Overcome Challenges Across the Design Cycle

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.

Keysight’s solution set for high-speed digital test is a combination of hardware, software, and broad expertise built on ongoing involvement with industry experts. Keysight’s tools for simulation, measurement, and compliance 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.

From initial concept to compliance testing, Keysight can help you uncover problems, optimize performance, and deliver your design on time. In the development of high-speed digital designs, Keysight is the only test and measurement company that offers hardware and software solutions across all stages of 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.

Innovate anywhere with PathWave design and test software. Boost your productivity with software that brings you faster insight, automates procedures, and speeds up simulation and measurement.

- Increase your productivity
- Extend your instrument capabilities
- Work remotely

Learn more at www.keysight.com/find/software
Start with a 30-day free trial. www.keysight.com/find/free_trials
Design and Simulation

Count on Keysight to help you through to a complete gigabit design. PathWave Advanced Design System (ADS) software and its capabilities model RF and microwave effects quickly and accurately. Use PathWave ADS and the Physical Layer Test System (PLTS) software to solve modeling problems such as long, lossy interconnects or crosstalk in densely packed interconnects. PLTS software calibrates and controls both vector network analyzer (VNA) and time domain reflectometry (TDR) measurements.

PathWave ADS provides an integrated workflow that unites system, circuit, and physical-level design and simulation. This tight integration eliminates time-consuming and error-prone transfers between single-function tools.

With PathWave 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 interconnects. Multi-domain analysis helps locate physical-layer problems in high-speed channels.
To help pinpoint problems, PathWave ADS provides integrated simulation and data displays. PathWave ADS includes eye-diagram, mask, and bit error rate (BER) contour displays for visualizing channel- or circuit-simulation results.

The PathWave ADS Channel Simulator (for serial buses) and DDR Bus Simulator (for parallel buses) produce ultralow BER contours in seconds by applying state-of-the-art statistical analysis techniques that include a unique treatment of transmitter jitter modeling that correlates closely with measured data. Both simulators support not only built-in generic models but also IC models conforming to the IBIS industry standard.

SIPro Signal Integrity EM Analysis Element provides signal integrity (SI) analysis of high-speed PCBs. This enables you to characterize loss and coupling of signal nets and extract an electromagnetic (EM)-accurate model, which can be used in the PathWave ADS Transient and Channel Simulators.

PiPro Power Integrity EM Analysis Element provides power integrity analysis of your power distribution network (PDN), including DC IR drop analysis, AC impedance analysis, and power plane resonance analysis. The EM technologies in PiPro are tuned for PI applications; they are much faster and more efficient than general-purpose EM tools. PiPro utilizes a common setup and analysis environment within PathWave ADS.

PathWave ADS supports your whole development flow, from early data-link engineering through the pre-layout and post-layout stages.
Analyze and Debug

With our high-speed digital solution set, you can estimate system performance with models of devices and structures before hardware design or fab shop results. Use proxy devices to estimate component behavior and vary device parameters to account for process variation, temperature drift, humidity effects, and more. To 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.

PathWave ADS lets you build a foundation for a 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 Keysight’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. They can 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 greater visibility, you can use simulation to interpolate and extrapolate waveforms in locations measurements can’t reach.

For greater confidence in actual VNA and TDR measurements, the PLTS software includes advanced calibration wizards that help you avoid costly calibration errors. For greater test flexibility, you can 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, choosing 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. You can now create de-embed models while removing fixture effects using a new technique called automatic fixture removal (AFR).
Today’s demanding environment means you have much less time to understand the intricacies of the technologies you are testing. Compliance applications save you time and money with built-in measurement automation.

Keysight’s Infiniium compliance applications are fully functional with design tools such as PathWave ADS. Imagine running your waveforms at design through the entire suite of compliance tests earlier than was previously possible. As the design moves to silicon and then to validation, you can run the same suite of tests live on your device.

Keysight compliance applications are certified to test to the exact specifications of each technology standard. If a test passes in your lab, it will pass in test labs and at plugfests worldwide. Keysight experts on technology boards and industry standards committees help define compliance requirements.
Today’s emerging high-speed digital applications require a special kind of design engineer who understands the subtle signal integrity issues at hand. High-frequency microwave effects cause the most problems within telecommunications and computer systems, channels, and components. High-speed interconnects such as connectors, printed circuit boards (PCBs), cables, integrated circuit (IC) packages, and backplanes are critical elements of differential channels that must be designed using today’s most powerful analysis and characterization tools. Both measurements and simulation must be done on the device under test, and both activities must yield data that correlates with each other.

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 Keysight Infiniium oscilloscopes. Take your measurement science further and increase your design margins by utilizing Keysight’s exclusive PrecisionProbe software.

Whether you handle SI analysis as an independent topic or a deeply interwoven part of digital design, Keysight 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 support the latest design, simulation, and measurement technologies.

We’re continually leveraging our work with SI thought leaders, industry standards committees, and our own design experts to evolve and improve our solutions’ measurement and simulation capabilities.
The table below shows our product solutions. They are each described in more detail with links to the appropriate web pages on www.keysight.com.

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Design and Simulation</th>
<th>Analysis</th>
<th>Debug</th>
<th>Compliance</th>
<th>Signal Integrity</th>
<th>See Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>PathWave Advanced Design System (ADS)</td>
<td>•</td>
<td></td>
<td></td>
<td></td>
<td>•</td>
<td>10</td>
</tr>
<tr>
<td>N1930B PLTS Software</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td></td>
<td>•</td>
<td>11</td>
</tr>
<tr>
<td>PNA-X Network Analyzer</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td></td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>ENA Option TDR</td>
<td></td>
<td>•</td>
<td>•</td>
<td></td>
<td>•</td>
<td>13</td>
</tr>
<tr>
<td>86100D DCA Sampling Oscilloscopes</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td></td>
<td>•</td>
<td>14</td>
</tr>
<tr>
<td>Infiniium 90000 Series Oscilloscopes</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td></td>
<td>•</td>
<td>15</td>
</tr>
<tr>
<td>Compliance Software</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>Logic Analyzers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>Protocol Analyzers/Exercisers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>BERTs / AWG</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td></td>
<td>•</td>
<td>19</td>
</tr>
</tbody>
</table>
PathWave Advanced Design System (ADS) Bundle for High-Speed Digital Design

PathWave ADS is unique in its integration of accurate channel, circuit, and EM simulators. This ensures that you get the right answers faster by avoiding data transfers between point tools. It includes:

- SIPro Signal Integrity EM Analysis
- PIPro Power Integrity EM Analysis
- Interconnect Toolbox Element to optimize your PCB stack up and design transmission line geometry
- Transient Convolution and Channel Simulation Element
- Layout Element

Learn More
Design and Simulation | Analysis | Debug | Compliance | Signal Integrity
---|---|---|---|---
• | • | • | • | •

**N1930B Physical Layer Test System (PLTS) Software**

The triple-play of voice, video, and data drive internet bandwidth requirements to extreme levels only attainable from telecommunication networks designed with the most advanced design tools. Keysight’s PLTS is just such a tool, providing the calibration, measurement, and analysis capabilities needed to characterize digital interconnects precisely and accurately.

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.keysight.com/find/plts](http://www.keysight.com/find/plts)
Gain deeper confidence with Keysight Vector Network Analyzers

Whether you’re testing active or passive devices, the right mix of speed and performance gives you an edge. Our vector network analyzers provide a level of measurement integrity in R&D that helps you transform in-depth understanding into better designs. On the production line, our VNAs provide the throughput and repeatability you need to transform parts into competitive components. Every Keysight 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 N524xB 10 MHz to 67 GHz** - Keysight’s most advanced and flexible network analyzer, providing complete linear and nonlinear component characterization in a single instrument with a single set of connects
- **PNA Series N522xB 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 N523xB 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.keysight.com/find/pna
E5071C ENA Option TDR

Signal integrity of interconnects drastically affects system performance at Gb/s data rates. Fast and accurate interconnect performance analysis in both time and frequency domains is critical to ensure reliable system performance. The ENA Option TDR provides a 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 a minimal 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.keysight.com/find/ena-tdr
DCA Oscilloscope

The N1000A DCA-X Wide-Bandwidth Oscilloscope performs precision measurements on high-speed digital designs from 50 Mb/s to more than 112 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) using time domain reflectometry (TDR)

www.keysight.com/find/dcax
Infiniium Oscilloscopes

Physical-Layer Characterization, Validation, and Compliance Testing

Today’s laboratory requires best-in-class measurement and stimulus tools that can help validate test needs now and in the future.

From physical-layer characterization to validation and compliance testing solutions, Keysight’s high-performance digital test tools enable you to design, verify, and characterize each step of your design workflow.

- Infiniium MXR-Series real-time oscilloscopes (500 MHz to 6 GHz) provide the world’s first real-time spectrum analyzer in an oscilloscope
- Infiniium UXR-Series oscilloscopes 5 to 100 GHz provide the most comprehensive set of probing, analysis applications, and measurements for advanced technologies

www.keysight.com/find/scope

---

<table>
<thead>
<tr>
<th>Design and Simulation</th>
<th>Analysis</th>
<th>Debug</th>
<th>Compliance</th>
<th>Signal Integrity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Compliance Test Applications

Keysight offers many measurement applications that extend your instruments’ capabilities by providing faster insight into complex applications. Our software addresses digital compliance test, wireless and digital connectivity, debug, and analysis. Keysight 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 Keysight instrument, you can spot problems sooner, troubleshoot them faster, and design your products right the first time.
Trust the Keysight experts. Our insider knowledge and involvement on digital and RF standards committees ensure early access to the newest testing standards – and those yet to be released.

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

For compliance, Keysight 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.
- Automatic instrument setup for each test and displays of measurement connection setups.
- Test results report test configuration, measurements made, pass/fail status, margin analysis, and waveforms.

www.keysight.com/find/measapps
Free Trials of Compliance Test Software
Logic Analyzers

A Keysight 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.

- 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 the time of purchase or later as your needs evolve.

www.keysight.com/find/logic
Protocol Analyzer and Exerciser

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

Keysight’s protocol test solutions for each technology typically consist of both protocol analyzer application and a stimulus solution, such as an exerciser or traffic generator. Keysight’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.

Protocol analyzer and exerciser solutions are available to meet your design challenges, including PCIe, MIPI, MHL, and USB.

www.keysight.com/find/protocol
Bit Error Ratio Test (BERT) Solutions

Make the next leap forward with Keysight BERTs

Keysight offers the broadest portfolio with four BERT families - covering affordable manufacturing test and high-performance characterization and compliance testing up to 58 Gb/s.

Keysight’s BERTs allow 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 devices.
- Get immediate test results with automated jitter-tolerance characterization routines.

www.keysight.com/find/bert
Arbitrary Waveform Generators (AWG)

From low-observable systems to high-density comms, testing is more realistic with precision arbitrary waveform generation.

Keysight AWGs are the source of greater fidelity, delivering high resolution and wide bandwidth simultaneously. This unique combination lets you create signal scenarios that push your design to the limit and bring new insight to your analysis.

These AWGs are modular instruments packaged in the AXIe form factor.

**M8190A 12 GSa/s Arbitrary Waveform Generator**

M8190A ensures accuracy and repeatability with 14-bit resolution, up to 8 GSa/s sampling rate, and up to 90 dBc SFDR. High dynamic range and excellent vertical resolution give you confidence that you are testing your device, not the signal source.

**M8195A 65 GSa/s Arbitrary Waveform Generator**

High-speed AWG with up to 65 GSa/s sample rate and 25 GHz bandwidth on up to four channels per module. The Keysight M8195A arbitrary waveform generator offers an output amplitude of up to 2 Vpp (diff.) and adjustable DC offset. Multi-channel operation with up to 16 channels per 5-slot AXIe chassis is supported. An outstanding feature of the M8195A is the build-in signal processing capabilities. Go where you have never been able to test before in speed, bandwidth, and channel density - explore your possibilities.

[www.keysight.com/find/M8195A](http://www.keysight.com/find/M8195A)