Data Center High-Speed Computing Products Catalog
<table>
<thead>
<tr>
<th>Page</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>03</td>
<td>Flexible Solutions for Evolving Industry Standards</td>
</tr>
<tr>
<td>04</td>
<td>Design and Simulation Software</td>
</tr>
<tr>
<td>06</td>
<td>Infiniium UXR-Series Oscilloscopes</td>
</tr>
<tr>
<td>08</td>
<td>Bit Error Ratio Testers</td>
</tr>
<tr>
<td>10</td>
<td>PCI Express Test</td>
</tr>
<tr>
<td>14</td>
<td>DDR Test</td>
</tr>
<tr>
<td>18</td>
<td>USB Test</td>
</tr>
</tbody>
</table>
Emerging technologies such as 5G, artificial intelligence, virtual reality, the Internet of Things, and autonomous vehicles generate an enormous amount of data in the network, creating new computing and performance demands in the data center.

Each new generation of high-speed computing standards introduces new features and faster data transfer rates, creating fresh test challenges for digital designers. Because standards evolve quickly, Keysight’s data center solutions test specific industry standards, reducing time and ensuring compliance and interoperability of devices.

This catalog covers the following standards:

- Peripheral Component Interconnect Express (PCI Express® or PCIe®)
- Double Data Rate (DDR) memory
- Universal Serial Bus (USB)
Design and Simulation Software

High-speed digital designs become significantly more complex as data rates increase. Channel topologies become more diverse, and you need to tune more parameters for active components. Use simulation to optimize the signal and power integrity of your designs and analyze the electromagnetic (EM) effects of components such as high-speed integrated circuit packages and printed circuit board (PCB) interconnects.

REDUCE DESIGN AND SIMULATION TIME

Design and simulation software enables you to optimize transmitter (Tx), receiver (Rx), and channel designs for the best performance and reliability at the desired speed grade. You can design to resolve signal integrity issues, ensure power efficiency, and stay within tight error margins before the first prototype.
PathWave ADS bundle for high-speed digital design
Software for high-speed digital designers

Signal Integrity EM Analysis Element (SiPro)
Signal integrity analysis software for high-speed PCBs

Power Integrity EM Analysis Element (PiPro)
Accurate and efficient net-driven power integrity analysis

Memory Designer
Software to analyze memory designs faster and link to compliance applications

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W2359EP PiPro Power Integrity EM Analysis Element
Infiniium UXR-Series Oscilloscopes

The Keysight Infiniium UXR-Series oscilloscopes offer ultra-high-performance acquisition with 10 bits of high-definition resolution. Designed for upgradability, the UXR will support current and future design and test needs. The UXR plus compliance test software provides a compliance test solution for PCIe, DDR, and USB:

- up to 110 GHz bandwidth
- 10-bit hardware analog-to-digital converter (ADC)
- maximum bandwidth on all channels
- industry’s lowest noise and best interchannel jitter performance
- up to 256 GSa/s sample rate
- two or four phase-coherent channels per frame
- up to 40 synchronized channels via MultiScope support
- ENOB (effective number of bits) from 6.8 to 5.0 (13 GHz to 110 GHz)

Learn more about the Infiniium UXR-Series

UXR0134A Infiniium UXR-Series 13 GHz
4 channel oscilloscope
## INFINIUM UXR-SERIES OSCILLOSCOPES

<table>
<thead>
<tr>
<th>Specifications (at max bandwidth)</th>
<th>3.5 mm models</th>
<th>1.85 mm models</th>
<th>1 mm models</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bandwidth</strong></td>
<td>13 - 33 GHz</td>
<td>40 - 70 GHz</td>
<td>5 - 110 GHz</td>
</tr>
<tr>
<td><strong>Maximum sample rate</strong></td>
<td>128 GSa/s</td>
<td>256 GSa/s</td>
<td>256 GSa/s</td>
</tr>
<tr>
<td><strong>Noise at highest sensitivity and bandwidth</strong></td>
<td>&lt; 0.3 mV (rms)</td>
<td>&lt; 0.5 mV (rms)</td>
<td>&lt; 0.9 mV (rms)</td>
</tr>
<tr>
<td><strong>ENOB at &gt;=400 mV&lt;sub&gt;r&lt;/sub&gt; (millivolts full scale) average value from DC to full licensed bandwidth of model</strong></td>
<td>from 6.8 to 5.9</td>
<td>from 5.8 to 5.4</td>
<td>from 5.5 to 5.0</td>
</tr>
<tr>
<td><strong>Maximum multiframe channels</strong></td>
<td>40 maximum (10 oscilloscopes)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Maximum detectable symbol rate (at full licensed bandwidth of model)</strong></td>
<td>26 Gbaud to 66 Gbaud</td>
<td>80 Gbaud to 140 Gbaud</td>
<td>50 Gbaud / 220 Gbaud</td>
</tr>
<tr>
<td><strong>Vertical sensitivity (HW)</strong></td>
<td>40 mV to 8 V full scale 1 mV/div to 1 V/div</td>
<td>60 mV to 4 V full scale 1 mV/div to 500 mV/div</td>
<td>60 mV to 4 V full scale 1 mV/div to 500 mV/div</td>
</tr>
<tr>
<td><strong>Vertical sensitivity (with zoom)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hardware acquisition / acceleration system</strong></td>
<td>10-bit ADC</td>
<td>1,000,000 wfms/sec</td>
<td>2.16 GHz digital downconversion (DDC analysis bandwidth)</td>
</tr>
<tr>
<td></td>
<td>5 to 10 GHz mmWave frequency extensions</td>
<td>equalization and clock recovery</td>
<td>real-time eye plotting and averaging</td>
</tr>
<tr>
<td><strong>Upgradability</strong></td>
<td>bandwidth (from 13 to 16, 20, 25, 33, 40, 50, 59, 70, 80, 100 to 110 GHz)</td>
<td>memory from 200 Mpts/CH to 1 Gpts or 2 Gpts</td>
<td>2 to 4 channels</td>
</tr>
</tbody>
</table>
Bit Error Ratio Testers (BERTs)

Whether you are working on data center or computing interface technologies, Keysight BERTs support manufacturing test to high-performance characterization and compliance test:

- supports symbol rates up to 64 Gbaud with both non-return-to-zero (NRZ) and pulse amplitude modulation (PAM4) coding schemes
- supports digital interfaces such as PCI Express, USB, MIPI®, Thunderbolt, DisplayPort, SATA / SAS, electrical and optical Ethernet 10G / 100G / 400G, OIF-CEI, Fibre Channel, and PON

Learn more about the M8000 Series Bit Error Ratio Testers
<table>
<thead>
<tr>
<th>M8020A J-BERT high-performance BERT</th>
<th>M8040A high-performance BERT</th>
<th>M8070B software</th>
</tr>
</thead>
<tbody>
<tr>
<td>data rate: 32 Gbit/s NRZ</td>
<td>data rate: 64 Gbaud NRZ, PAM3, and PAM4</td>
<td>The M8070B system software controls all modules for the M8040A and M8020A</td>
</tr>
<tr>
<td>channels: 1, 2, 4</td>
<td>channels: 1, 2</td>
<td></td>
</tr>
</tbody>
</table>
PCI Express Test

PCIe is a core technology used in many types of computer servers and endpoint devices. The PCI Special Interest Group (PCI-SIG®) defines specifications and compliance tests that guarantee the interoperability of PCIe systems. Each generation of the PCIe standard doubled the data transfer rate and increased the complexity of test. PCI-SIG must approve test solutions to ensure that tested products comply with the standard.

PCI EXPRESS TRANSMITTER TEST

Test the performance of a PCIe transmitter device to ensure that it meets the specifications defined by the PCIe standard.

As PCIe moves from Gen3 to Gen4 and Gen5, PCIe receivers use strong equalization. Although the equalizer can compensate for intersymbol interference (ISI), uncorrelated transmitter jitter remains a challenge as companies work to bring PCIe devices to market.

To ensure the performance of PCIe transmitter designs, Keysight solutions include a real-time oscilloscope (Infiniium UXR) plus electrical performance validation and compliance software.

<table>
<thead>
<tr>
<th>D9050PCIC PCIe 5.0 transmitter electrical performance validation and compliance software</th>
<th>D9040PCIC PCIe electrical performance validation and compliance software</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test, debug, and characterize PCIe Gen5 designs. The software automatically configures the oscilloscope for each test and generates an HTML report upon test completion.</td>
<td>Verify and debug PCIe 4.0, 3.0, 2.0, and 1.1 / 1.0a designs for silicon validation and for PCIe 3.0, 2.0, and 1.1 / 1.0a add-in cards and motherboard systems.</td>
</tr>
</tbody>
</table>
| • PCI Express Tx analysis of PCIe 5.0 signals at speeds up to 32 GT/s  
• uncorrelated jitter, preset testing, uncorrelated PWJ, and more  
• configurable pass / fail margin reporting  
• HTML summary report | • workshop compliance mode for rapid PCISIG compliance testing  
• support for de-embedding of test fixtures, high-speed switches, and cables  
• automate testing of multilane devices under test (DUTs)  
• test setup wizard  
• pass / fail margin analysis |

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Extracting digital content from the PCIe signal is significantly more challenging as PCIe speeds exceed 8 GT/s. At these high data transfer rates, PCIe receivers often get a heavily degraded signal because of the channel’s high-frequency-loss characteristics, resulting in unacceptable bit error ratios. To overcome this, you must design and validate a robust receiver that can tolerate these distorted signals, using equalization techniques that restore the quality of the transmitted signal:

- The Keysight M8020A J-BERT and N5991 receiver compliance test automation platform for computer applications cover PCIe transfer rates of 2.5 and 16 GT/s.

- The Keysight M8040A high-performance BERT-based solution for data center applications covers PCIe transfer rates of 32 GT/s, as well as 16 GT/s and 8 GT/s.
N5991 receiver compliance test automation platform

- guided setup with automated, fast, stress signal calibration, and compliance measurement functions
- characterization mode for in-depth testing
- single-lane and multilane device testing
- one-button compliance capability
- HTML and Microsoft Excel reports for easy post-processing
- link training suites for debugging DUTs
PCI EXPRESS INTERCONNECT TEST

The channel is a key element of PCIe systems. Crosstalk, jitter, and intersymbol interference (ISI) can all cause channel distortion, degrading transmitter-to-receiver signal quality.

Keysight solutions measure loss characteristics across the channel to ensure that they are within the PCIe specification limits.

<table>
<thead>
<tr>
<th>E5080B ENA vector network analyzer (VNA)</th>
<th>N1930B physical-layer test system (PLTS) 2020 software</th>
<th>M9375A PXIe vector network analyzer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completely characterize passive components, amplifiers, mixers, and frequency converters with a single instrument with integrated measurement capabilities</td>
<td>Industry-standard solution for signal integrity measurements and data post-processing of high-speed interconnects such as cables, backplanes, PCBs, and connectors</td>
<td>pay for only the frequency range you need, with a choice of six frequency ranges up to 26.5 GHz</td>
</tr>
<tr>
<td>9 kHz to 4.5 / 6.5 / 9 / 14 / 20 GHz, 100 kHz to 26.5 / 32 / 44 / 53 GHz</td>
<td>64-bit PLTS code for huge S-parameter files</td>
<td>improve accuracy, yield, and margins with the best PXI VNA speed, dynamic range, trace noise, and stability</td>
</tr>
<tr>
<td>most flexible, integrated ENA network analyzer</td>
<td>PAM4 eye diagram decision feedback equalization</td>
<td>add functionality to your test system with a scalable VNA that can accommodate up to 32 channels in a single chassis</td>
</tr>
<tr>
<td>wide range of measurement applications</td>
<td>automatic tap optimization for multichannel simulation</td>
<td>cascade multiple models for multiport applications</td>
</tr>
<tr>
<td>second source available on 4-port models</td>
<td>mode-conversion analysis for early insight into EMI problems</td>
<td></td>
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<tr>
<td></td>
<td>advanced error-correction techniques</td>
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</tr>
</tbody>
</table>

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Each new generation of the DDR synchronous dynamic random access memory (SDRAM) standard delivers increased speeds, reduced footprint, and improved power efficiency. However, these improvements introduce design and test challenges for chip designers and device manufacturers. Test the performance of DDR devices to ensure that they meet the specifications defined by the Joint Electronic Devices Engineering Council (JEDEC).

**DDR TRANSMITTER TEST**

Keysight’s DDR Tx test solutions include a real-time oscilloscope, such as the Infiniium UXR, and electrical performance validation and compliance software for the version of DDR that you need to test to precise industry specifications.

**DDR TRANSMITTER COMPLIANCE TEST SOFTWARE**

Keysight’s DDR Tx compliance software tests, debugs, and characterizes your DDR and Low-Power DDR (LPDDR) designs quickly and easily. It automatically configures the oscilloscope for each test and generates an HTML report at the end of the test. The application compares the results with the specification test limit and includes margin analysis, indicating how closely the device passes or fails each test.

Key features include the following:

- validation and characterization of clock jitter, electrical, and timing measurements according to JEDEC specifications
- automated JEDEC test measurement
- comprehensive debug mode
- statistical analysis on read and write data for margin testing
- data analytics capabilities — data import into data repository server and aggregate test results viewing
D9050DDRC DDR5 Tx compliance test software

D9040DDRC DDR4 and LPDDR4 compliance test software

D9030DDRC DDR3 and LPDDR3 compliance test software

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DDR RECEIVER TEST

DDR 5.0 introduces receiver compliance tests that previous generations of the standard did not require. Keysight's DDR5 receiver test solution includes the M8020A J-BERT high-performance BERT and M80885RCA compliance software, which allows you to use the M8020A J-BERT to perform automated testing and margin analysis on DDR5 receiver designs:

- automatically configure the J-BERT for each test and get an informative test result
- margin analysis indicates how close your device passes or fails each test parameter
- automate the measurement as defined in the test specification

Assist and simplify stress signal calibration for testing the inputs of DDR5 SDRAM devices, including DIMM, DRAM, RCD, and buffer devices at the physical layer. This ensures minimum required performance and interoperability.

- remote control of the test instruments
- automatic programming of your DUT into test mode for each test
- automated calibration following the procedure recommended in the specification
- automatic and unattended conformance testing and characterization measurements
- quick and easy measurement results to assess the performance of your DUT without expertise in BERT and DDR5 standard
- support for data analytics using Keysight's PathWave Measurement Analytics
When DDR memory systems do not behave as expected, functional debug, analysis, and protocol compliance validation solutions provide trace capture and analysis capabilities.

**DDR PROTOCOL VALIDATION SOLUTION**

To enhance insight from Keysight's U4164A trace captures, the B4661A memory analysis software offers tools to accelerate setup and configurations for DDR2 / 3 / 4 / 5 and LPDDR1 / 2 / 3 / 4 / 5 measurements. It includes a variety of licensing options for DDR2 / 3 / 4 / 5, LPDDR1 / 2 / 3 / 4 / 5 and ONFI (Open NAND Flash Interface) memory analysis and compliance validation.

**U4164A Logic Analyzer Module**

Combine reliable data capture with analysis and validation tools to validate and debug high-speed digital designs operating at speeds up to 4 Gb/s

- state speed mode options up to 4 Gb/s
- quad sample state mode provides four samples at two thresholds from a single probe point
- clock hysteresis settings for state mode
- full memory depth timing modes up to 10 GHz
- up to 400 Mb memory depth options (400 Mb full channel timing, 800 Mb half-channel timing, 1.6 Gb quarter-channel timing)
- deskew interface for timing modes

GET A QUOTE
The USB Type-C connection includes four sets of transmit and receive pairs, which enables one, two, or all four channels to transfer data simultaneously at any time. Enhanced power delivery provides up to 100 watts (W) for bidirectional device charging. These combined Type-C features and enhancements significantly increase the complexity of USB Tx / Rx conformance testing. Automated compliance test software can help you quickly and accurately validate your USB interfaces. Keysight’s USB transmitter and receiver test solutions can help you seamlessly integrate USB Type-C into your devices:

- USB transmitter test solutions include a real-time oscilloscope, such as the Infiniium UXR-Series, and compliance test software appropriate for the version of USB that you need to test to precise industry specifications
- USB receiver test solutions include either the M8020A J-BERT high-performance BERT or the M8040A high-performance BERT, plus compliance test software

<table>
<thead>
<tr>
<th>Transmitter compliance test software</th>
<th>Receiver compliance test software</th>
</tr>
</thead>
<tbody>
<tr>
<td>D9040USBC USB4 Tx compliance test software</td>
<td>N5991U40A USB4 receiver compliance test software</td>
</tr>
<tr>
<td>D9020USBC USB 3.2 Tx compliance test software</td>
<td>N5991U32A USB 3.2 receiver compliance test software</td>
</tr>
<tr>
<td>U7243C USB 3.1 transmitter compliance software</td>
<td></td>
</tr>
</tbody>
</table>

**Related products**

- N7019A USB4 Type-C active link test fixture
- D9010USBP USB4, USB 3.x, USB 2.0 and eUSB2 protocol decode / trigger software