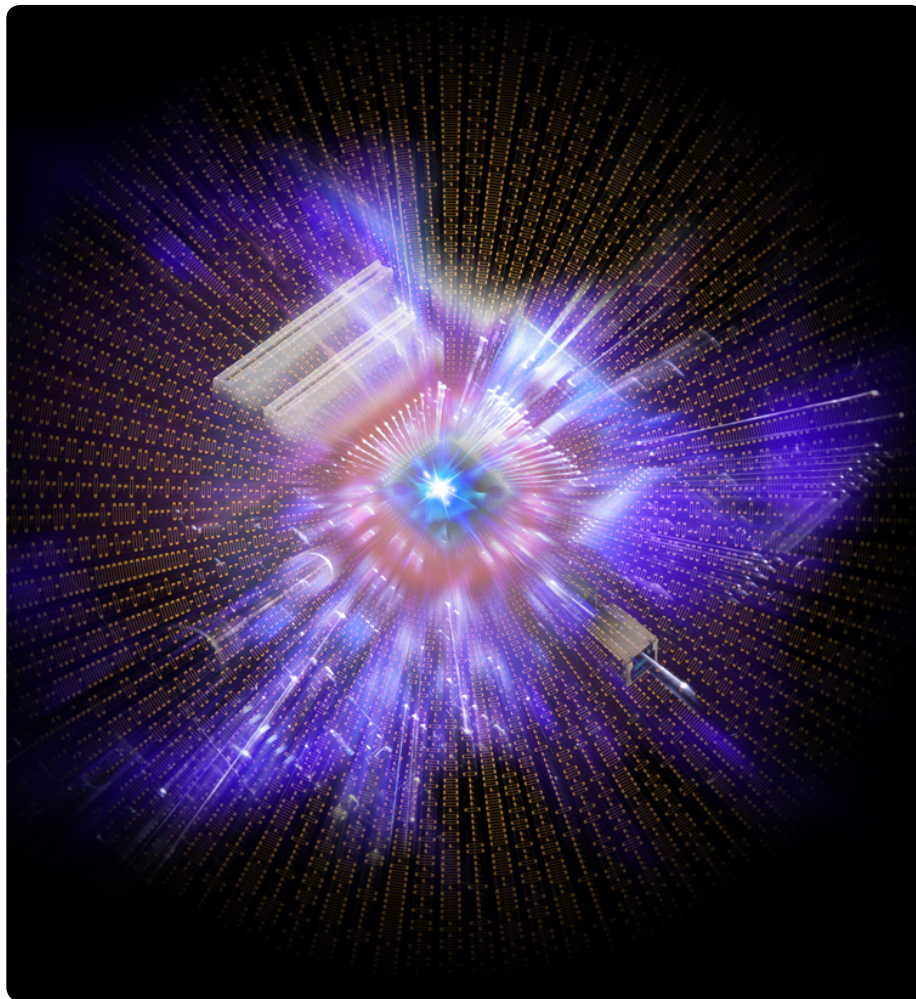# Digital Design & Interconnect Standards

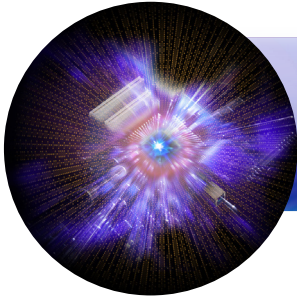

Achieve your best design with Agilent

Agilent Technologies

Introduction

When digital signals reach gigabit speeds, "the unpredictable" becomes normal. In digital standards, every generational change puts new risks in your path. We see it firsthand when creating our products and working with engineers like you. The process of getting your project back on track starts with the best tools for the job.

Agilent's solution set for high-speed digital test is a combination of instrumentation and broad expertise built on our ongoing involvement with industry experts. Agilent's tools for measurement and simulation will help you cut through the challenges of gigabit digital designs. These tools provide views into the time and frequency domains, revealing underlying problems and ensuring your designs meet specifications.

With Agilent, you'll be equipped to achieve your best design, on time and to budget. By sharing our latest experiences, we can help anticipate challenges and accelerate your ability to create products you'll be proud of.

From initial concept to compliance testing, Agilent can help you uncover 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.

www.agilent.com/find/HSD

Design and Simulation
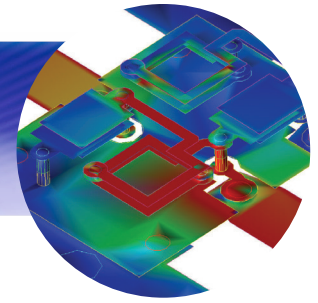
Count on Agilent to help you through to a complete gigabit design. Our deep expertise in this area is built into our Advanced Design System (ADS) software and its capabilities that model RF and microwave effects quickly and accurately. You can use ADS and the Agilent physical layer test system (PLTS) 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 domain 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. Straddling the domains is an effective way to debug stubborn problems. For example, mode-conversion analysis in the PLTS software helps pinpoint crosstalk problems in high-speed inter-connects, and multi-domain analysis will help you locate physical layer problems in high speed channels.

Mentor Graphics is a trademark of Mentor Graphics Corporation in the U.S. and other countries.

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[1] 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 for the low frequency PDN impedance changes from the decoupling capacitors.

**High Speed Digital Design Flow**
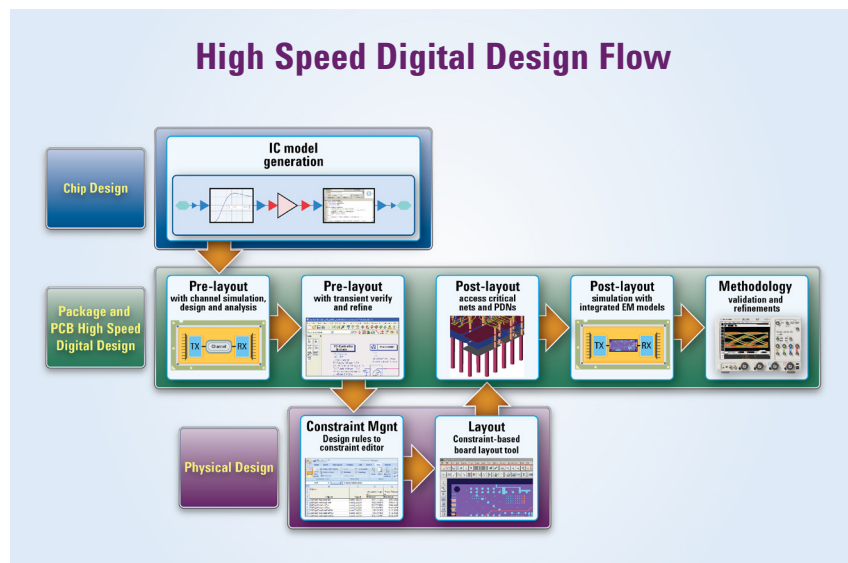
Analyze and Debug

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, back-planes and elsewhere. Collectively, these capabilities can help you predict and optimize yields.

ADS lets you build a foundation for deeper understanding through detailed models of the target system. You can then use measurement data to validate simulations with actual measurements made on the accessible ports of a physical prototype. With Agilent's measurement tools, you have access to a wide range of physical parameters: oscilloscopes offering advanced measurement applications, logic analyzers, bit error ratio testers, vector network analyzers providing optional time domain reflectometry capability, and more.

Real world measurements reveal performance parameters that can help you identify 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. For even greater visibility, you can use simulation to interpolate and extrapolate waveforms in locations measurements can't reach.

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).
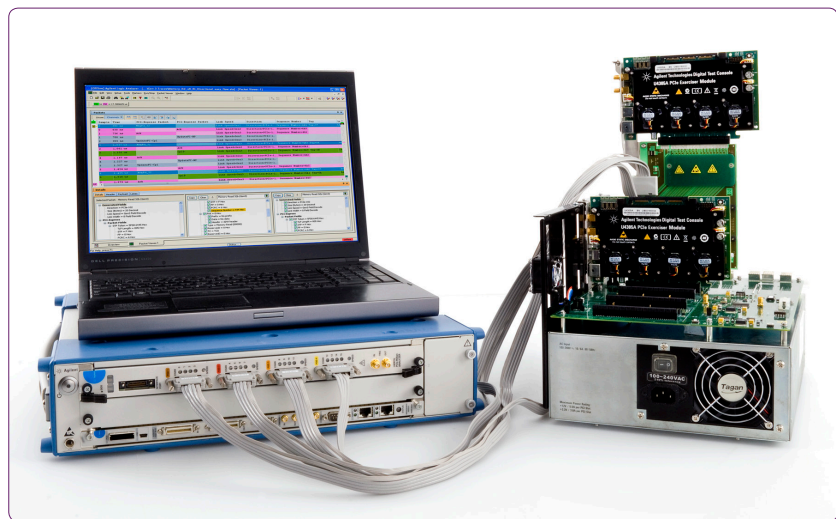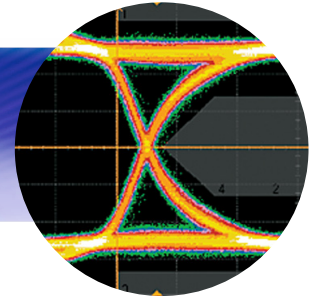
Compliance

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 Design Kits, 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++.
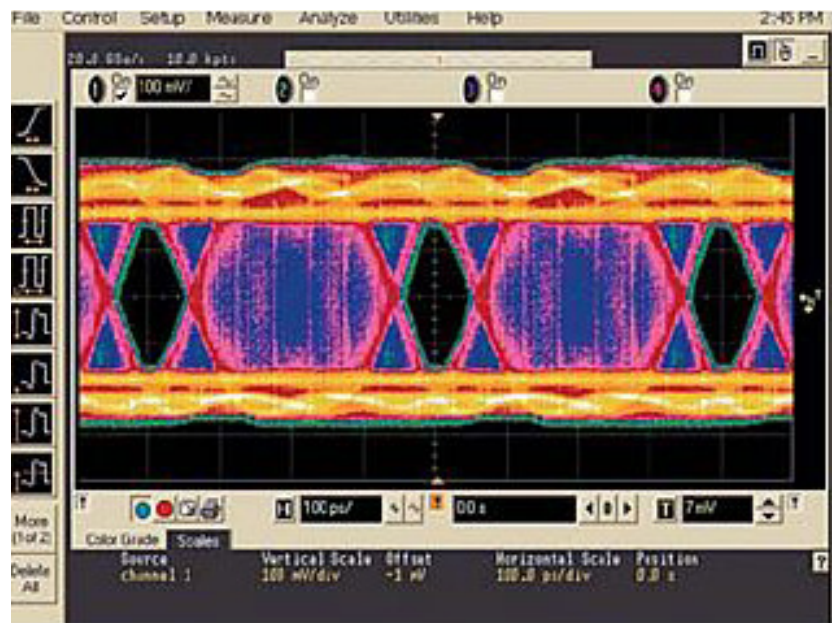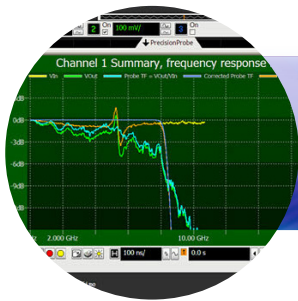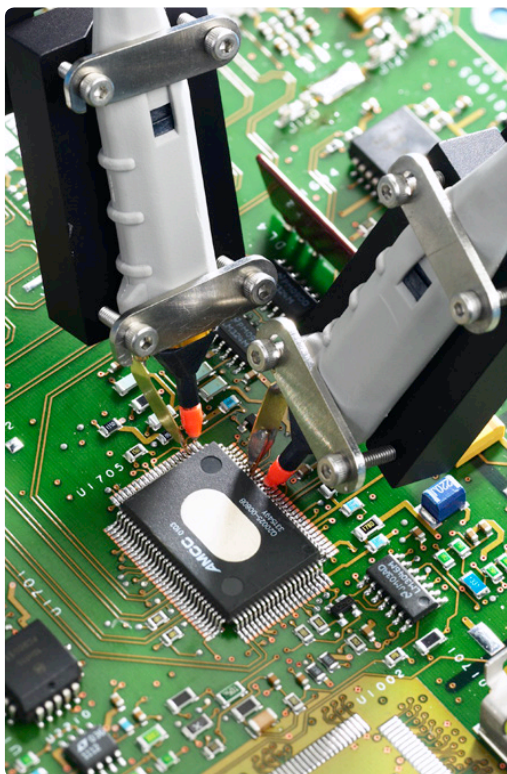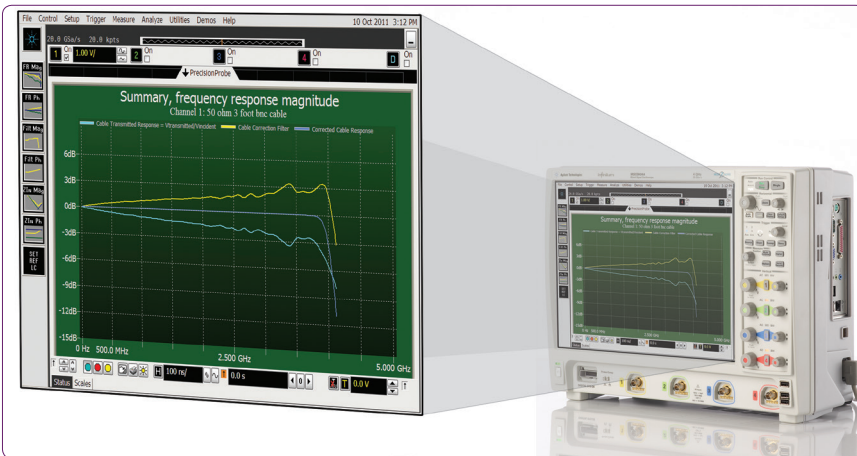
Signal Integrity

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.

Whether you handle SI analysis as an independent topic or a deeply interwoven 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 characterization in the time, frequency and simulation 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 capabilities in our solutions.

Solution Map

The table below shows our product solutions. They are each described in more detail with links to the appropriate web pages on **www.agilent.com**.

	Design and Simulation	Analysis	Debug	Compliance	Signal Integrity	See Page
ADS, EMPro and SystemVue	●				●	8
N1930B PLTS Software	●	●	●		●	9
PNA-X Network Analyzer	●	●	●			10
ENA Option TDR		●	●	●	●	10
86100 DCA Sampling Oscilloscopes		●	●	●	●	11
Infiniium 90000 Series Oscilloscopes	●	●	●	●	●	11
Compliance Software				●		12
Logic Analyzers			●			13
Protocol Analyzers/ Exercisers			●			14
J-BERT & ParBERT			●	●	●	15
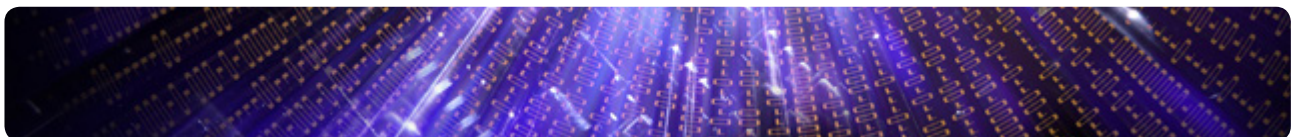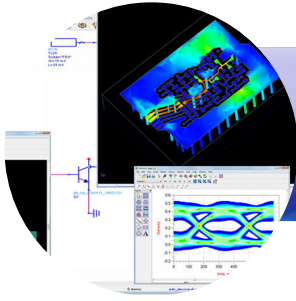
Product Descriptions

Design and Simulation	Analysis	Debug	Compliance	Signal Integrity
●				●

Advanced Design System (ADS)

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

ADS is unique in its integration of accurate channel, 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 compo- nents as well as causal and passive models from S-parameters with patented convolution engine
- Perform EM and circuit co-design with Momentum and FEM para- meterized look-alike components (finite element modeling element is available separately as detailed below)

www.agilent.com/find/eesof-w2211

EMPro + 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

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

www.agilent.com/find/eesof-w1714

Product Descriptions

Design and Simulation	Analysis	Debug	Compliance	Signal Integrity
●	●	●		●
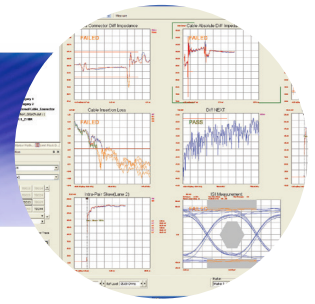
## N1930B Physical Layer Test System (PLTS) 2013 Software

Developing and refining channel models enables you to meet project schedules and performance requirements. When these models don't extend to high enough frequencies to emulate prototype performance, then PLTS can be utilized to measure prototype S-parameters and refine the model to perform at higher frequencies.

As data rates exceed 5 Gb/s, linear passive interconnects become more critical to channel performance. Physical layer 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 with 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

www.agilent.com/find/plts
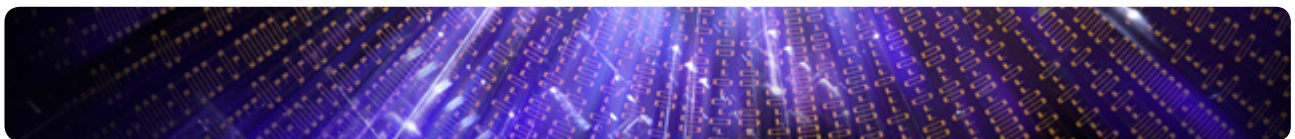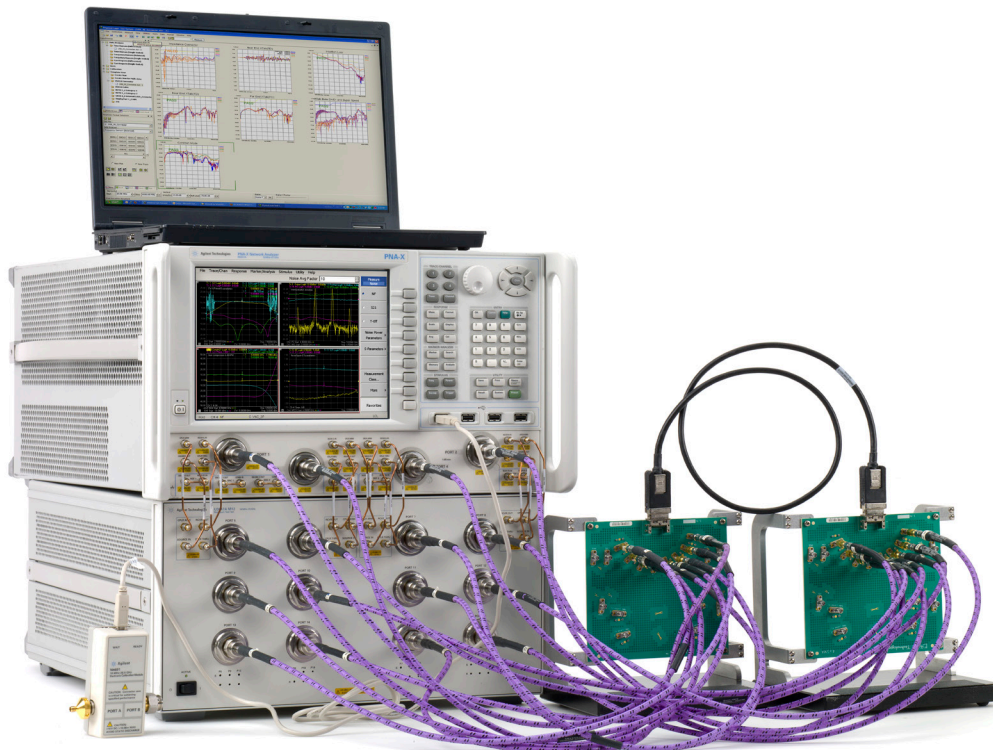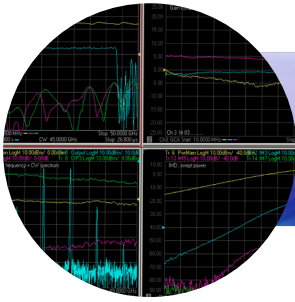
Product Descriptions

| Design and Simulation	Analysis	Debug	Compliance	Signal Integrity
●	●	●		

Gain deeper confidence with Agilent Vector Network Analyzers

Whether you're testing active or passive devices, the right mix of speed and performance gives you an edge. In R&D, our vector network analyzers provide a level of measurement integrity that helps you transform deeper understanding into better designs. On the production line, our VNAs provide the throughput and repeatability you need to transform parts into competitive components. Every Agilent VNA is the ultimate expression of our expertise in linear and nonlinear device characterization. On the bench, in a rack or in the field, we can help you gain deeper confidence.

- **PNA-X Series N524xA 10 MHz to 67 GHz** - Agilent's most advanced and flexible network analyzer, providing complete linear and non-linear component characterization in a single instrument with a single set of connects

- **PNA Series N522xA 10 MHz to 67 GHz** - The industry's highest performing network analyzer and offers many advanced measurement applications for passive and active device test

- **PNA-L Series N523xA 300 kHz to 20 GHz and 10 MHz to 50 GHz** - Designed for S-parameter and simple nonlinear testing of passive components, amplifiers, and frequency converters

www.agilent.com/find/pna
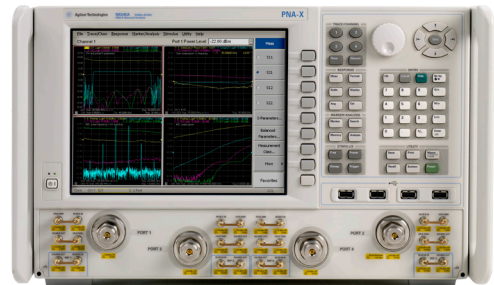
E5071C ENA Option TDR

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 cable and high speed interconnect analysis, enabling time domain, frequency domain, and eye diagram analysis for system integrity and compliance testing.

- TDR oscilloscope look-and-feel allows for simple and intuitive operation with minimum learning curve.

Design and Simulation	Analysis	Debug	Compliance	Signal Integrity
	●	●	●	●
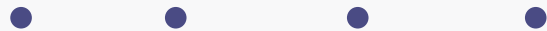
- Proprietary electrostatic discharge (ESD) protection chip integrated inside the instrument allows for significantly increased ESD robustness, freeing you of the continuous fear of instrument failure due to ESD.

- Wide dynamic range results in accurate and repeatable measurements, allowing you to reduce guard bands and increase yield.

www.agilent.com/find/ena-tdr
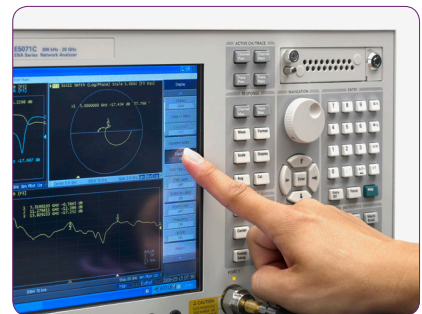
www.agilent.com/find/HSD

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Product Descriptions

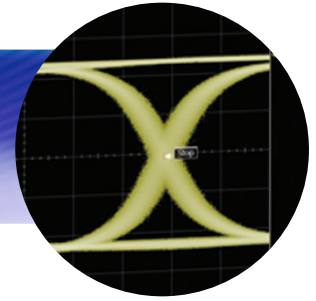## 86100 DCA Sampling Oscilloscopes

The 86100D DCA-X Wide-Bandwidth Oscilloscope performs precision measurements on high-speed digital designs from 50 Mb/s to more than 80 Gb/s. Covering electrical, optical, and TDR/TDT/S-Parameter applications, the DCA-X is a key tool in identifying the root causes of jitter, noise and interference, enabling better designs and compliant end products.

- ASIC / FPGA / IC Design and Characterization
- Transceiver Design and Manufacturing
- Signal Integrity measurements on high-speed digital designs, cables, Printed Circuit Boards (PCB)

www.agilent.com/find/dcax

Infiniium Oscilloscopes

From extreme value to extreme performance — we have the solutions you need

Agilent's Infiniium Series oscilloscopes give you industry-leading features, ease-of-use, instrument integration and investment protection to help you get your designs to market faster. They are equipped with deep memory, comprehensive math and analysis, and a wide variety of optional applications so you can unlock your oscilloscope's full potential.

- **Infiniium 9000 Series oscilloscopes (600 MHz - 4 GHz)** — Engineered for broadest measurement capability

- **Infiniium 9000 H-Series oscilloscopes (250 MHz - 2 GHz)** — See your signals in HD
- **Infiniium 90000A Series oscilloscopes (2.5 - 13 GHz)** — Engineered for unmatched real-time measurement accuracy
- **Infiniium 90000 X-Series oscilloscopes (13 - 33 GHz)** — Engineered for 33 GHz true analog bandwidth that delivers

- **Infiniium 90000 Q-Series oscilloscopes (20 - 63 GHz)** — Achieve your real edge

www.agilent.com/find/scope
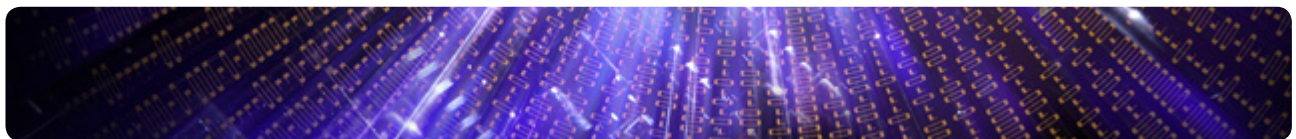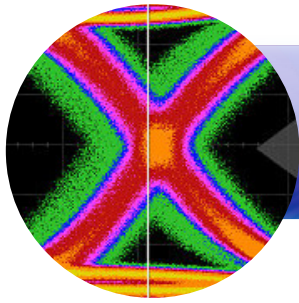
Product Descriptions

Compliance Test Applications

Agilent has a wide offering of measurement applications designed to extend your instruments' capabilities by providing faster insight into complex applications. Our software addresses digital compliance test, wireless and digital connectivity, debug and analysis. Agilent instruments, together with our measurement applications work together to:

Accelerate your speed-to-market with measurement apps that make it easier to test changing technology standards earlier and faster than ever.

Save time by getting it right, right out of the box. With insight built into every Agilent instrument, you can spot problems sooner, troubleshoot them faster, and design your products right the first time.

Trust the Agilent experts. Our insider knowledge and involvement on Digital and RF standards committees ensures early access to the newest testing standards – and those yet to be released.

Maximize the value of your instrument. Only Agilent offers world-class hardware plus innovative measurement algorithms and up-to-date compliance test software in one instrument. No programming required.

Typically for compliance, Agilent provides software for all major technologies including DDR, MIPI, HDMI, DisplayPort, MHL, USB, PCIe, SFP+ and many more.

- Automated setup ensures result repeatability and allows test engineers to run the application without being an expert on the procedures

- Test setup wizard guides users through test selection, configuration, connection, execution and results reporting

- Instrument setup is automatically configured for each test, and measurement connection setups are displayed

- Test results report test configuration, measurements made, pass/fail status, margin analysis and waveforms

www.agilent.com/find/measapps
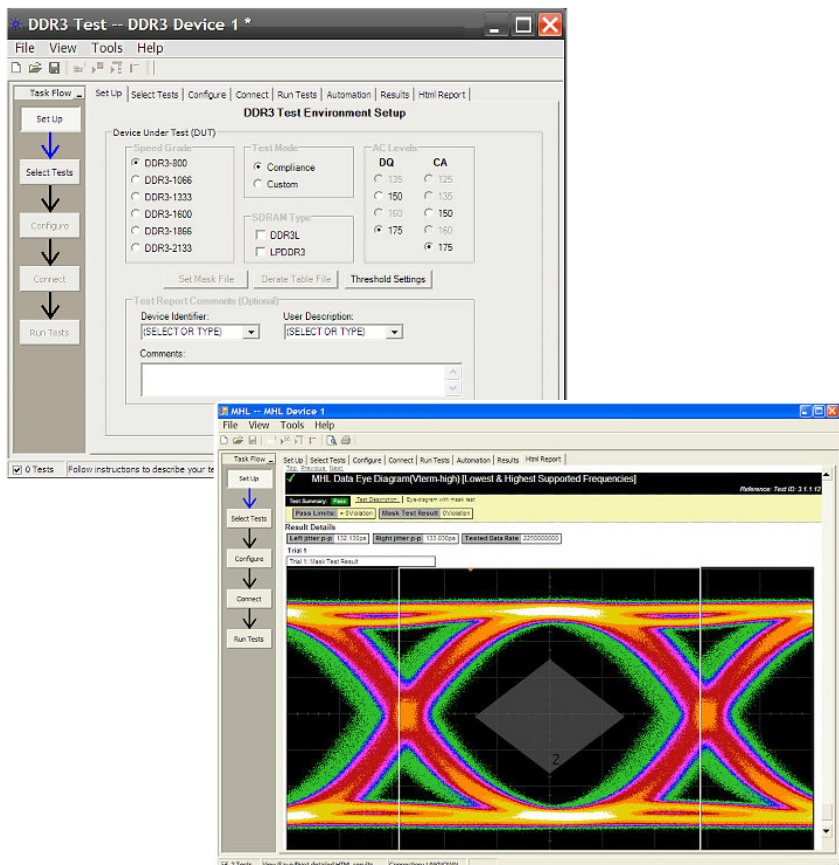
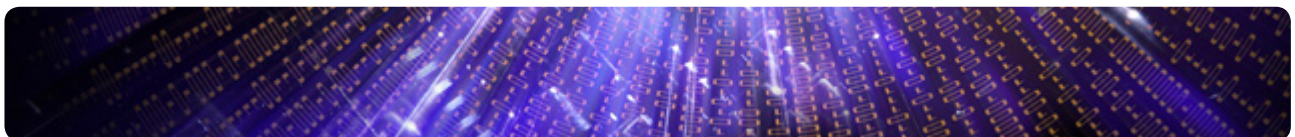# Product Descriptions
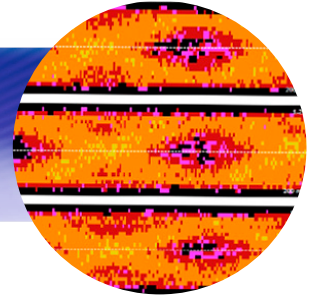
Logic Analyzers

An Agilent logic analyzer helps you minimize project risk by providing the most reliable, accurate measurements and the most complete view of system behavior. This comprehensive family of logic analyzer products offers the measurement capabilities, probing, application support and analysis tools to meet your toughest digital debug needs

- **AXIe-based logic analyzers** provide the highest performance available, with state acquisition rate up to 4 Gb/s, 136 channels per module, and memory depth up to 200M.

- **16900 Series modular logic analyzers** deliver the best long-term value. You get the flexibility to configure a system the way you want. Purchase what you need now then upgrade as your needs evolve.

- **"NEW" 16850 Series portable logic analyzers** deliver the fastest timing capture with deep memory for fast digital system debug. Take advantage of 2.5 GHz timing capture with up to 128 M sample memory, up to 1.4 GHz trigger sequencer for state and timing capture, and both single-ended and differential probing options.

- **16800 Series portable logic analyzers** offer you an exclusive combination of high-performance logic analysis and pattern generation in a fixed logic analyzer configuration at an affordable price. State speed and memory depth are upgradeable at time of purchase or later as your needs evolve.

www.agilent.com/find/logic
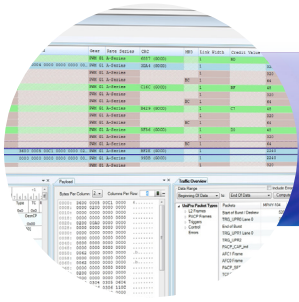
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Product Descriptions

Protocol Analyzer and Exerciser

As your design includes multi gigabit serial interconnect standards, Agilent protocol analyzer and exerciser products are the most effective solution to debug, validate and optimize semiconductors, software and system that use serial protocol standards for computer, storage, display, mobile and embedded systems.

Agilent's protocol test solutions for each technology typically consist of both protocol analyzer application as well as a stimulus solution, such as an exerciser or traffic generator. Agilent's protocol test solutions combine multi-protocol analysis, traffic generation, performance, and conformance verification to debug, validate and optimize your designs using high speed protocol standards.

- U4431A MIPI M-PHY Protocol Analyzer
- U4421A MIPI D-PHY Protocol Analyzer
- U4995A MHL Protocol Test Point Adapter (TPA)
- U4998A HDMI and MHL Protocol Audio/Video Analyzer and Generator Module
- U4301A PCIe Protocol Analyzer
- U4305A PCIe Exerciser and PCIe LTSSM Exerciser

www.agilent.com/find/protocol

Product Descriptions
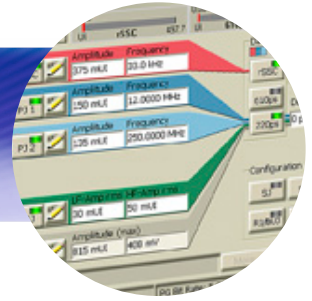
Bit Error Ratio Test (BERT) Solutions

Make the next leap forward with Agilent BERTs

Agilent offers the broadest portfolio with four BERT families - covering affordable manufacturing test and high-performance characterization and compliance testing up to 32 Gb/s.

Agilent's BERTs allow the most accurate and efficient design verification, characterization, compliance and manufacturing test of high-speed communication ports for today's ASICs, components, modules and line-cards in the semiconductor, computer, storage and communication industry.

- Streamlining receiver test setup by providing the highest level of integration. It offers built-in jitter injection, 8-tap de-emphasis, interference sources, reference clock multiplication, clock recovery and equalization.

- Ensuring accurate and repeatable measurements by automating in situ calibration of signal conditions.

- Reducing the effort required to bring devices into loopback test mode because the M8020A behaves like a link partner for the device under test and supports interactive link training for PCIe(r) devices.

- Get immediate test results with automated jitter-tolerance characterization routines.

www.agilent.com/find/bert

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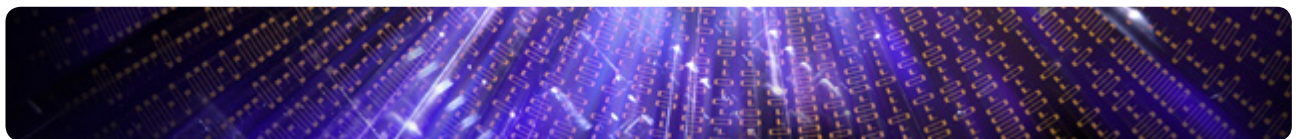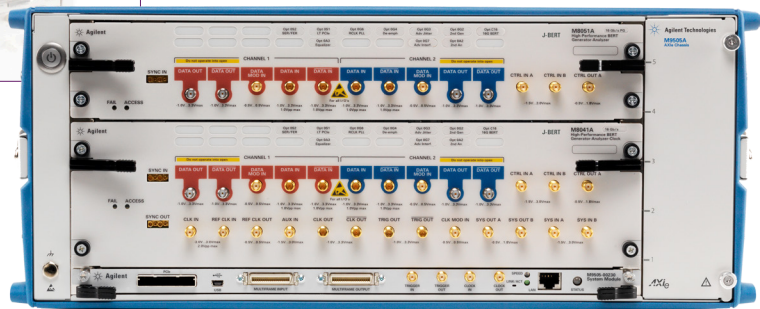
Achieve your best design

In digital standards, every generational change puts new risks in your path. We see it firsthand when creating our products and working with engineers like you. Agilent's solution set for high-speed digital test is a combination of instrumentation and broad expertise built on our ongoing involvement with industry experts. By sharing our latest experiences, we can help anticipate challenges and accelerate your ability to create products you'll be proud of.
Agilent – achieve your best design.

myAgilent

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A personalized view into the information most relevant to you.

Three-Year Warranty

www.agilent.com/find/ThreeYearWarranty
Beyond product specification, changing the ownership experience.
Agilent is the only test and measurement company that offers three-year warranty on all instruments, worldwide.

Agilent Assurance Plans

www.agilent.com/find/AssurancePlans
Five years of protection and no budgetary surprises to ensure your instruments are operating to specifications and you can continually rely on accurate measurements.

www.agilent.com/quality

Agilent Electronic Measurement Group
DEKRA Certified ISO 9001:2008
Quality Management System

Agilent Channel Partners

www.agilent.com/find/channelpartners
Get the best of both worlds: Agilent's measurement expertise and product breadth, combined with channel partner convenience.

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