Pinpoint. Optimize. Deliver.
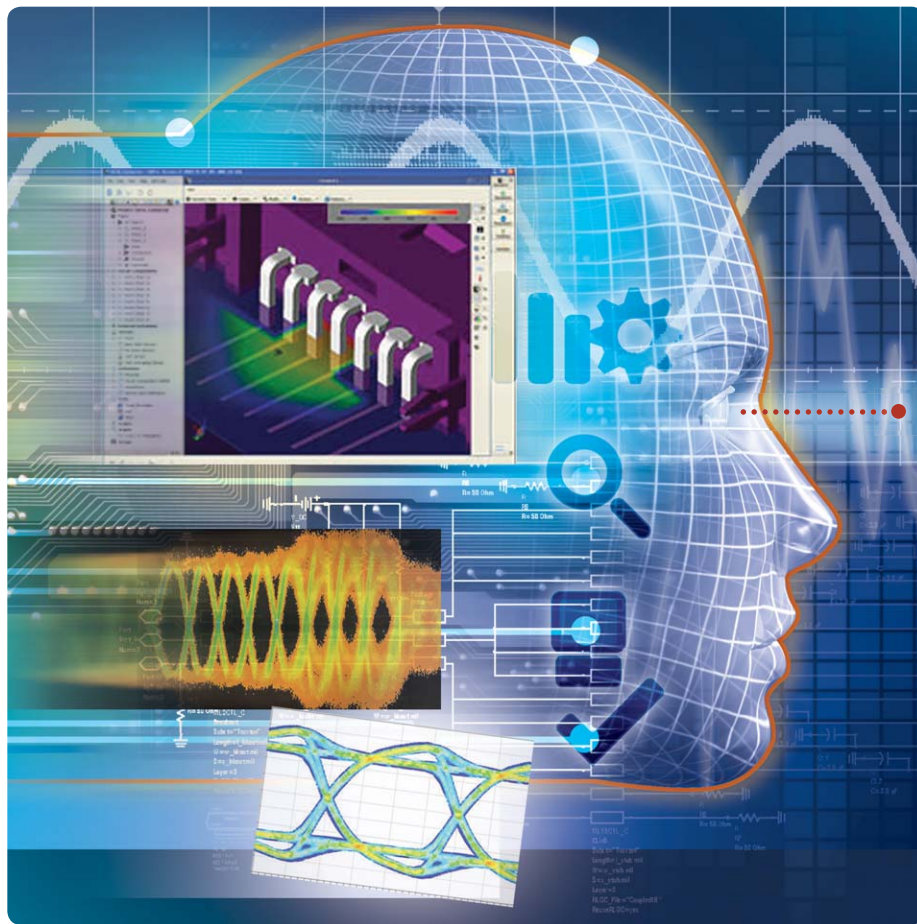

Cut through the challenges of gigabit digital designs

Agilent Technologies
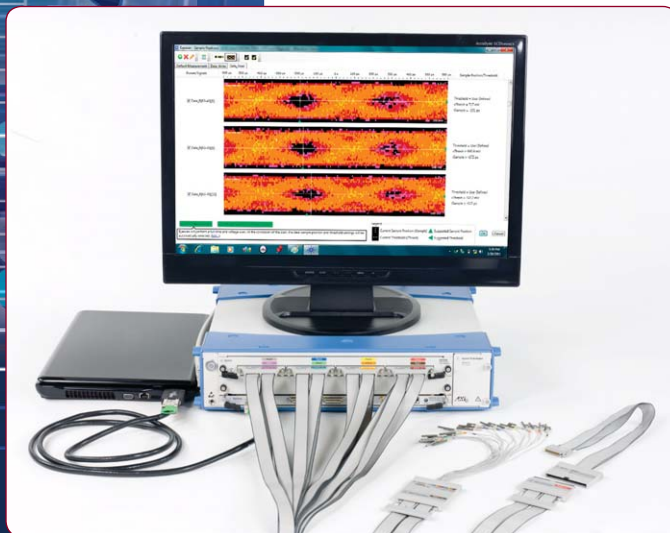
Pinpoint. Optimize. Deliver.

When digital signals reach gigabit speeds, "unpredictable" becomes the normal state of things. The process of getting your project back on track starts with the best tools for the job.

Agilent's high-speed digital solution set is a range of essential tools—for measurement and simulation—that will help you cut through the challenges of gigabit digital designs. These tools provide views into the time and frequency domains, revealing the underlying problems and ensuring compliant designs.

With Agilent, you'll be equipped to pinpoint, optimize and deliver—on time.

U4154A AXIe-based logic analyzer module
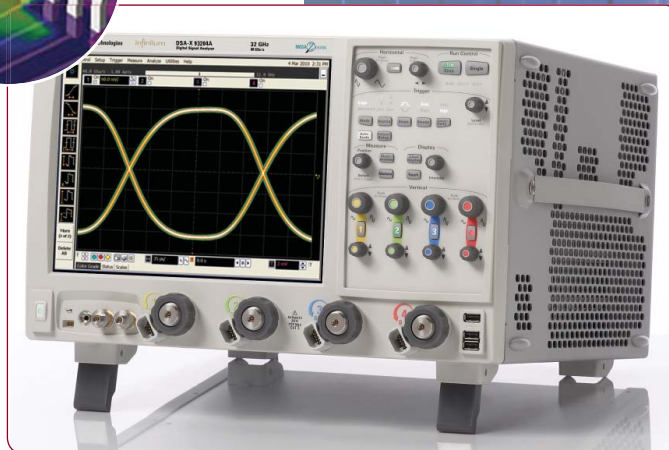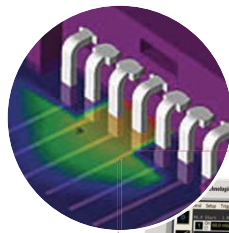
www.agilent.com/find/HSD

Navigate the Entire Design Cycle

From initial concept to compliance testing, Agilent can help you pinpoint problems, optimize performance and deliver your design on time. In the development of high-speed digital designs, our solution set includes software and instrumentation that spans the entire design cycle: design and simulation; analysis; debug; and compliance testing. These same tools are essential to signal integrity (SI) analysis, whether you perform it independently or as a tightly interwoven part of the digital design process.

Our range of tools lets you work where you're most comfortable: in the time or frequency domain, and with measurements or simulations. Shift between the time and frequency domains—or straddle both—to find the underlying causes of your toughest problems. Use measurement data to enhance simulations, and combine simulations with actual measurements to optimize performance before hardware is designed or fabricated. Perform pre-compliance testing with the same equipment used by independent test labs—and benefit from Agilent's strong presence on standards committees and at industry plugfests.

Pages 4 through 13 of this brochure provide overviews of our solutions within all four stages of the design cycle as well as the crucial—and integral—field of SI analysis. To get the latest information about new products, application notes, online seminars, and more, please visit our high-speed digital page at www.agilent.com/find/HSD.

Pinpoint Problems and Solutions

Count on Agilent to help you cut through the challenges of gigabit design and simulation: Our deep expertise in this area is built into our Advanced Design System (ADS) software and its capabilities that model RF and microwave effects quickly and accurately. You can use ADS and the Agilent physical layer test system (PLTS) software to solve tough modeling problems such as long, lossy interconnects or crosstalk in densely packed interconnects. Furthermore both vector network analyzer (VNA) and time distance reflectometry (TDR) measurements can be easily calibrated and controlled by the PLTS software.

ADS provides an integrated workflow that unites system, circuit and physical-level design and simulation. One important benefit of this tight integration is the elimination of time-consuming and error-prone transfers between single-function tools.
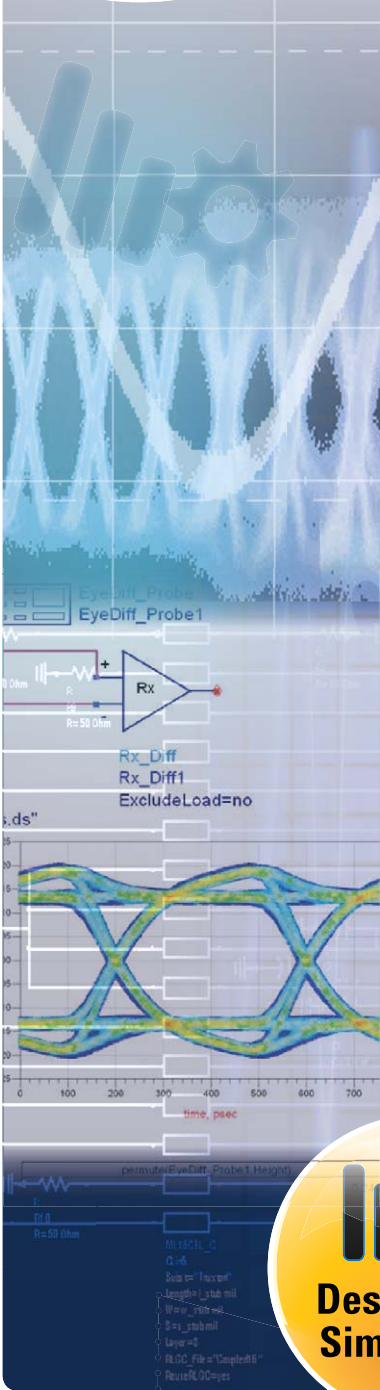
With ADS, you can work where you're most comfortable: Work in the time or frequency domain—or straddle both—to suit each task, component or problem. You can also mix and match signal-processing algorithms with lumped and distributed elements. The ADS convolution method ensures that time-domain models built from frequency-domain data are

causal and, optionally, passive. This helps you avoid the inherent inaccuracies and instabilities of tools that use a simplistic inverse-Fast Fourier Transform approach.

To help pinpoint problems, ADS provides integrated simulation and data displays. These include the ADS Stereoscopic Viewer, which provides greater insight into electromagnetic (EM) simulation results by leveraging NVIDIA 3D Vision hardware. For the visualization of channel- or circuit-simulation results, ADS also includes eye-diagram, mask and bit error rate-contour displays.

The ADS Channel Simulator produces ultralow BER contours in seconds—not days—by applying state-of-the-art statistical analysis techniques that include a unique treatment of transmitter jitter modeling that correlates closely with measured data. Channel Simulator supports not only built-in generic models but also IC models conforming to the IBIS AMI industry standard.

ADS supports your whole development flow, from early data-link engineering through the pre-layout and post-layout stages. You can import post-layout artwork from constraint-based enterprise tools such as Cadence Allegro, Mentor* Expedition and Zuken CR5000. Using ADS Momentum, you can create an EM model of your critical net and power delivery network PDN artwork for use in both the frequency and time domains. For power integrity analysis in the time domain, ADS supports hybrid convolution that accurately accounts the low frequency PDN impedance changes from the decoupling capacitors.

Design and Simulation

Tools for Design and Simulation

Agilent ADS is the leading electronic design automation software for RF, microwave and SI applications. In high-speed digital designs and SI analysis, engineers look to ADS for the correct treatment of effects such as distortion, mismatch and crosstalk.

www.agilent.com/find/signal-integrity-analysis

ADS Core, Transient Convolution, Layout, Momentum G2 bundled (W2211)

ADS is unique in its integration of accurate system, circuit, and EM simulators. This ensures that you get the right answers—and get them faster by avoiding data transfers between point tools.

- Generate ultralow BER contours and eye diagrams in seconds using the ADS Channel Simulator

- Run SPICE-like transient simulations on lumped and distributed components as well as causal and passive models from S-parameters with patented convolution engine

- Perform EM and circuit co-design with Momentum and FEM parameterized look-alike components (finite element modeling element is available separately as detailed below)

www.agilent.com/find/eesof-w2211

EMPro Core + FEM Bundle with FDTD Simulator Element (W2402B and W2405)

Generate high-frequency S-parameter models of arbitrary 3D shapes such as connectors in Agilent electromagnetic professional (EMPro) with the finite element model (FEM) and finite difference time domain (FDTD) simulators. The parameterized models can then be included in an ADS design kit that can be distributed and installed into ADS and co-simulated with lumped and distributed planar components.

- Create 3D components that can be simulated together with 2D circuit layouts and schematics within ADS using EM-circuit co-simulation

- Set up and run analyses using both time- and frequency-domain 3D EM simulation technologies—FEM and FDTD

- Quickly create arbitrary 3D structures with a modern, simple GUI that saves time and provides advanced scripting features

www.agilent.com/find/eesof-empro

PCI Express Channel Simulation

Electromagnetic Professional (EmPro)

Analyze electromagnetic effects of RF & Microwave components

Additional tool of interest

- N1930B Physical Layer Test System (PLTS) software
  www.agilent.com/find/plts

www.agilent.com/find/HSD

Perform Detailed Characterization with Powerful Analysis Tools

With our high-speed digital solution set, you can estimate system performance with models of devices and structures before your hardware is designed or returned from the fab shop. Use proxy devices to estimate component behavior, and vary device parameters to account for process variation, temperature drift, humidity effects, and more. To help maximize design margins, you can assess a system's segmented performance at IC pins, interface connectors, backplanes and elsewhere. Collectively, these capabilities can help you predict and optimize yields.

To provide greater confidence in actual VNA and TDR measurements, the PLTS software includes advanced calibration wizards that will help you avoid costly calibration errors. For greater test flexibility you can also mix and match coaxial and probe calibration kits with a single
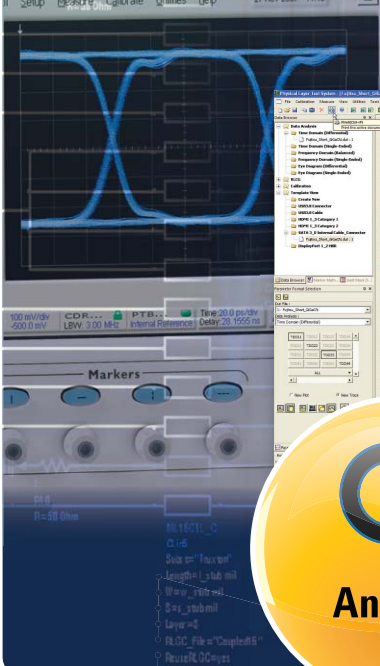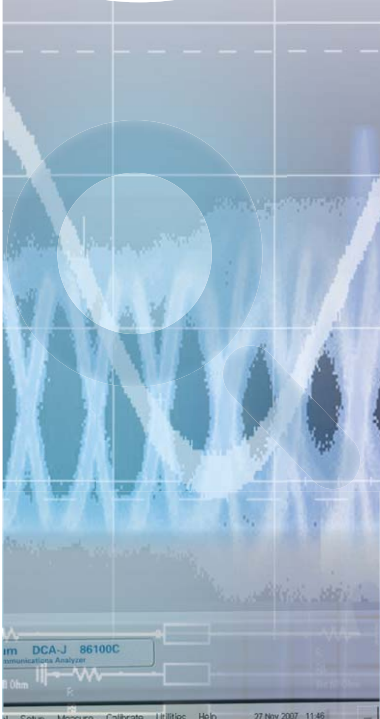
device under test (DUT). The probe calibration wizard will automatically download de-embed models for the probes used within probing stations.

When viewing your measurements and test results, PLTS lets you easily switch between the time and frequency domains—whichever you prefer, and whichever is most informative for the problem under consideration. You can optimize your analysis by performing PLTS data correlation in either the time or frequency domain.

Furthermore, you can now create your own de-embed models while removing fixture effects using a new technique called automatic fixture removal (AFR).

For accurate device characterization, the J-BERT N4309B high-performance serial bit error ratio tester (BERT) provides complete jitter-tolerance testing of embedded and forward-clocked devices. Its built-in and calibrated jitter source ensures accurate jitter-tolerance testing of receivers.

Signal integrity is often another major consideration in the analysis stage. Achieve your expected digital speeds by applying the powerful SI tools available from Agilent (*see pages 12-14 for more*).

Analysis

Tools for the Analysis Stage

Most serial data links begin and end with high-speed ICs designed for standards-compliant interoperability. As bit rates increase, the margins for jitter, interference and other imperfections make it increasingly difficult to achieve BER of less than 10^{-12}. The following tools will help you characterize and analyze your designs in detail.

N1930B Physical Layer Test System (PLTS) software

Developing and refining models enables you to meet project schedules and performance requirements. When models don't extend high enough to emulate prototype performance, PLTS lets you measure prototype S-parameters and use them to refine the model at higher frequencies.

- Automatic fixture removal (AFR) for the industry's most useful type of error correction
- Advanced test suite wizard with enhanced calibration and de-embedding for one button compliance testing
- Data integrity check and enforcement for simulation engine compatibility
- Save/load formula to existing view for ease of use.

www.agilent.com/find/plts

Bit Error Ratio Testers (BERTs)

Measure bits in real time and see virtually everything. J-BERT N4903B and ParBERT 81250 address a variety of speed classes and usability concepts. Along with application-specific stimulus and analysis tools, the BERTs cover high-speed serial and communications standards to provide flexible multi-tap de-emphasis capability.

- Find a receiver's maximum jitter resistance with calibrated built-in jitter injection capability
- Use J-BERT to perform precise jitter-tolerance sweeping and create realistic and worst-case stress conditions through control of jitter composition

www.agilent.com/find/bert

Infiniium 90000 X-Series and Infiniium 90000 Series Oscilloscopes

Use your jitter budget in your design, not on your scope. These scopes are engineered for demanding high-speed measurements, providing up to 32 GHz analog bandwidth; full-bandwidth probing solutions; hardware-accelerated de-embedding and equalization; excellent noise floor; and highly accurate real-time jitter measurements.

- Import design models, acquire real-time scope data and transform models to specific measurement locations with the InfiniiSim toolset
- Simplify and automate random jitter/deterministic jitter separation with EZJIT Plus and test to industry standards
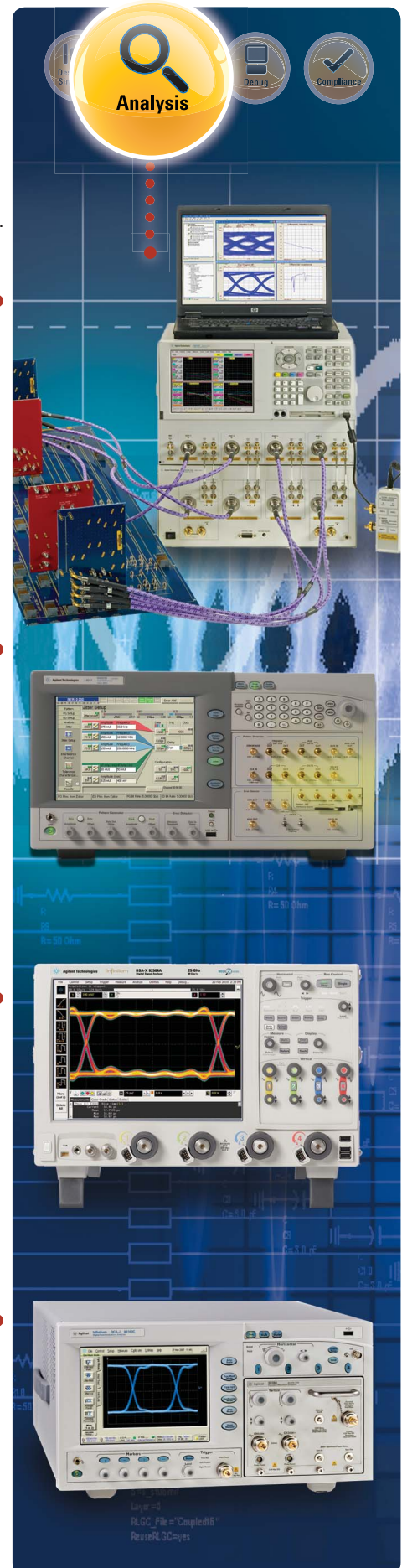
www.agilent.com/find/90000family

86100C/D Infiniium DCA-J

Advanced analysis decomposes jitter into its components and presents accurate views of interference and jitter contributions. Often used with a J-BERT, the DCA-J is a key tool in identifying the root causes of jitter, noise and interference, enabling better designs and compliant end products.

- Get fast insight into sources of jitter with Advanced Eye Analysis Software (Option 401) and Advanced Waveform Analysis Software (Option 201)
- Perform highly accurate measurements of ultralow jitter by adding the 86108A precision waveform analyzer to the DCA-J

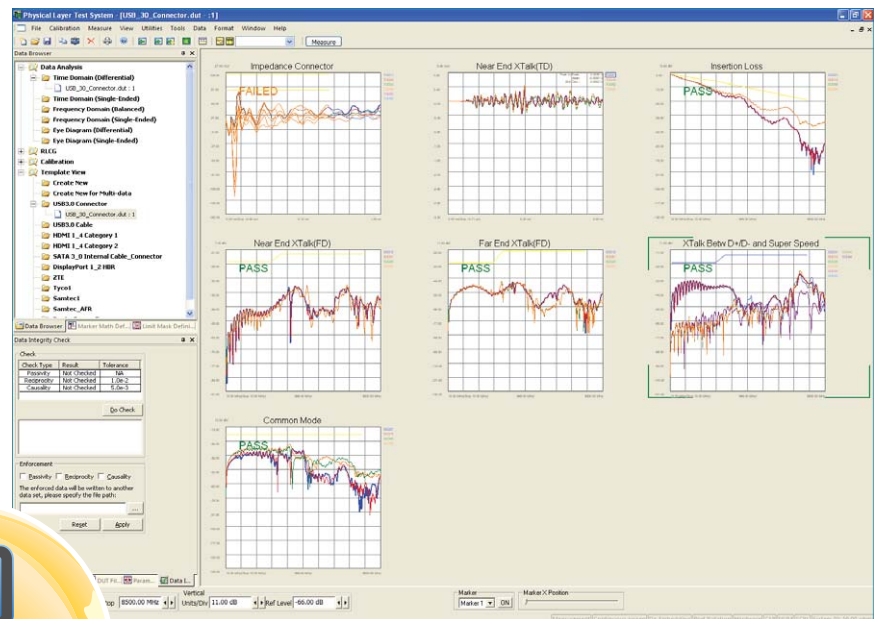**www.agilent.com/find/DCA-Jfamily**

Save Time During Debug by Correlating Models and Measurements

Approaching a problem from multiple perspectives is often the key to success when debugging designs that use gigabit rates. With Agilent, you can explore your design through models, simulations and actual measurements—and you can view all of these in the time and frequency domains.

One example is ADS, which lets you build a foundation for deeper understanding through detailed models of the target system. You can then use our instruments to validate simulations with measurements made at the accessible ports of a physical prototype. For even greater visibility, you can use simulation to interpolate and extrapolate waveforms in locations measurements can't reach.

Real-world measurements reveal performance parameters that help you identify the critical components within a specific budget. Measurements also help you validate or refine assumptions in your simulations and enable correlation of model results with actual tests. To create consistent data sets, you can correlate data in the time, frequency and simulation domains.

Straddling the domains is another effective way to debug stubborn problems. For example, mode-conversion analysis in the PLTS software helps pinpoint crosstalk problems in high-speed interconnects. Multi-domain analysis will help you locate physical-layer problems in high-speed channels.

Creating Test Suites using PLTS can save time when doing multi-domain analysis and characterization. In this example, a USB 3.0 connector fails differential impedance, while passing other parameters.

Debug

Tools that Enhance the Debugging Process

Whether you need to monitor bus traffic, capture infrequent events or measure bits in real time, we offer a range of essential tools that enable fast, deep and insightful debugging. Isolate the most challenging problems—and solve them with confidence.

U4154A AXIe-Based Logic Analyzer Module

This logic analyzer module provides reliable measurements on high-speed digital systems operating up to 4 Gb/s with eye openings as small as 100 ps by 100 mV. 12.5 GHz Timing Zoom with 256K sample memory gives you simultaneous state and high-resolution timing measurements covering a time span of 20 us.

- Data rates up to 4 Gb/s, addresses all DDR memory speeds
- 200 M samples of available memory ensure you capture enough system activity to troubleshoot complex systems

www.agilent.com/find/U4154A

Bit Error Ratio Testers (BERTs)

Measure bits in real time and see virtually everything. J-BERT N4903B and ParBERT 81250 address a variety of speed classes and usability concepts. Along with application-specific stimulus and analysis tools, the BERTs cover high-speed serial and communications standards to provide flexible multi-tap de-emphasis capability.

- Find a receiver's maximum jitter resistance with calibrated built-in jitter injection capability
- Use J-BERT to perform precise jitter-tolerance sweeping and create realistic and worst-case stress conditions through control of jitter composition
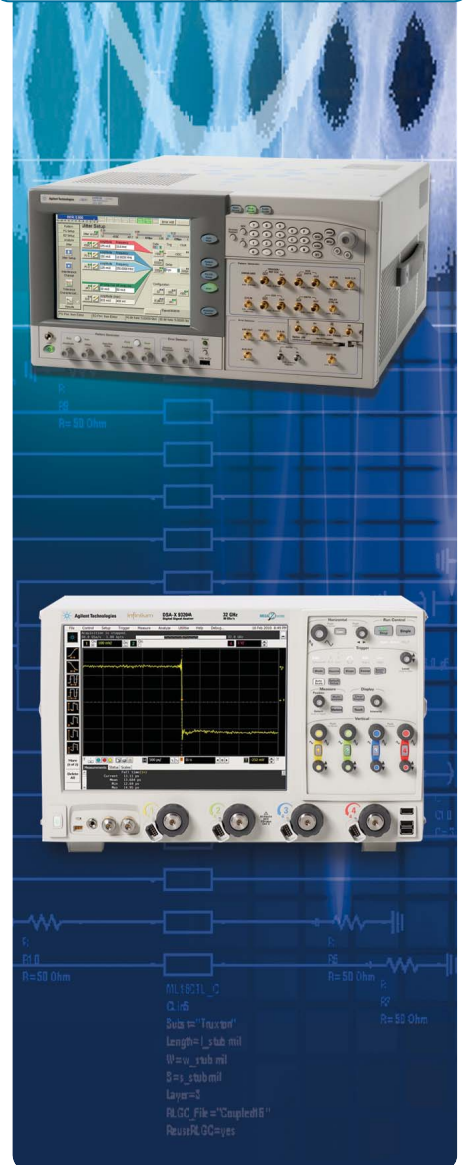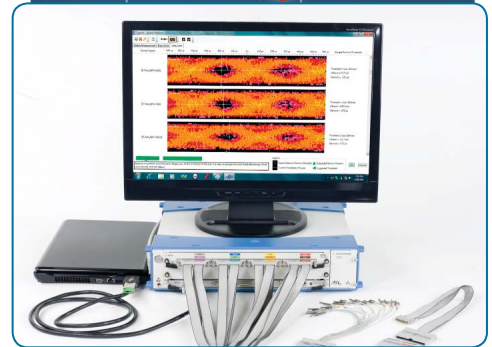- Get immediate test results with automated jitter-tolerance characterization routines
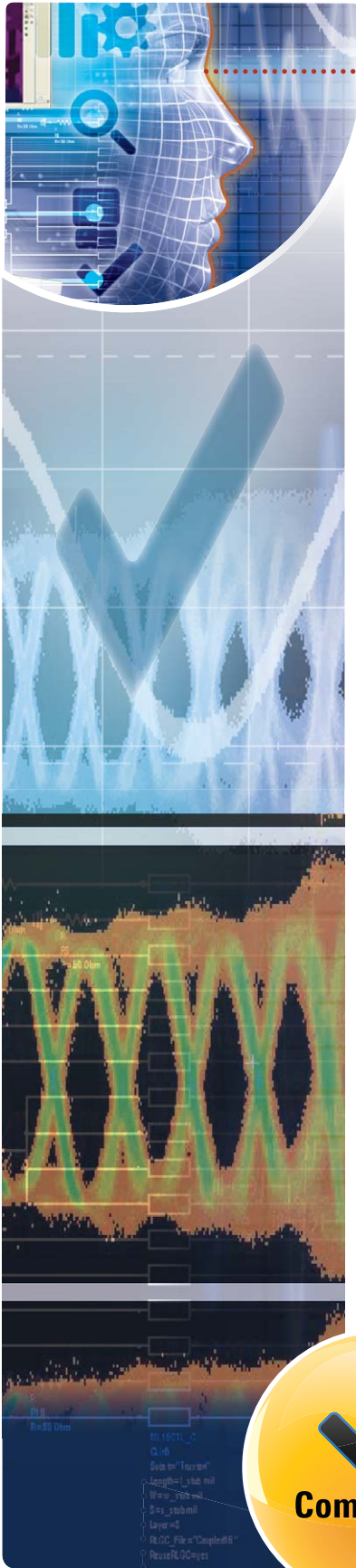
www.agilent.com/find/bert

Infiniium 90000 X-Series and Infiniium 90000 Series Oscilloscopes

Debug your toughest designs with confidence. These scopes offer wide range of measurement applications: serial debugging and low-level protocol viewing; jitter testing; advanced triggering; measurement customization; and more. Capture complicated signals and infrequent events with up to 2 Gpts of memory and combined hardware/software triggering. The 90000 X-Series also offers up to 32 GHz of analog bandwidth.

- Trigger on complex events and identify SI issues with InfiniiScan event identification
- Use EZJIT analysis software to quickly characterize and evaluate jitter measurements such as cycle-cycle, N-cycle, measurement trending and jitter spectrum
- Set up measurements quickly with standards-based protocol triggering and decode applications

www.agilent.com/find/90000family

Track Down Potential Issues with Thorough Compliance Testing

In compliance, gain confidence by tapping into Agilent's expertise as an active participant in the relevant standards bodies. Our solutions include compliance tests certified by the governing bodies responsible for numerous interfaces. What's more, these are the same instruments used by independent test labs—so you can trust your results. Obtain greater accuracy by removing channel artifacts. Change the measurement parameters to learn sensitivities and distributions, and to understand marginal performance. Maximize design margins by correlating measurement results in the time and frequency domains.

Our instruments include capabilities such as the intuitive creation of mask templates, which accelerates the creation of pass/fail criteria for interconnects. Specialized test suites for high-speed protocols help you make an efficient transition from prototype to production. Our use of familiar nomenclature and features enables faster throughput in manufacturing test.

You can begin compliance testing before committing the first prototype with the ADS Compliance DesignKits, which are free add-ons that cover standards such as DDR2 and DDR3 The design kits can easily be customized to other protocols and standards using industry-standard tools such as Excel, XML and C++.

At this stage of the life cycle it can also be useful to address underlying SI issues. Save time and reduce costs with SI-specific solutions such as InfiniiSim for Agilent Infiniium oscilloscopes. Also take your measurement science further and increase your design margins by utilizing Agilent's exclusive PrecisionProbe software.

Compliance

Tools for Compliance Testing

Leverage years of training and experience in every measurement you make: Agilent's measurement experts sit on industry standards committees and help define the compliance requirements. They also make sure our tools—including the ones highlighted here—deliver exactly to the standards.

Infiniium 90000 X-Series and Infiniium 90000 Series Oscilloscopes

Pass demanding compliance tests more quickly: Our scopes are certified on interfaces including SATA 6G, PCIe Gen 2.0 and USB 3.0. We offer a wide range of compliance applications, ensuring fast setup for complete, automated testing and reporting. Stress your design to the max with 2 Gpts of memory that supports real-time testing to pattern lengths of PRBS23.

- Select the application software you need: USB 2.0, USB 3.0, PCI Express®, SATA, Wireless USB, DDR, HDMI and more
- Quickly capture of complicated signals and infrequent events with 2-Gpt memory and combined hardware/software triggering—and achieve highly effective compliance testing

www.agilent.com/find/90000family
www.agilent.com/find/appsfamily

E5071C ENA Option TDR

Simplify your work with a one-box solution for compliance testing of cables and connectors. Time domain, frequency domain, and eye diagram analysis are available, enabling fast and accurate compliance tests. The ENA Option TDR is certified on a variety of high speed digital standards, including SATA, HDMI, and USB.

- TDR oscilloscope look-and-feel allows for simple and intuitive operation with minimum learning curve.
- Proprietary electrostatic discharge (ESD) protection chip integrated inside the instrument allows for significantly increased ESD robustness, freeing you of the continuous fear of instrument failure due to ESD.
- Wide dynamic range results in accurate and repeatable measurements, allowing you to reduce guard bands and increase yield.
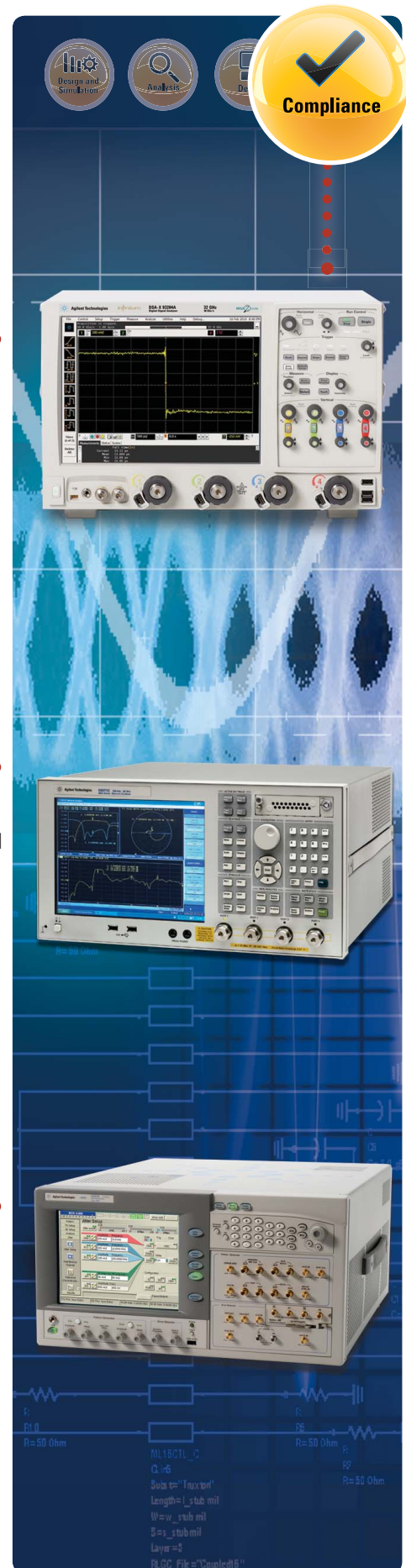
www.agilent.com/find/ena-tdr

Bit Error Rate Testers (BERTs)

J-BERT and ParBERT address a variety of speed classes and usability concepts. Automated checks let you quickly and easily determine if a receiver meets compliance criteria. With an Agilent BERT, automated jitter-tolerance compliance tests check receiver performance versus the standard and determine non-compliant settings.

- Use jitter tolerance characterization to search for the maximum jitter value a receiver can tolerate by sweeping sinusoidal jitter (SJ) and periodic jitter (PJ) in modulation frequency and magnitude
- Get immediate test results from compliance routines that provide clear pass/fail indications
- Utilize the convenience of automated receiver compliance testing with the N5990A test automation platform
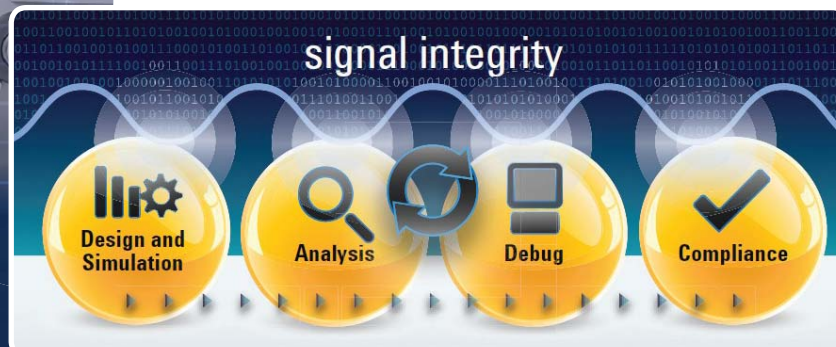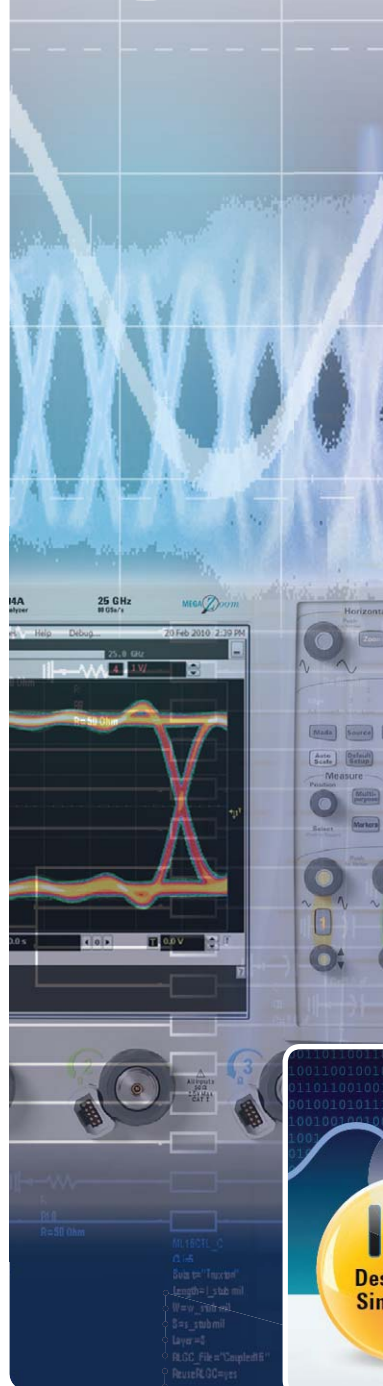
www.agilent.com/find/bert

Use Advanced SI Tools to Define Next-Generation Processes

Whether you handle SI analysis as an independent topic or a deeply inter-woven part of digital design, Agilent offers today's most powerful range of SI tools. Leverage your own multi-domain expertise through solutions that provide complete characteriza-tion in the time, frequency and simu-lation domains. Solve your toughest problems—in a new standard or a new product—with advanced toolsets such as our SI portfolio for high-speed digital design.

If your organization has a dedicated SI lab, enhance its capabilities with product platforms that are designed to support the latest design, simulation and measurement technologies. We're constantly leveraging our work with SI thought leaders, industry standards committees and our own design experts to evolve and improve the measurement and simulation capabili-ties in our solutions.

signal integrity

Design and Simulation

Analysis

Debug

Compliance

www.agilent.com/find/HSD

Tools for Signal Integrity Analysis

Whether you perform SI analysis independently or as a tightly integrated part of the digital design process, the breadth of tools available from Agilent can help you find problems today and prevent problems in the future.

N1930B Physical Layer Test System software

As data rates exceed 5 Gb/s, linear passive interconnects become more crucial to channel performance. Structures such as SMA launches, inductive wire bonds and capacitive via paths require precise examination to enable tuning for controlled-impedance environments.

- Optimize high-speed data transmission through precise control of channel-performance parameters
- Examine only the DUT structure of interest—simply—with automatic fixture removal
- Aid design characterization and application of user-fabricated TRL calibration kits with TRL cal wizard
- Remove crosstalk inside differential fixtures with differential crosstalk calibration algorithm
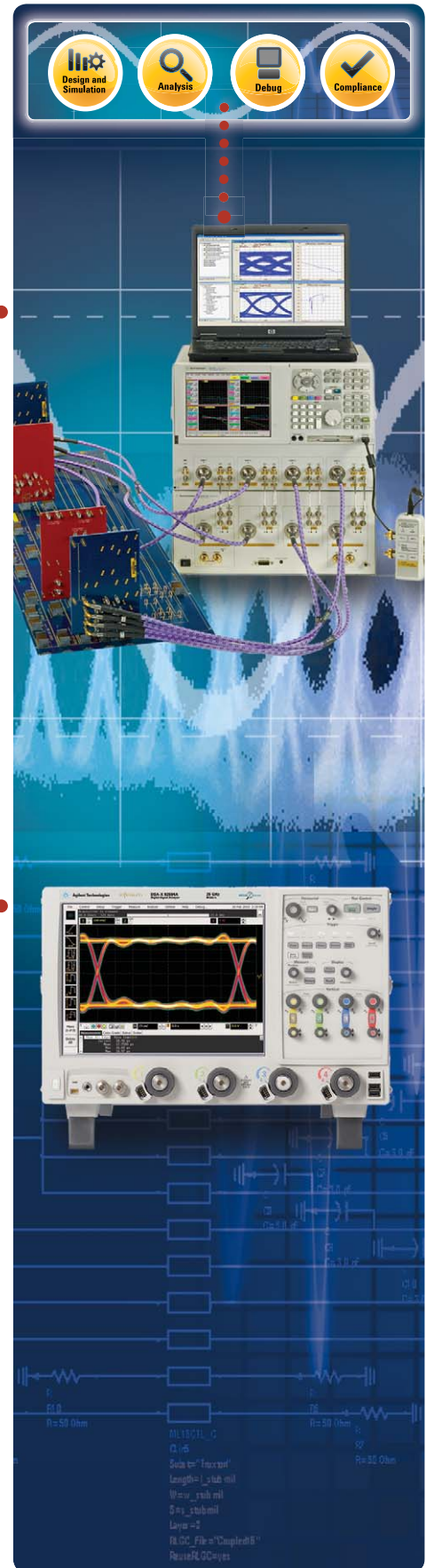
www.agilent.com/find/plts

Infiniium 90000 X-Series and Infiniium 90000 Series Oscilloscopes

When investigating SI problems, many people reach for an oscilloscope first—and 90000 Series scopes are a great place to start. Their accurate measurements will help you identify the tools, processes, design rules and de-embedding techniques that lead to better SI.

- Get exceptionally low noise and 32 GHz true analog bandwidth with the 90000 X-Series
- Understand system budget metrics by using InfiniiSim to remove fixture effects or to add or remove media losses
- Characterize infrequent events and low-frequency effects with 2 Gpts of memory and hardware/software triggering

www.agilent.com/find/90000family

www.agilent.com/find/HSD

More Tools for Signal Integrity Analysis

Bit Error Rate Testers

In SI analysis, J-BERT and ParBERT measure bits in real time and ensure that you won't miss anything. Available application-specific stimulus and analysis tools include control of jitter composition for precise jitter-tolerance sweeping that creates realistic and worst-case stress conditions (J-BERT).

- Get clean eye measurements with very little intrinsic error using the calibrated and repeatable jitter generator
- Make long-term BER measurements

www.agilent.com/find/bert

SystemVue AMI Modeling Kit (W1714)

SystemVue AMI Modeling Kit (W1714) lets you build industry-standard IBIS AMI SERDES models from the optimized data flow block diagram of the signal processing architecture without laborious and error prone hand-coding. Once the signal processing is optimized, building the AMI model is a one-click operation, saving months of work.

- Optimize the signal processing blocks for your serializer-deserializer (SerDes) integrated circuit (IC) at the electronic system level (ESL).
- Automatically generate an IBIS AMI model from the block diagram
- Freely distribute the generated model to your customers as an 'executable datasheet' to help them design your chip into their system.

www.agilent.com/find/eesof-w1714

The SerDes model blocks can be specified in several ways. You can use built-in standard blocks like FIR or (as illustrated here) you can create your own block with custom code
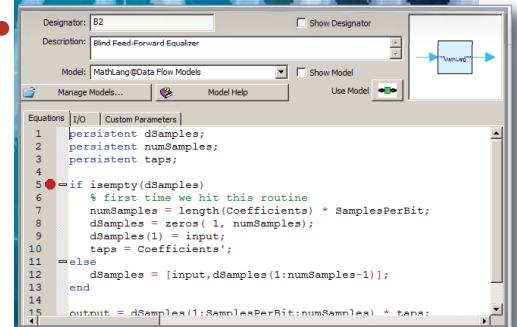
E5071C ENA Network Analyzer Option TDR

Signal integrity of interconnects drastically affect system performance at Gb/s data rates. Fast and accurate analysis of interconnect performance in both time and frequency domains become critical to ensure reliable system performance. The ENA Option TDR provides an one-box solution for high speed interconnect analysis, enabling time domain, frequency domain, and eye diagram analysis.

The ENA Option TDR provides the following breakthroughs for SI design and verification:

- TDR oscilloscope look-and-feel allows for simple and intuitive operation.
- Proprietary electrostatic discharge (ESD) protection chip integrated inside the instrument allows for significantly increased ESD robustness.

www.agilent.com/find/ena-tdr
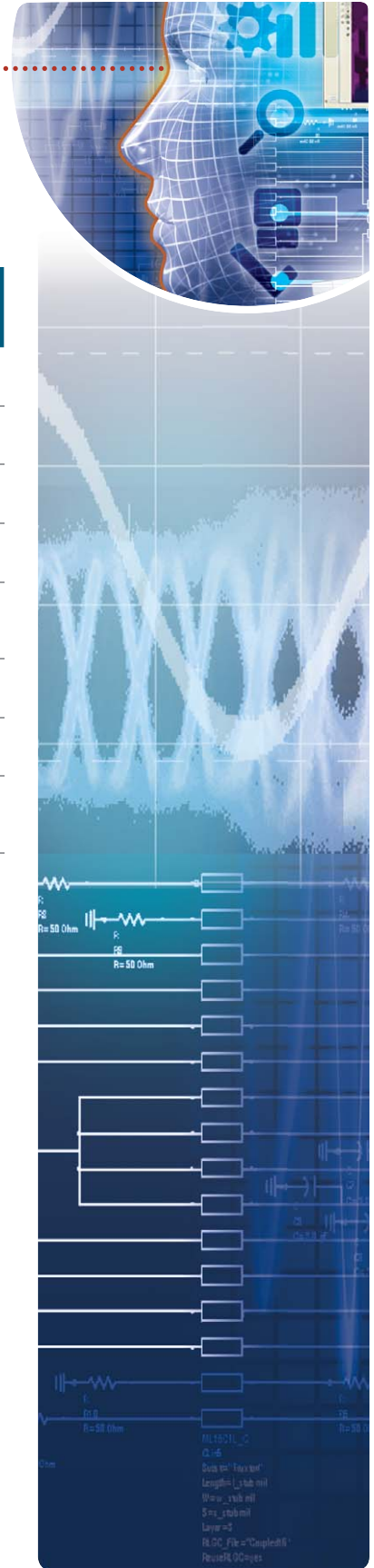

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Solution Map

The following table maps key products and solutions onto the life cycle of a typical high-speed digital device. Blue check marks indicate the "best fit" solutions, as highlighted on pages 5, 7, 9, 11 and 13.

	Design & simulation	Analysis	Debug	Compliance	Signal integrity
ADS software	√				√
PLTS software		√	√	√	√
86100 Series		√			
90000 Series		√	√	√	√
J-BERT & ParBERT			√	√	√
ENA Option TDR		√	√	√	√
U4154A Series			√		
Compliance software				√	

Supported Standards

Agilent offers solutions that can address the needs of designers developing products that incorporate the following high-speed digital standards:

- DDR
- DVI
- Display Port
- Ethernet, including 10GBaseT
- Fully buffered DIMM
- HDMI
- MIPI
- PCI Express
- SATA
- Serial Attached SCSI
- USB
- Wireless USB
- XAUI

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Pinpoint.
Optimize.
Deliver.

Agilent's high-speed digital solution set is a range of essential tools—measurement and simulation—that will help you cut through the challenges of gigabit digital designs. Our tools provide views into the time and frequency domains, revealing the underlying problems and ensuring compliant designs. With Agilent, you'll be equipped to pinpoint, optimize and deliver—on time.

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Agilent Advantage Services

Agilent Advantage Services is committed to your success throughout your equipment's lifetime. To keep you competitive, we continually invest in tools and processes that speed up calibration and repair and reduce your cost of ownership. You can also use Infoline Web Services to manage equipment and services more effectively. By sharing our measurement and service expertise, we help you create the products that change our world.

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DEKRA Certified
ISO 9001:2008
Quality Management System

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