
- Save time and gain confidence in measurement results that are automatically de-skewed.
- Debug from either the analog or digital domain with the flexibility to trigger the oscilloscope from the logic analyzer (or vice versa).
- Precisely relate information on the oscilloscope's display to the corresponding point in time on the logic analyzer display with tracking markers. The oscilloscope's time markers automatically track adjustments of the logic analyzer's global markers.

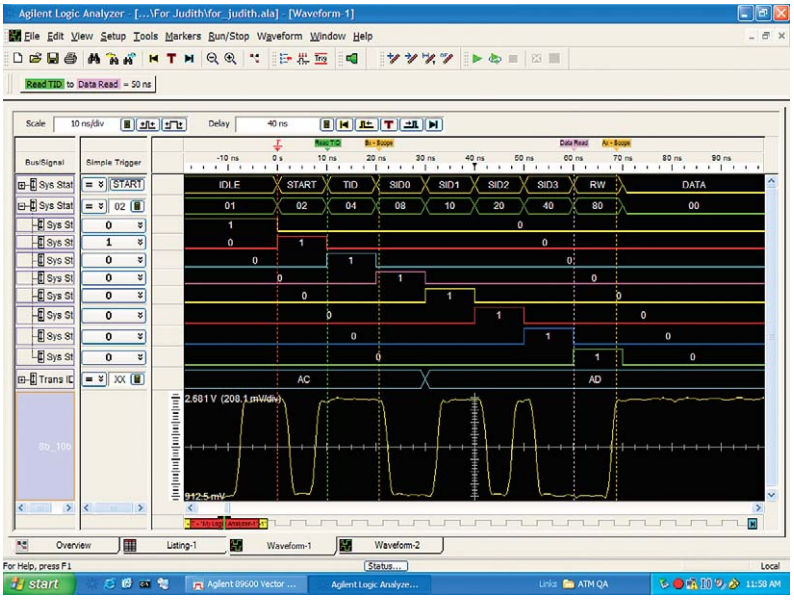


Figure 6. View Scope integrates time-correlated oscilloscope and logic analyzer waveforms into a single waveform display.

4 Get the full power of a vector signal analyzer for digital baseband, IF and RF signals

Wireless design teams are quickly moving to architectures that eliminate the traditional measurement spots for analog RF signals. The need to reduce pin count for lower cost, enable interoperability of devices from different vendors, and maximize battery life for wireless devices is driving the baseband to RF-IC interface to digital. Agilent is uniquely positioned to address this measurement challenge through the tight integration of our industry leading logic analyzers and 89600 vector signal analyzer capabilities.

A logic analyzer is the obvious choice for measuring digital buses. Since the 1's and 0's that a logic analyzer captures tend to be foreign to wireless designers, Agilent developed the B4602A signal extractor software to quickly extract I and Q information from acquired digital baseband data. The I and Q data is then imported into Agilent's 89600 vector signal analysis application allowing teams to view the information in the traditional formats required to validate and optimize wireless designs. For the first time, digitized transmit and receive signals found on data buses between the baseband and RF blocks of digital radio applications can be analyzed in the time, frequency, and modulation domains just as if they were in full analog form. This allows an unprecedented view into circuit behavior at the digital interface between the baseband and RF integrated circuits. The result is a powerful digital vector signal analysis measurement system that delivers precise, accurate modulation measurements on the digitized communication signals found in today's DSP- (digital signal processor) based radio transceivers used in cell phones, base stations, satellite and military communications systems, and radar applications.

In addition to the full capability of the Agilent 16800 and 16900 Series logic analyzers, for digital measurements, the Digital VSA solutions provide:

- A unified user interface within the logic analyzer that allows baseband and RF teams to share the same measurements and more easily solve cross-domain problems.
- Analysis of the digital baseband or digital IF signal in a variety of different formats, including Scalar baseband, Scalar IF, complex I and Q, Magnitude and Phase, and Phase Only.
- Flexible demodulations that measure carrier offset, error vector magnitude (EVM) and frequency error for QPSK, QAM, GSM, EDGE, WiMAX, W-CDMA and others.
- Multiple display formats, including phase vs. time, frequency vs. time, and spectrogram, for rapid insight into complex signal behavior.

Get the full power of a vector signal analyzer for digital baseband, IF and RF signals

These unique capabilities extend the capture and analysis power of Agilent's logic analyzers by providing advanced tools for making modulation quality measurements on a variety of digital communication signals from software defined radios to systems with a DigRF v3 interface. You get greater insight into true circuit functionality, enabling you to quickly identify design flaws and accurately characterize circuit performance.

Agilent supports a wide range of over-air standards and continues to add support on a regular basis. Contact your Agilent sales representative for a complete list or to discuss support for your next wireless design.

For more detailed information on this topic, including videos, data sheets and application notes, go to **www.agilent.com/find/dvsa** or **www.agilent.com/find/digrf**.

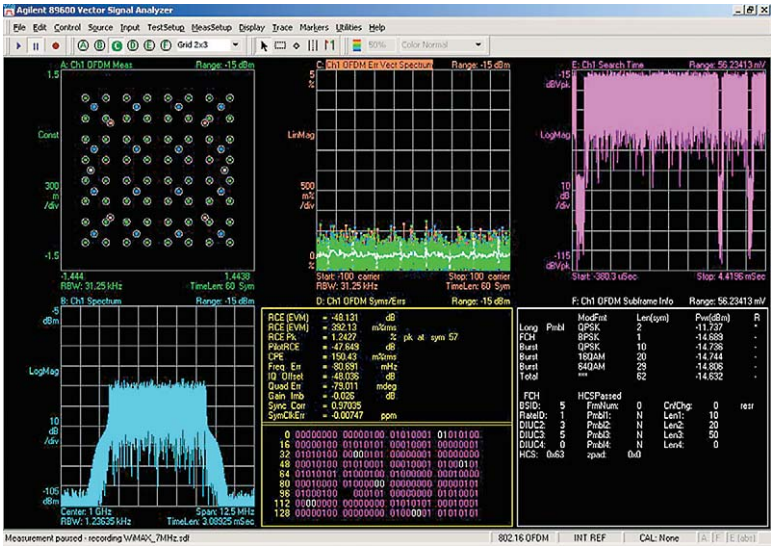


Figure 7. Perform in-depth time, frequency, and modulation domain analysis on your digital baseband and IF signals. Agilent's 89600 vector signal analysis software provides flexible tools for making quality RF and modulation measurements on digital communication signals.

5 Customize your logic analyzer to provide unique insight into your design

Whether you're viewing shallow traces across a few signals or deep traces over hundreds of signals, you need to find your unique problems quickly. You often spend hours turning low-level measurement data into meaningful insight related to your system's operation. Maybe you even write your own application software to perform these tasks. Agilent can save up to weeks of development time and eliminate errors caused by manual data interpretation with our suite of logic analyzer application software.

- **B4610A Data Import Package** – Use the logic analyzer displays (waveform, listing, packet viewer) to view data obtained from tools other than a logic analyzer.
- **B4606A and B4607A Advanced Customization Environment** – Tailor your logic analyzer interface with a wide range of control, analysis and display capabilities specific to your measurement application. Create integrated dialogs, graphical displays and analysis functions to quickly manipulate measurement data into a format that provides custom measurements.
- **B4601C Serial to Parallel Analysis Package** – This general purpose software enables easy viewing and analysis of serial data in a parallel format, thereby eliminating the tedious task of sifting through thousands of serial bits in long vertical columns of captured 1's and 0's.
- **B4630A MATLAB® Connectivity and Analysis Package** – Make an easy connection to MATLAB and transfer your logic analyzer measurement data for processing. Display the results on the logic analyzer in an XY scattergram chart.

In addition, Agilent and our partners offer an extensive range of bus and processor analysis probes that deliver non-intrusive, full-speed, real-time analysis to accelerate your debugging process for most standard devices and buses.

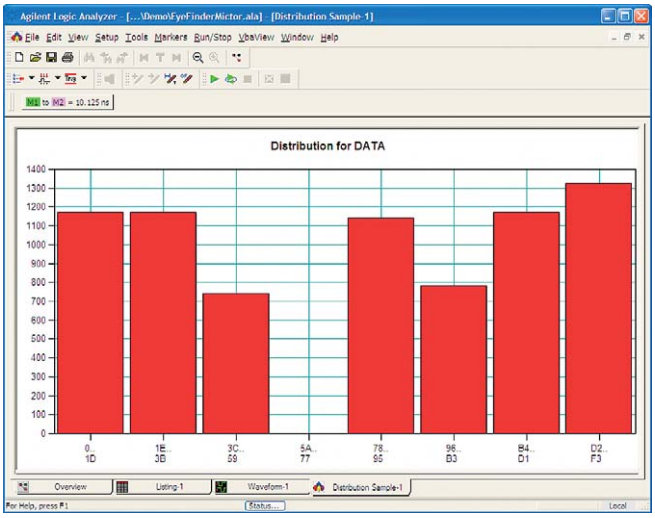


Figure 8. Customize your data view with the Filter/Colorize tool and Agilent's exclusive VBA view.

6 Find the cause of elusive problems with the industry's deepest acquisition memory depth

Complex architectures and bus protocols make your debugging job increasingly challenging. Split transactions, multiple outstanding transactions, pipelining, out-of-order execution, and deep FIFOs all mean that the flow of data related to a problem can be distributed over thousands if not millions of bus cycles. The frequency with which a problem occurs can also vary from once every bus cycle to once in several days. Once you capture the problem you need as much data as possible to narrow in on the cause of your problem.

Deep memory lets you observe a device's activity over a longer time span. Longer time captures mean acquisition of more information surrounding the events of interest, and this in turn enables more insightful analysis. Capturing longer time spans is also important for serial signals that are increasingly used in today's designs. Deep memory increases your chances of finding elusive problems where the symptom and root cause are widely separated in time or where you need to see all of the events leading up to an elusive crash.

You can capture even more time with features like advanced triggering and store qualification that allow you to specify what gets stored in memory. This allows you to use your available acquisition memory more efficiently, rather than filling it with unwanted activity such as wait loops.

Once captured, you need to quickly turn large amounts of low-level measurement data into meaningful insight related to your system. Agilent's hardware-assisted memory management provides responsive display updates, search, rescaling and scrolling to help find information and answers quickly.

Since you can't always anticipate how much memory depth you will need, Agilent provides the industry's deepest acquisition memory with up to 512 M samples and allows you to purchase the memory depth you need today and upgrade as your needs evolve.

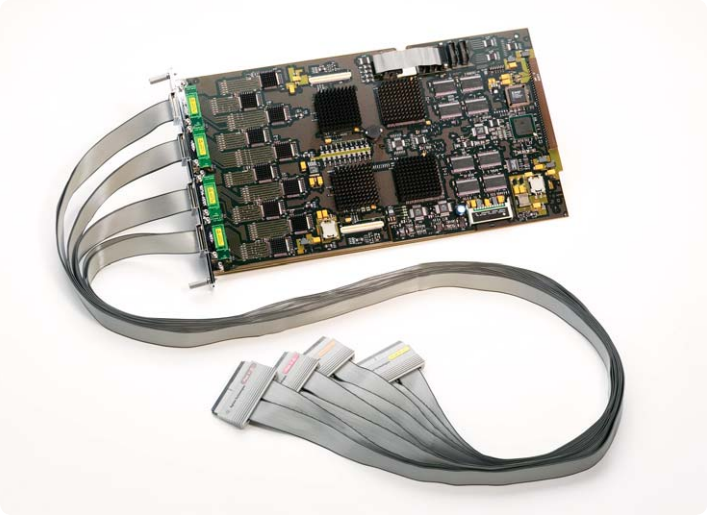


Figure 9. Find elusive cause and effect problems separated in time by using deep memory.

7

Superior performance for the latest high-speed designs

You still might need to upgrade your logic analyzer for performance reasons. As processor and bus speeds increase, you need a logic analyzer that not only keeps pace but provides you the headroom for future needs. Agilent offers a wide range of portable and modular systems with the state/timing speeds, channels and memory depth for the simplest to most demanding debug needs.

Agilent logic analyzers provide:

- 4 GHz timing zoom with 64 K deep memory
- Up to 1.2 GHz timing with 512 M deep memory
- Up to 1.5 Gb/s state speed
- Up to 1066 Mb/s data rates
- From 256 K up to 256 M (512 M in half-channel timing) memory depths
- Up to 9,782 channels
- Support for single-ended and differential signals

8 Making logic analyzer measurements as simply as possible with enhanced usability and use models

When you're debugging a design, you need to focus on solving your problems – not on struggling with using the instrument. That's the thinking behind the 16800 and 16900 Series logic analyzers. These instruments work intuitively, so you can resolve critical design problems without having to become a logic analyzer expert. The key to getting answers fast is to make accurate measurements fast. The automated threshold and sample position setup feature has you capturing your signals with the highest accuracy in seconds.

The straightforward triggering capabilities help you quickly narrow in on the root cause of an elusive problem so you can debug and validate your design more quickly.

a. **Simple Trigger** – Set the trigger according to how you think about your target signals. Use standard events, such as rising edge, falling edge, glitch or pattern to define a trigger event. These events are accessible via an easy pull-down menu without leaving the waveform display. You can set the trigger for an event on the basis of activity on one or more buses or signals. Simply select the patterns, edge or levels for the signals that apply.

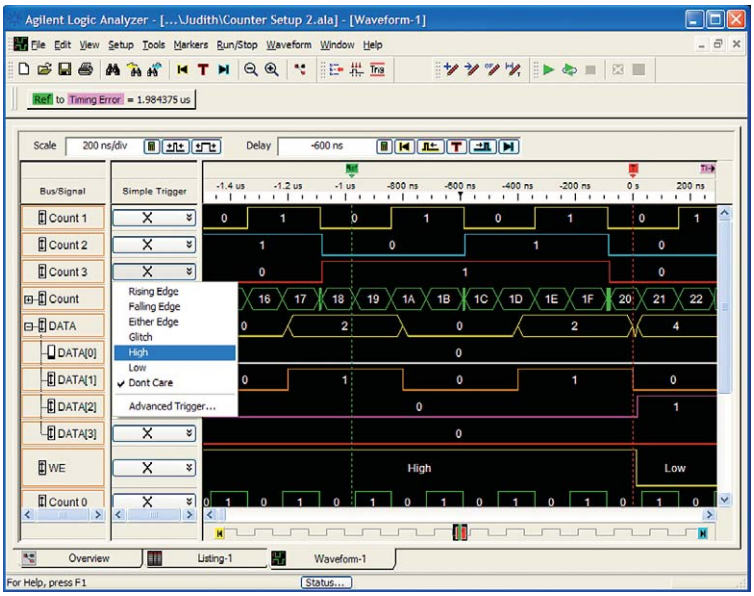


Figure 10. Define a single trigger event as a combination of levels, edges, patterns or glitches across multiple signals and buses.

Making logic analyzer measurements as simply as possible with enhanced usability and use models

b. Quick Trigger – Simply draw a box around the questionable event in the current trace and select Set Quick Trigger to see if it occurs again. You don't have to spend time defining the trigger. The logic analyzer does the work for you.

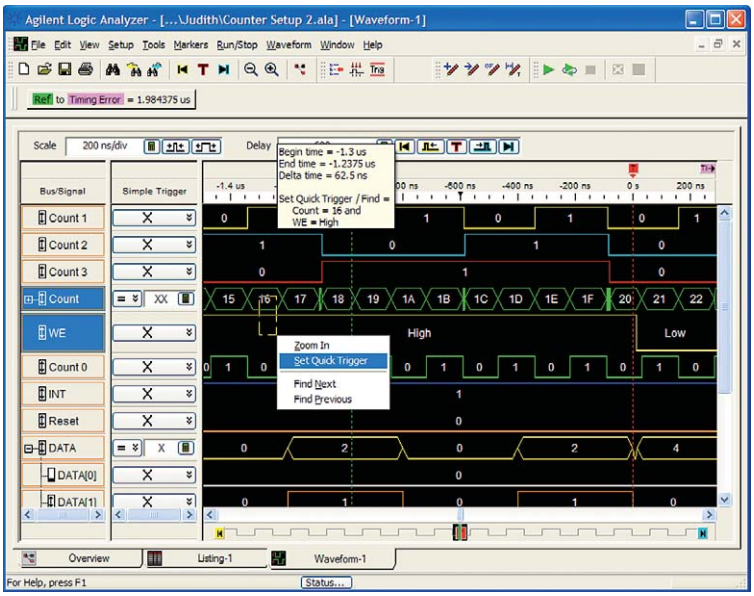


Figure 11. Create a trigger by simply drawing a box around an event in the current trace.

c. Advanced Trigger – Customize a trigger for your specific situation. You can use modifiable trigger functions as individual trigger events or as building blocks for complex scenarios. Icons provide a graphical representation for each trigger function. Simply drag-and-drop an icon into the trigger sequence. To fully define the trace event, fill in the blanks with values or select standard options from the pull down menu.

Making logic analyzer measurements as simply as possible with enhanced usability and use models

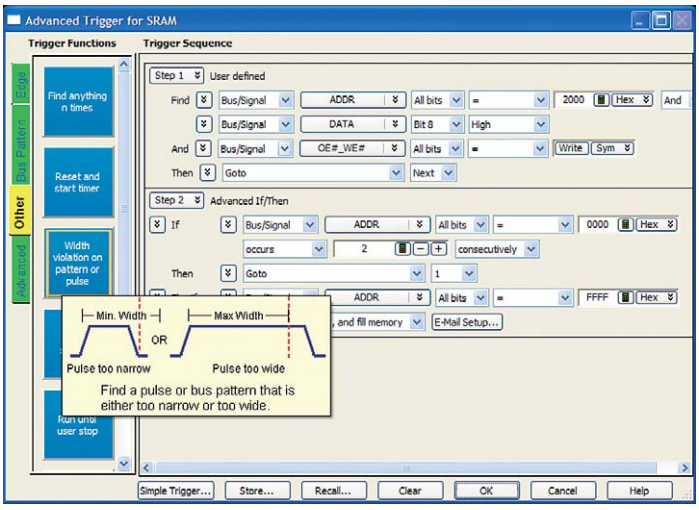


Figure 12. Customize a trigger to specify the sequence of events leading up to a trigger event.

Experience the ease-of-use first hand, download the logic analyzer application software from **www.agilent.com/find/la-sw-download** or view the videos at **www.agilent.com/find/logicdemos**.

Ease-of-use also means that the logic analyzer fits with your work style and lab environment. Whether you work alone at a bench or with team members distributed around the world, the 16800 and 16900 Series logic analyzers provide multiple use models that easily integrate into your debug environment. Use models include:

- Working at your bench
- Working offline to analyze captured traces or set up a new measurement
- Controlling and monitoring the logic analyzer from a remote location
- Running automated tests
- Offloading data for custom analysis
- Sharing results and setups easily, anywhere in the world
- Combining individual logic analyzers to expand measurement capability

9 Ensure measurement accuracy with complete and reliable probing

The single most important decision you make about your logic analyzer configuration isn't the logic analyzer's acquisition capabilities – it's the logic analyzer's probing. If your probing connection is intermittent or if the probing accessories you use limit the signal bandwidth, your logic analyzer may not be getting the information it needs to properly represent signal activity. Even if you determine that you don't need to upgrade your logic analyzer, you need to consider the latest available probing options to ensure you get the best measurement possible. Probing is critical to high-performance acquisition and Agilent's state of the art probing technology ensures you don't have any worries with high-speed signals.

The advantages of Agilent's latest probing innovation, soft touch connectorless probes, include:

- Provides quick, easy connection
- Reduces board cost and shortens the design cycle by eliminating a connector
- Eliminates the capacitive loading of a connector yielding the lowest loading (less than 0.7 pF), highest performance (>2.5 Gbit/s rate) logic analyzer probing option available
- Reliable contact even for contaminated or uneven board surfaces using a pliable micro-spring pin design with four-point crown tip
- Flow through signal routing streamlines design flow and maintains differential pair spacing to ensure constant differential mode impedance and virtually eliminate stubs
- Acquire high-speed single-ended or differential signals without impacting the performance of your circuit, while providing an accurate representation of your signal
- Browse multiple signals by pressing the probe against the target device
- Compatible with all board finishes, including lead free

Intermittent or faulty probe connections compound your debug problems, causing you to spend your time debugging your probes instead of your circuit. Avoid costly and complex solutions that require gold plating and handling stiffeners, keep-out area on the back of the board, multi-step cleaning processes or complex setups to hold your probes in place. Agilent's soft touch connectorless probes are the latest innovations in probing technology that provide rugged, reliable, high-bandwidth connections.

Ensure measurement accuracy with complete and reliable probing

You also may need to measure signals that are physically far apart or that are located where a probe connector hasn't been designed in. Make sure you have probes and accessories available that allow you to probe a signal no matter where it resides on the board – at an IC pin, trace, pad, via...even internally in an FPGA. Agilent's wide probe selection minimizes the keep-out area while maximizing the number of signals you can probe in a small area. Agilent gives you flexibility by offering a wide variety of probing options that ensure you have the right probe for the job.

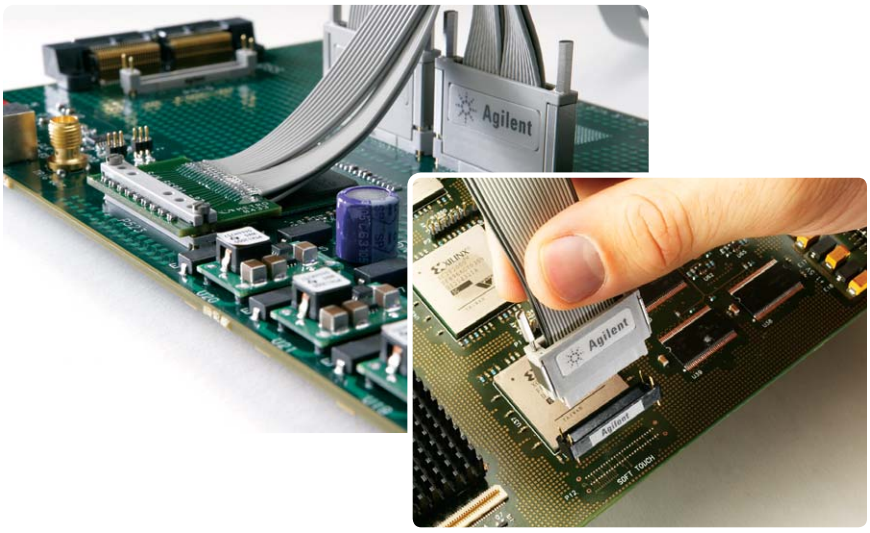
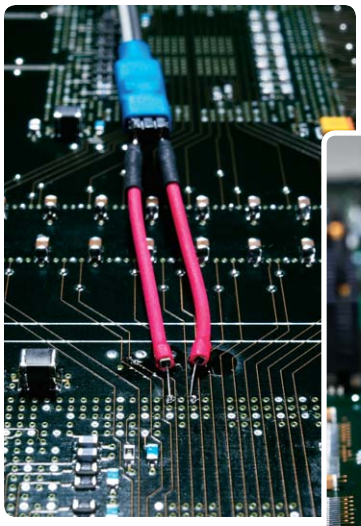


Figure 13. Soft touch connectorless probes provide a powerful combination of easy, reliable connection with high performance.

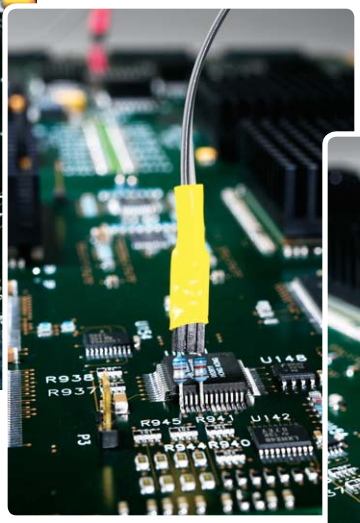
Figure 14. Use Agilent's high-performance flying-lead probes when you need the most flexibility in probing.

Ensure measurement accuracy with complete and reliable probing

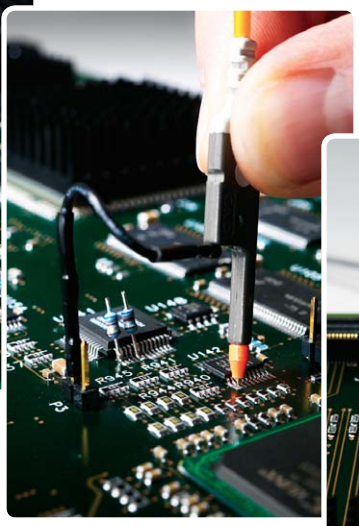
Figure 15. Use flying lead accessories to...



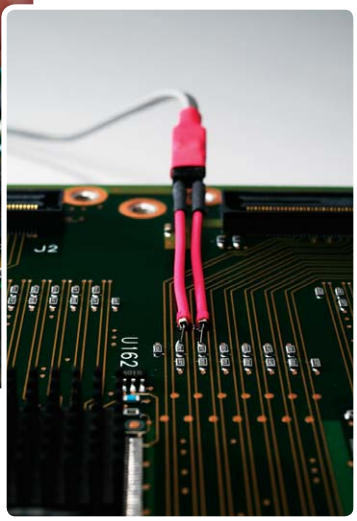
...probe the back side of a BGA



...probe a pin of a QFP package



...quickly browse from signal to signal



...probe surface mount resistors

10 Obtain added value and investment protection from a long list of standard features

Upgrading to a 16800 or 16900 Series logic analyzer also provides the following capabilities standard:

- **Large 15 inch (38.1 cm) color display** – a viewing area that allows you to see more data. Viewing relationships between large numbers of signals and buses helps you identify a problem sooner.
- **Built-in pattern generator** – When you need to start testing before your system is complete, an integrated pattern generator lets you reduce risk early and verify operation across a variety of test conditions. Digital stimulus patterns let you emulate missing components or inject faults to see how your system responds...at full speed or by stepping through individual states. Three models of the 16800 Series portable logic analyzers include a 48-channel pattern generator standard, and a 48-channel pattern generator module is available as an option for the 16900 series modular logic analysis system.
- **Source code correlation** – Correlate your logic analyzer trace to the high-level source code that produced it to give you a software view into your system's behavior.
- **Headroom for your future needs** – Easily upgrade your logic analyzer memory depth or state speed. Purchase the capability you need now then upgrade as your needs evolve. No hardware changes or returns are required.
- **Optional removeable hard drive** – for use in secure environments.
- **Fast system performance with 3 GHz CPU, six USB 2.0 ports (two front and four rear), and Gbit LAN.**
- **Open Windows® platform** – add any additional analysis tools you may need directly on your logic analyzer.

Conclusion

From our HP test and measurement foundation, Agilent's leadership in logic analysis spans four decades. Beginning with the invention of the logic analyzer in the 1970's, Agilent consistently delivers high-value products that keep pace with your latest designs and set the standard of price-performance and ease of use in the logic analysis market.

Agilent's latest generation of logic analyzers, the 16800 Series portables and 16900 Series modular systems, have evolved to provide expanded measurement capability and use models traditionally not associated with a logic analyzer. These new measurement and analysis tools provide you faster insight and increased productivity, allowing you to stay on top of industry trends and get to market faster.

Web site

For the most up-to-date and complete application and product information, please visit our product web site at **www.agilent.com/find/logic**.

Agilent Email Updates

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Get the latest information on the products and applications you select.

Agilent Direct

www.agilent.com/find/agilentdirect
Quickly choose and use your test equipment solutions with confidence.

Agilent Open

www.agilent.com/find/open
Agilent Open simplifies the process of connecting and programming test systems to help engineers design, validate and manufacture electronic products. Agilent offers open connectivity for a broad range of system-ready instruments, open industry software, PC-standard I/O and global support, which are combined to more easily integrate test system development.

LXI

www.lxistandard.org
LXI is the LAN-based successor to GPIB, providing faster, more efficient connectivity. Agilent is a founding member of the LXI consortium.

www.agilent.com/find/logic

Remove all doubt

Our repair and calibration services will get your equipment back to you, performing like new, when promised. You will get full value out of your Agilent equipment throughout its lifetime. Your equipment will be serviced by Agilent-trained technicians using the latest factory calibration procedures, automated repair diagnostics and genuine parts. You will always have the utmost confidence in your measurements.

Agilent offers a wide range of additional expert test and measurement services for your equipment, including initial start-up assistance onsite education and training, as well as design, system integration, and project management.

For more information on repair and calibration services, go to

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India	1 800 112 929
Japan	81 426 56 7832
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