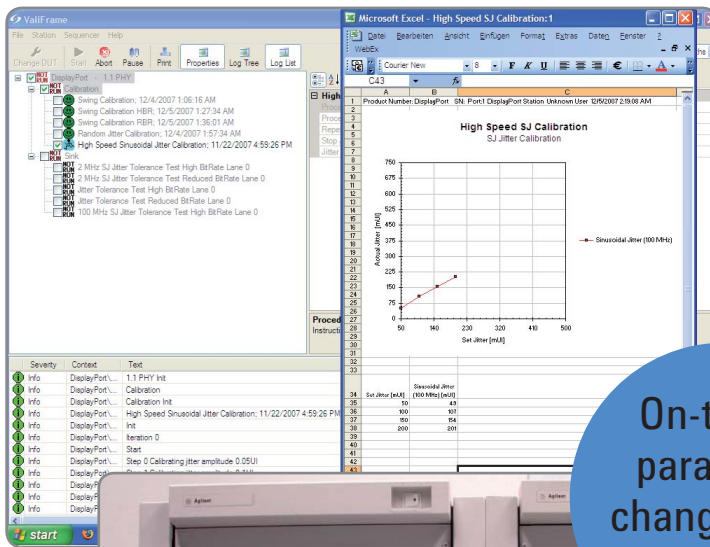# Agilent Technologies
N5990A Test Automation
Software Platform

Generic Stimulus/Response Test Software
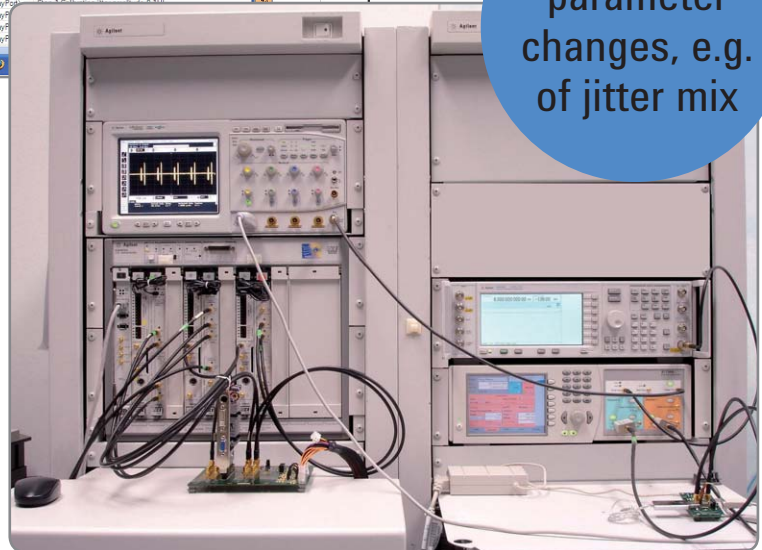Ideal for Established and Emerging High-Speed Buses

Data Sheet, Version 2.3

Overview

- Genuine bus test solution

- Supports MIPI D-PHY, HDMI, DisplayPort, PCI Express®, SATA and USB 2.0, other standards are under development

- Single and multi-lane device testing

- Complements and enhances Infiniium oscilloscope bus test software applications

- Fast system calibration

- One button compliance tests

- Characterization mode for in-depth testing

- Supports real-time parameter changes of amplitude levels etc.

- Results in Microsoft® Excel format for easy post-processing

- Optional interfaces to web and database servers

- Optional user programming for legacy code integration (e.g. LabView, VEE, C++)

- Complementary services

N5990A takes test automation to the next level of performance and convenience

On-the-fly parameter changes, e.g. of jitter mix

Agilent Technologies
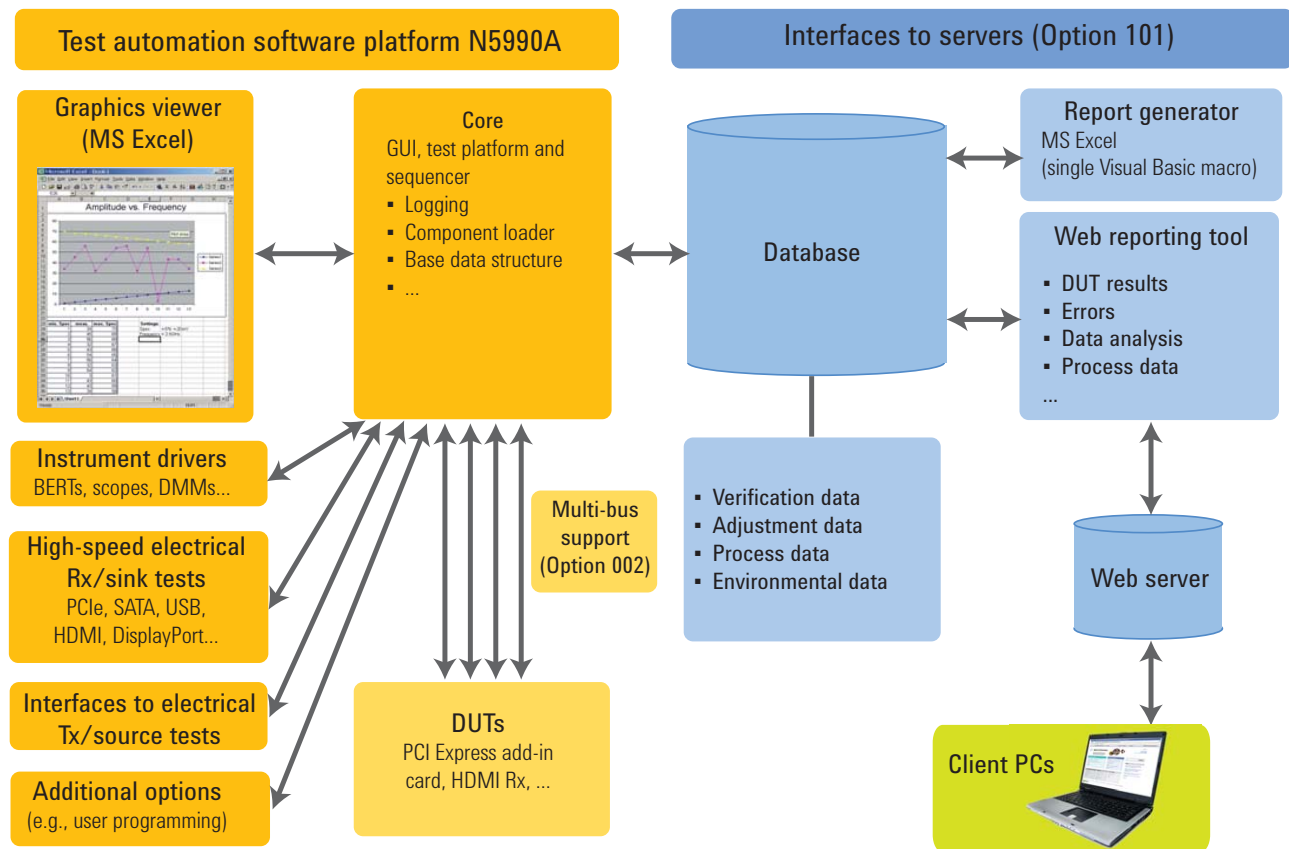
Features and Benefits

Figure 1. Software platform block diagram

Turn your system into a solution

An efficient test strategy is a proven competitive advantage. Agilent Technologies N5990A test automation software platform is a key element of winning strategies.

By combining the performance of your instruments with the convenience of your PC, the N5990A provides unprecedented test integration, high throughput and ease-of-use for a wide range of stimulus and response systems. It is this level of control that turns a collection of instruments into a generic test solution.

Fast and reliable testing

The comprehensive N5990A software platform increases testing speed, reduces test costs and ensures greater thoroughness than manual electrical testing. Using PCI Express as an example, it is suitable for testing devices such as transmitters, receivers and bridges, network adapters, DSP, TV and data acquisition cards, whether you are evaluating production ready prototypes or development boards or chipsets.

Proven reference solution

The N5990A has proven its compliance testing abilities at many interoperability workshops ("plug fests") since its introduction in January

2006. As a result, N5990A is recommended e.g. in the HMDI CTS 1.3b and the SATA RSG MOI 1.2. N5990A already delivers what competitive products are just starting to explore.

Receiver tests

The N5990A's receiver test options provide dedicated receiver and sink compliance tests for popular and emerging digital buses. The libraries ideally complement Agilent's portfolio of transmitter and source test software applications for computer buses such as PCI Express (N5393A) or video buses like HDMI (N5399A). Apart from the fast reassurance of the compliance mode, the characterization mode offers in-depth analysis.

Features and Benefits

Integrated, generic solution

The N5990A supports a broad portfolio of Agilent instruments, such as serial bit error ratio testers (BERTs), the multi-channel ParBERT platform, and Infiniium oscilloscopes (see Figure 2). It also makes controlling jitter sources, like function, arbitrary waveform, or high-quality signal generators, efficient and convenient.

You can select the hardware performance you need to test your specific DUT, single or multi-lane. The N5990A's software layers complement the instrument software seamlessly to provide a common, generic test environment.

Standardize your tests

The automation platform makes it simple to test multiple buses. User selectable tests, such as the crucial jitter tolerance tests, are consistent for buses as different as HDMI, SATA or PCI Express. This translates to significant productivity gains. More time is gained by the common Excel format for reporting results (see Figure 3), and common data structures for advanced data management using data bases.

Maximum throughput

The N5990A's software architecture is based on C# code in the Microsoft .NET framework. This ensures fast interaction, calibration and test execution for greater throughput than competitive platforms.

As an example, for HDMI 1.3 the long calibration and test execution times of the old 1.2a solutions were reduced by an order of magnitude.
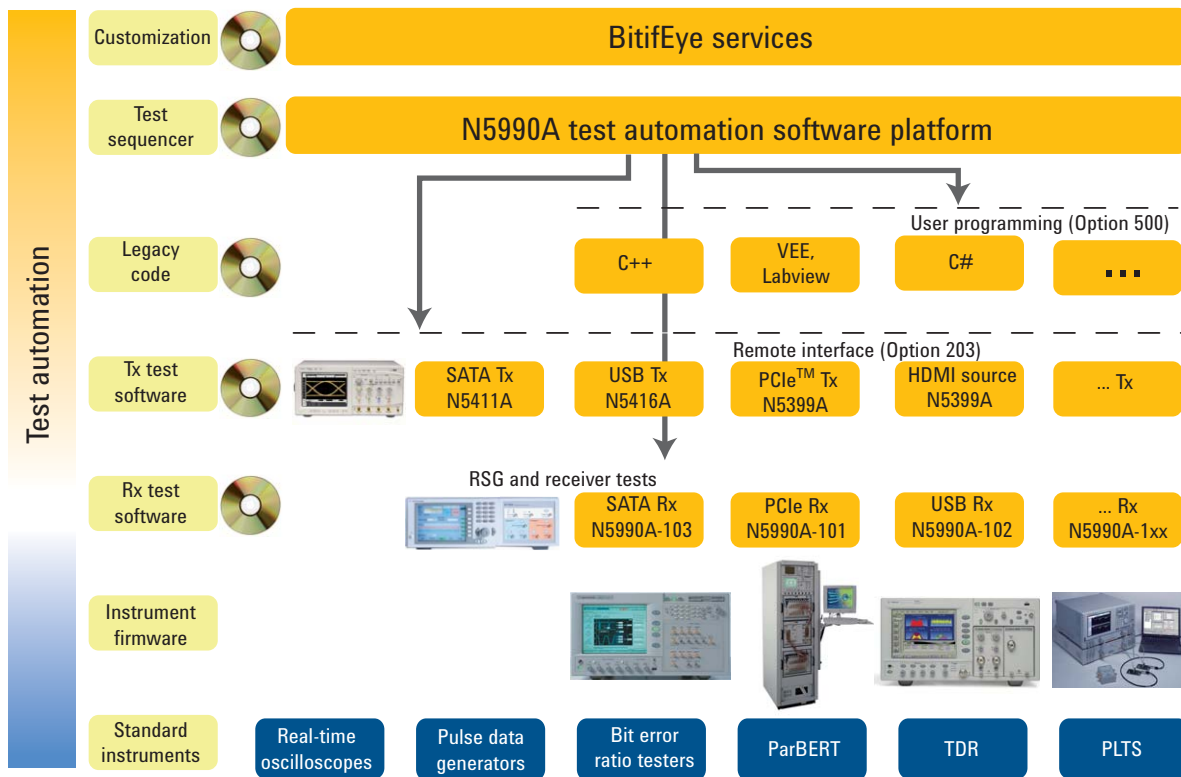
Figure 2. Test platform elements for digital stimulus/response test, example SATA

Features and Benefits

User programming

The test platform is flexible and open. This means you can integrate your own C# code or program your own test sequences with the user programming option.

You can also easily integrate software dynamic link libraries (dlls) implemented in graphical environments such as LabView or VEE (contact Agilent).

Strong partnership for flexibility and support

Based on an Agilent manufacturing test program, the test software and services provider BitifEye digital test solutions developed the N5990A software platform. Agilent guarantees worldwide service and support. To meet specific needs, BitifEye offers customization services (see **www. bitifeye.com**).

Test selection

The test automation software plat-form lets you select tests from an intuitive tree-structure with multiple levels of detail. A key element of the platform is the test sequencer. This lets you define which tests are to run, for example, and the number of repetitions (loops).

Test results

The test automation software platform provides test results in Microsoft Excel format. When you measure parameter curves, it delivers both the curves (see Figure 4) and a data table.

The N5990A displays and updates all the results on-line. After stopping or pausing the sequencer, you can access any result for analysis at your convenience.

Compliance and characterization modes

In compliance mode, you run individual tests as specified by the applicable standards. In characterization mode, experienced users have access to test properties such as frequency range, frequency step width and limits (see Figure 5). This makes it easy to perform margin tests.
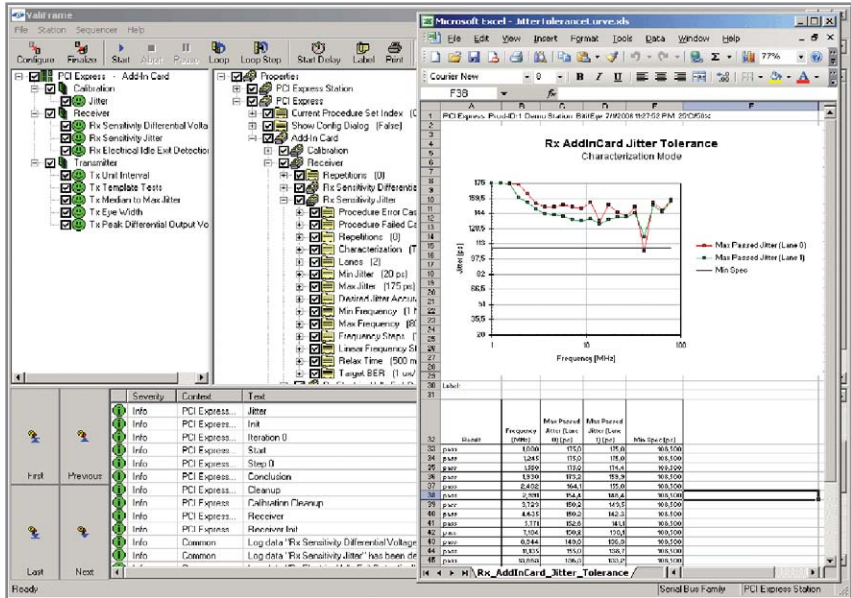

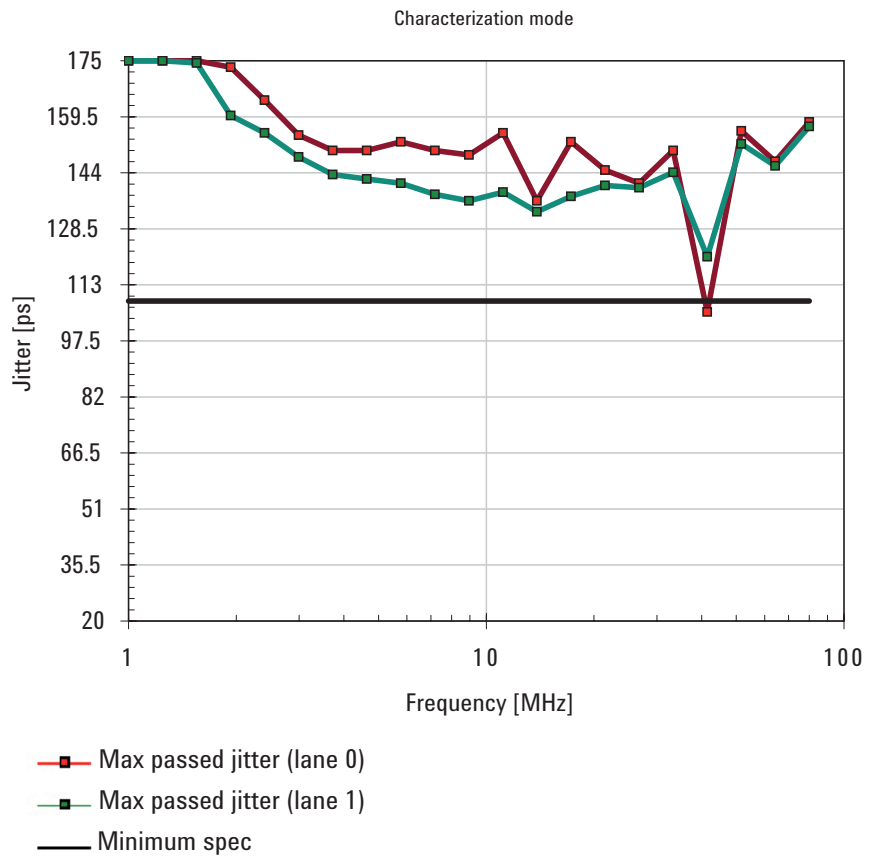*Figure 3. User interface and results display*

Figure 4. Multi-lane jitter tolerance test results

4

Computer Bus Applications - PCI Express

Compliance test and characterization

Options 101 and 201 simplify PCI Express receiver and transmitter characterization as well as compliance testing.

The PCI Express receiver tests (N5990A Option 101) fully support Agilent Technologies' ParBERT 81250 parallel bit error ratio tester, as well as Agilents' J-BERT N4903A high-performance serial BERT. This ensures you can test single lane and multi-lane receivers efficiently. For ParBERT configurations exceeding four lanes, the high-lane count Option 003 is required.

Receiver jitter tolerance tests complement transmitter tests

Option 101 provides the important jitter tolerance test. In the configuration shown below (see Figure 6), a function generator inserts sinusoidal jitter. This PCI Express receiver test complements the transmitter compliance tests conducted on Infiniium ocscilloscopes (N5393A). The oscilloscope is needed for the transmitter tests.

The N5393A is exclusively integrated into the N5990A and enhanced with option 201. This lets you select test parameters conveniently on the PC controller. You can use the PC to display and analyse oscilloscope data too, so that productivity is further increased.
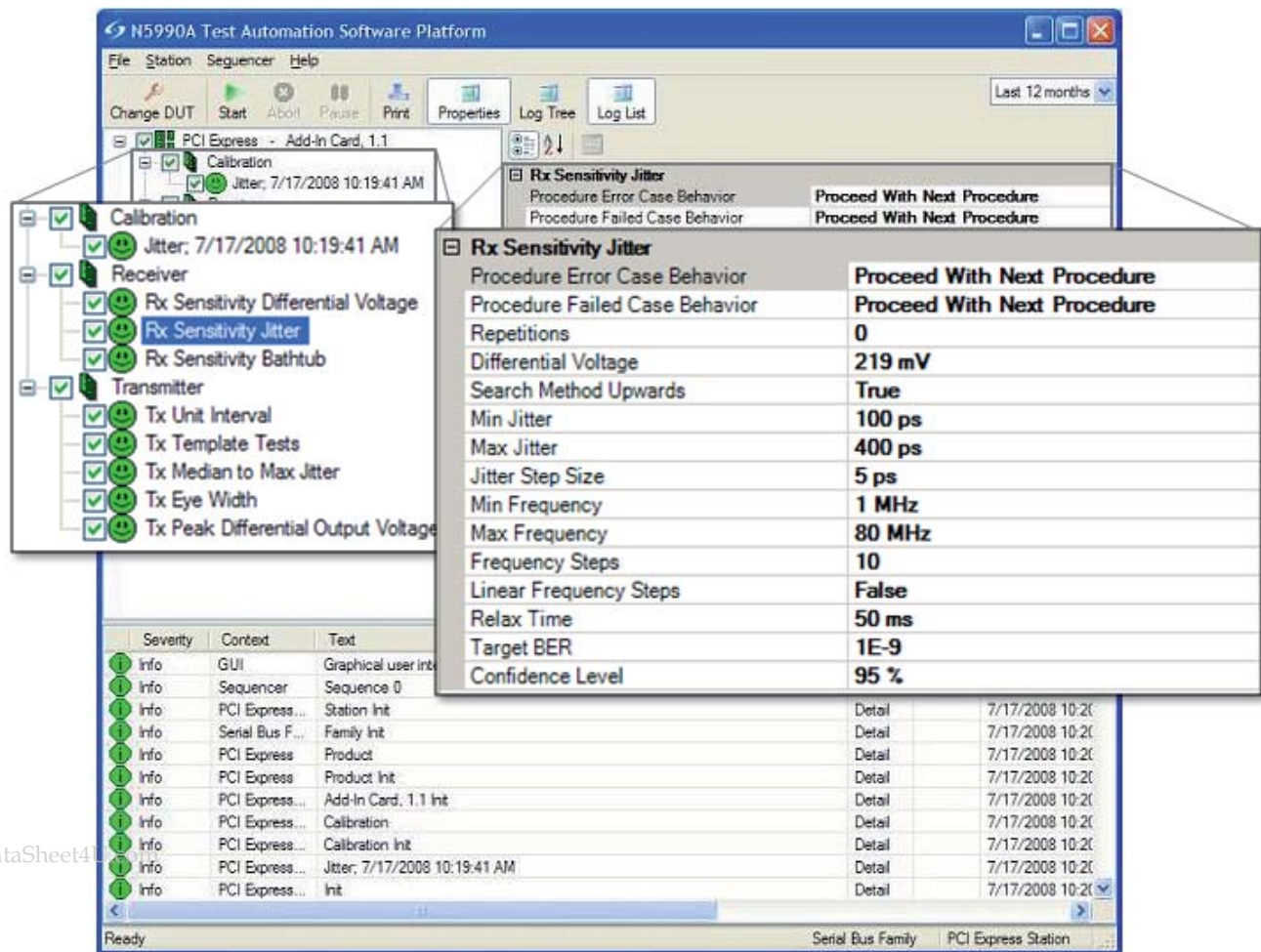

Figure 5. Test selection details (characterization mode)

Computer Bus Applications - PCI Express

CBB and CLB support

The configuration in Figure 6 tests multi-lane add-in cards, using a graphics card as an example. The DUT is plugged into a Compliance Base Board (CBB) available from the PCI-SIG®.

The CBB needs to be modified slightly for use with the N5990A. Details are available from Agilent. Agilent can also provide details for system board tests using a Compliance Load Board (CLB, also available from the PCI-SIG).

Test coverage

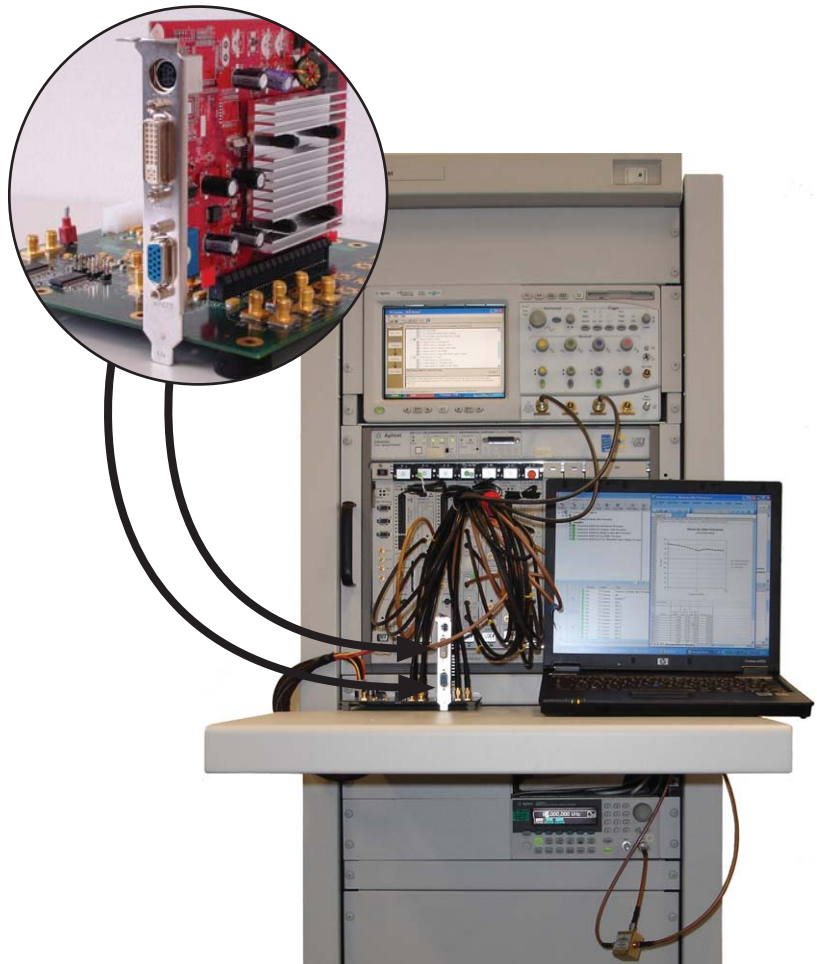See Table 1 below. For PCI Express Gen 2, please contact Agilent.

Figure 6. PCI Express test station

Table 1. PCI Express 1.0a and 1.1 test coverage

Test number	Assertion	Description	N5393A	N5990A Opt 101
1.4	PHY .3.3#2	Non-SSC transmitter data rate	x	
1.5	PHY .3.2#1, 2, 14, PHY .3.3#1, 4, 9, EM.4#13, 14, 15, 19, 20	Signal quality	x	
1.6	PHY .3.1#12, 26	TX DC common mode voltage	x	
1.12	PHY .3.3#3	TX output rise/fall time	x	
1.13	PHY .3.3#5	TX RMS AC common mode voltage	x	
1.21	PHY .3.4#1, 6, EM.4#21	Receiver sensitivity		x
1.24	EM .4#4	Wake enabled platform vaux power	x	

Computer Bus Applications - SATA

Test the standard with the standard

In the past years, serial ATA (serial advanced technology attachment or SATA) became the de-facto standard for connecting hard drives into computer systems. SATA is by design less susceptible to crosstalk and EMI than its predecessor parallel implementation. Testing it to the standard defined by the SATA-IO (International Organization, **www.serialata.org**) to guarantee compatibility and inter operability however is still mandatory and actually vital to vendors.

Convenient, automated RX tests

So far, SATA compliance and interoperability testing have been conducted mainly manually. The N5990A test automation software platform now provides rapid testing and fully controls the test setup, incl. sinusoidal and random noise sources (Figure 7).

The coverage of the receiver tests N5990A Option 103 is given in Table 2. The crucial receiver jitter tests are provided for Gen1 and Gen2 devices in both the pure compliance and the advanced expert mode. For device characterization, complementary tests are available in expert mode.

Figure 7. Automated SATA test station – user-friendly, full automation is achieved by supporting the Agilent N4915A-005 SATA switch
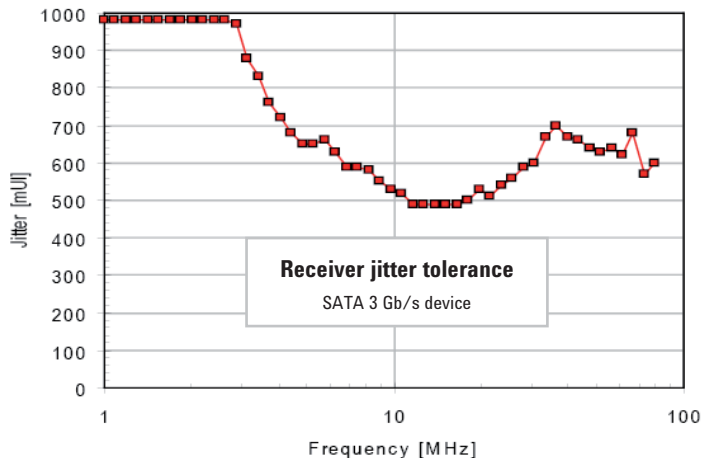
Interface to oscilloscope transmitter tests

The full range of the Agilent N5411A oscilloscope SATA electrical performance measurements, such as general specifications and transmitted signal requirements, is available for PC-controlled test through the interface Option N5990A-203. See the N5411A data sheet 5989-3662EN for the long list of supported measurements.

System calibration

This initial step is mandatory for reliable measurements. It used to be slow and inconvenient in the past. N5990A's automated calibration provides a new user experience. Stress your device with precisely calibrated jitter! The oscilloscope is needed for the calibration of the receiver test subsystem.

Interface to SATA control software

N5990A Option 103 requires that the device is in the far end re-timed loopback (BIST-L) mode. This can be achieved with commercial or custom control software. Option 103 supports the ULINK DriveMaster software.

Test results

The SATA test data is available in the common, ready-to-use N5990A Microsoft Excel format graphs and data tables (Figure 8). This enables quick and easy post-processing.

Receiver jitter tolerance

SATA 3 Gb/s device

Figure 8. Excel results for Maximum passed jitter

Table 2. SATA receiver test coverage (host and device DUTs)

Use Model	Test requirement	Test name	Compliance mode	Expert mode
Interoperability tests	RSG-01	Gen1 (1.5 Gb/s) receiver jitter test	x	x
	RSG-02	Gen2 (3 Gb/s) receiver jitter test	x	x
Characterization		Rcvr differential sensitivity (Gen1, Gen2)		x
		Rcvr. jitter tolerance (Gen1, Gen2)		x
		Rcvr. constant parameter stress test (Gen1, Gen2)		x

Computer Bus Applications - USB

Why still test USB?

USB is a well-established bus technology. One might be tempted to believe that no additional testing is required but the contrary is true. Chip designs which combine new and traditional interfaces may invoke painful bugs - on the traditional intefaces too!

Broadest USB receiver tests coverage

The N5990A Option 102 provides unprecedented USB 2.0 receiver device test coverage. The crucial jitter tolerance test is suported as well as other critical tests (see Table 3). Note that USB host receiver tests are not supplied!
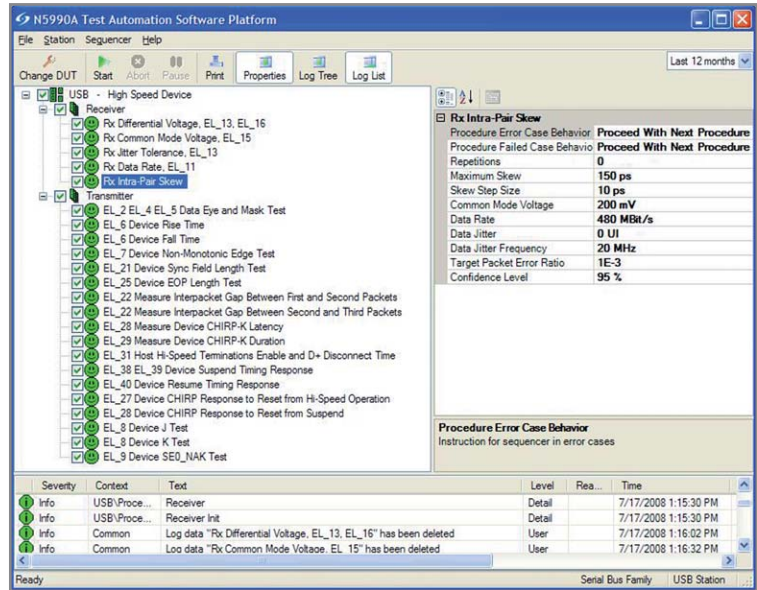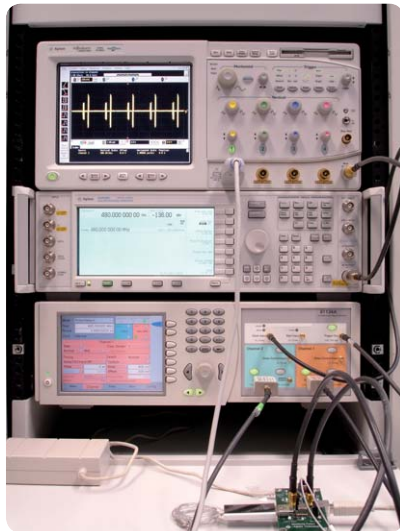
Figure 10. N5990A USB test selection

Figure 9. N5990A USB test solution

USB test station

A full USB device test station (see Figure 9) comprises of an 81134A data generator with an ESG jitter source, an Infiniium oscilloscope, a USB fixture and the USB test software. The oscilloscope is needed for the transmitter tests and the calibration of the receiver test subsystem.

Automated USB tests

The N5990A test software automation platform user interface is common across all bus test applications (see Figure 10), regardless of whether the bus is emerging or established, such as USB. This leverage tremendously increases productivity.

Complementing USB transmitter tests

The N5990A Option 102 complements the Infiniium oscilloscope transmitter compliance test software N516A. The transmitter test software is currently being integrated into the test software automation platform. It is already available for PCI Express and HDMI.

Receiver tests

As an example, the jitter tolerance characterization results of a good device are shown in Figure 11.

Table 3. USB 2.0 device test coverage - For USB 3.0 please contact Agilent.

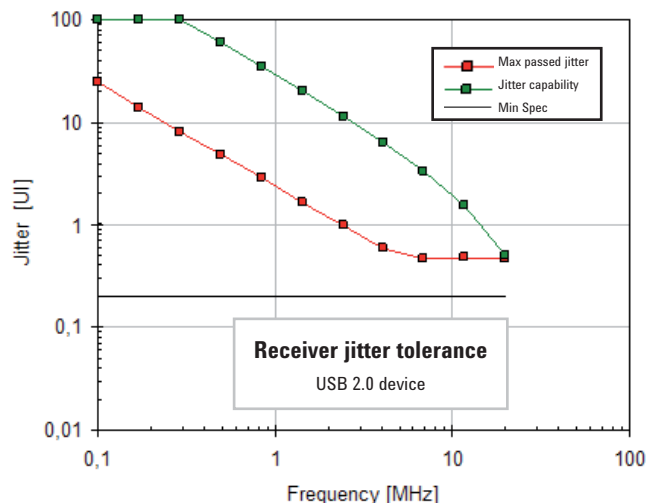| N5990A Option 102	Receiver test name
EL_11	Receiver data rate
EL_13	Receiver differential voltage
EL_13	Receiver jitter tolerance
EL_15	Receiver common mode voltage
EL_16	Receiver squelch detection
EL_18	Receiver minimum SYNC field

Figure 11. USB jitter tolerance

Consumer Electronics and Video Test Applications - HDMI

Go beyond the instruments

By combining the performance of Agilent instruments with the flexibility of a PC (see Figure 12), N5990A provides unprecedented test integration, minimum calibration time and maximum test throughput as well as ease-of-use for HDMI test. It is this level of control and performance which leap-frogs competitive solutions.

Fast and reliable HDMI testing

The comprehensive N5990A automation software platform increases testing speed, reduces test cost and ensures greater thoroughness than manual HDMI compliance testing and characterization. Competitive, stand-alone software applications are often outperformed by a factor of two or more.

Broadest test automation

N5990A supports the Infiniium oscilloscopes recommended for HDMI. The N5399A source test software is complemented with sink tests conducted with the E4887A TMDS signal generator (see Table 4). The oscilloscope is needed for the transmitter tests and the calibration of the receiver test subsystem.

Additional value is provided by the integration of the quantum data 882EA video test instrument which covers EDID, video, CEC and CTS-approved HDCP tests (Figure 13).

Full support for independent clock and data jitter insertion

N5990A enables and fully supports the unique independent clock and data jitter insertion capability of the Agilent TMDS signal generator.
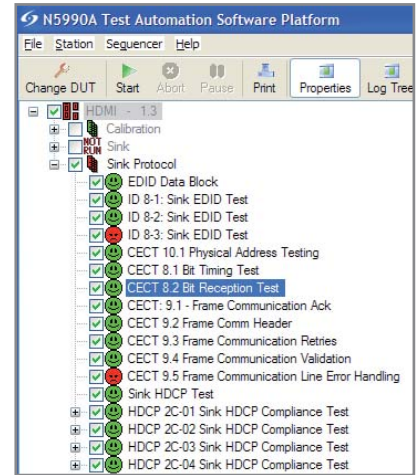
Figure 13. Integrated HDMI EDID, CEC and HDCP tests

This capability was already required in previous versions of the HDMI specification such as 1.2a for the crucial jitter tolerance test. Due to the limitations of the old HDMI test solutions, it however could not be implemented in the past. Now available with HDMI 1.3, this functionality is especially appealing for in-depth device characterization.

Figure 12. N5990A HDMI test solution

Table 4. HDMI test coverage by CTS 1.3b test ID and name

N5399A & N5990A Option 250	Source test name	N5990A Option 150	Sink and cable test name	N5990A Option 350	Test name
7-2	TMDS VL	5-3	TMDS data eye diagram	8-1	EDID readable
7-4	TMDS rise & fall times	8-5	TMDS min. differential sensitivity	8-2	EDID VESA structure
7-5	TMDS over/undershoot	8-6	TMDS intra-pair skew	8-3	CEA timing extension structure
7-6	TMDS inter-pair skew	8-7	TMDS jitter tolerance	8-17	861B format support
7-7	TMDS intra-pair skew	8-15	Character synchronization	8-18	HDMI format support
7-8	TMDS clock duty cycle	8-19	Pixel encoding	8-19	Pixel encoding
7-9	TMDS clock jitter	8-20	Video format timing	8-20	Video format timing
7-10	TMDS data eye diagram	8-22	Audio sample packet jitter	2C-01 to 2C-04	HDCP tests
		8-24	Interoperability with DVI	CECT 7 to 11	CEC tests
		8-25	Deep color[1]		

1. See E4887A data sheet for supported video formats

9

Consumer Electronics and Video Test Applications - DisplayPort

DisplayPort, an emerging standard

DisplayPort defines a high-bandwidth interface for connecting laptops or personal computers with display monitors or connecting computers with high-definition consumer electronic devices. VESA, an organization comprised of leading companies in the high definition digital display industry drives the development of this new digital interface.

Meet the test requirements

As part of its standards compliance, VESA has established a comprehensive compliance test program for DisplayPort that includes product certification, at independent third-party test houses, for physical layer and link layer compliance testing. Physical layer test is comprised of source, sink and cable (media) tests detailed in the DisplayPort CTS (compliance test specification). The Agilent test products and methodologies are approved as MOI (method of implementation) by VESA.

Automated tests

As with all other supported computer bus or video standard tests, the N5990A software platform provides fast, calibrated, automated receiver testing. The receiver tests, N5990A Option 155 (Figure 14) require DUT register access. They complement the Infiniium oscilloscope transmitter compliance test software U7232A. U7232A is fully integrated into the N5990A with Option 255.
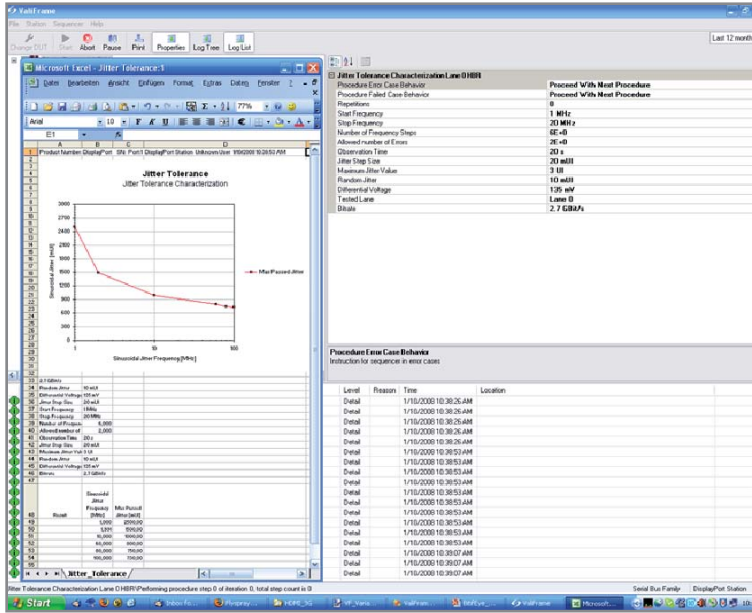

Figure 14. N5990A display port receiver jitter tolerance test

Compliance and characterization

In the configuration dialog (Figure 15) the user selects between compliance and expert mode. The latter provides access to all relevant test parameters for advanced tasks such as debugging, validation, characterization and margin test.
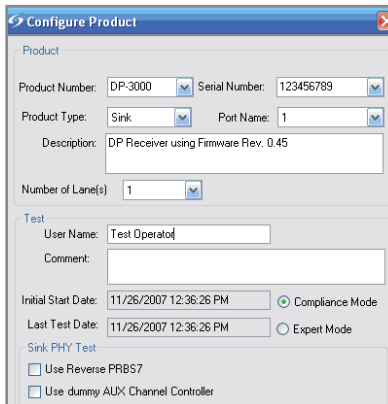

Figure 15. Configuration screen

Supported hardware

The standard DisplayPort receiver test setup is given in Figure 16. It is based on the J-BERT N4903A, the W2641A test fixture, the W2642A DisplayPort test controller, the N4915A-006 ISI generator and an external PC running N5990A. The oscilloscope is needed for the transmitter tests and the calibration of the receiver test subsystem.

For investment protection of HDMI customers, the TMDS signal generator E4887A-007 is supported alternatively. Note that in this setup, an additional 81150A jitter source is needed.

The source tests are conducted with DSO80000B or DSO90000A Series oscilloscopes.

Figure 16. Receiver test station

Table 5. Display port test coverage

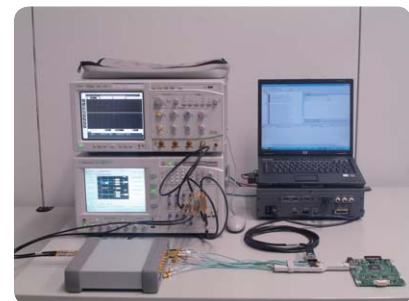| Receiver test name |
| --- |
| RBR and HBR sensitivity tests |
| RBR and HBR jitter tolerance tests |
| RBR and HBR intra-pair skew test |
| Variable parameter test (user-selectable swing, SJ and RJ) |

Consumer Electronics and Video Test Applications – MIPI D-PHY

MIPI, the mobile standard

The Mobile Industry Processor Interface (MIPI™) Alliance is an open membership organization that includes leading companies in the mobile industry that share the objective of defining and promoting open specifications for interfaces in mobile terminals. MIPI specifications establish standards for hardware and software interfaces between the processors and peripherals typically found in mobile terminal systems such as cell phones. MIPI D-PHY operates at about 500 Mbits/s.

Meet the test requirements

As part of its standards compliance, the MIPI Alliance has established a comprehensive compliance test program for MIPI D-PHY that includes product certification at independent third-party test houses for physical layer and link layer compliance testing. Physical layer test is comprised of receiver and transmitter tests detailed in the MIPI D-PHY compliance test suite. The Agilent test products and methodologies are approved as MOI (method of implementation) by the MIPI Alliance.

Automated tests

Like for all other supported computer bus or video standard tests, the N5990A software platform provides fast, calibrated, automated testing. MIPI D-PHY operates at about 500 Mbits/s. The receiver tests, N5990A Option 160, complement the Infiniium oscilloscope transmitter compliance test software U7238A. U7238A is fully integrated into N5990A with Option 260. Option 361 provides control of the PPI interface for frame error detection. The test automation software provides compliance tests and device characterization, incl. margin test.

MIPI D-PHY frame generator

The MIPI frame generator (Figure 17) allows conducting semi-automatic tests, e.g. for debugging. It provides full calibration and control of the receiver test hardware (Figure 18), including real-time parameter changes.

Supported hardware

The standard MIPI receiver test setup is shown in Figure 18. It is based on a ParBERT 81250A with external clock, jitter and noise sources, a logic analyzer, an oscilloscope and an external PC running the N5990A software.

For investment protection of HDMI and DisplayPort customers, the MIPI receiver test configurations are extensions of the TMDS signal generators, E4887A.

The source tests are conducted with DSO80000B or DSO90000A Series oscilloscopes. The oscilloscope is needed for the calibration of the receiver test subsystem.
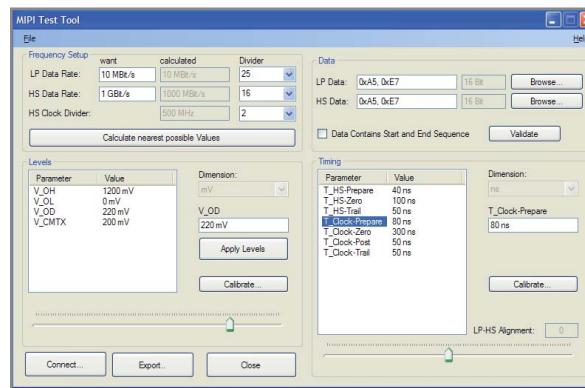

Figure 17. MIPI frame generator

Table 6. MIPI D-PHY test coverage

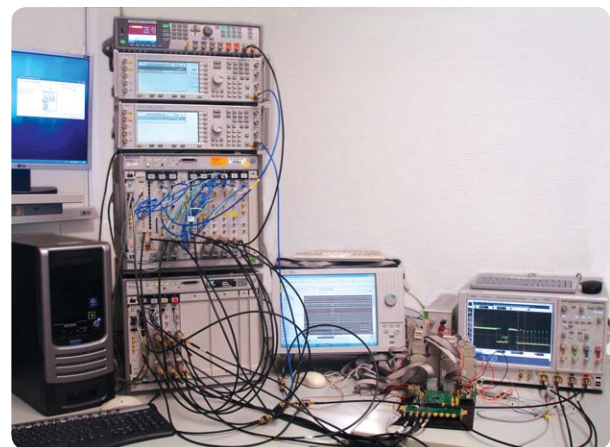| Receiver Test Name	
HS Rx tests	Common-mode voltage tolerance (VCMRX(DC))
	Differential input high threshold (VIDTH)
	Differential input low threshold (VIDTL)
	Single-ended input high voltage (VIHHS)
	Single-ended input low voltage (VILHS)
	Common-mode interference beyond 450 MHz (ΔVCMRX(HF))
	Common-mode interference 50MHz – 450MHz (ΔVCMRX(LF))
LP Rx tests	Logic 1 input voltage (VIH)
	Logic 0 input voltage, non-ULP state (VIL)
	Input pulse rejection (eSPIKE)
	Minimum pulse width response (TMIN-RX)
	Interference tolerance (VINT and FINT)

Figure 18. Receiver test station

11

Instrument Compatibility

The following instruments are supported for the applications indicated.

Table 7. Instrument compatibility (Agilent instruments if no vendor mentioned)

Recommended instrument	Max. data rate or bandwidth	PCIe	USB	SATA		HDMI	DisplayPort		MIPI D-PHY
				81134A	J-BERT		ParBERT	J-BERT	
Generator									
81250 ParBERT	3.4 Gb/s, 7 Gb/s or 13.5 Gb/s					x[1]	x[1,2]		x
N4903A J-BERT	7 Gb/s or 12.5 Gb/s	x			x			x	
81134A	3.35 Gb/s		x	x					
Jitter source									
N4903A J-BERT	100 MHz PJ and RJ	x						x	
E4438C Options 504, 601, 1E5	20 MHz SJ depending on amplitude		x				x[3]		x[3]
N5182A Option 503, 654	25 MHz SJ depending on amplitude		x						
81150A-002	Up to 240 MHz SJ and RJ	x		x			x		x
33220A, 33250A, E4438C						x[1]			
Error detector									
16800/16900 Series logic analyzer, OR…					x[4]				x[5]
Crescent heart SATA-II-FER adapter					x				
N4903A-C07 or N4903A-C13		x						x[6]	
Oscilloscope[7,8]		N5393A	N5416A	N5411A		N5399A	U7232A		U7238A
DSO81304B, DSO 91304A	13 GHz	x	x	x		x	x		x
DSO81204B, DSO 91204A	12 GHz	x	x	x		x	x		x
DSO81004B, DSO 91204A	10 GHz	x	x	x		x	x		x
DSO80804B, DSO 90804A	8 GHz	x	x			x	x		x
54855A[9], DSO 90604A	6 GHz	x	x						x

1. Configurations and specifications: see E4887A data sheet (5989-5537EN)

2. E4887A-003 not supported

3. 81150A required

4. E5378A and N4219B required, supported logic analyzer configurations, see N4219B product overview (5989-1762EN)

5. For PPI support (N5990A-361), configuration depends on the specific implementation of the PPI interface

6. W2642A required

7. All applications except PCIe: oscilloscope required for the calibration of the receiver test subsystem.
   DisplayPort: N4903A-C07 or N4903A-C13 error detector can be used alternatively.

8. N5990A supports Agilent Infiniium oscilloscopes through the electrical performance specification applications, transmitter tests, and compliance software applications shown to the right

9. 4 channels required for USB, not supported for MIPI™

System Requirements

Minimum system requirements for the Agilent N5990A

Software requirements
- Windows® XP with Service Pack 2 or higher, English version

- Microsoft .NET Framework version 2.0

- Microsoft Internet Explorer 6.0 or higher

- Agilent IO Libraries Suite 14.0 or higher

- Microsoft Office Excel 2003 or higher, English version

Note: Microsoft Excel is not included in the N5990A. It must be furnished by the customer, e.g., as part of MS Office.

PC hardware requirements and recommendations
- 1.6 GHz CPU x86

- 512 MB RAM or higher recommended

- 100 MB free hard disk space

- CD-ROM drive (if installing from CD)

- Super VGA (800 x 600) display or higher resolution monitor with 256 colors or more

- PC keyboard and 2-button mouse

- Required connectivity options

- for instrumentation:

  ◦ IEEE 1394 (Firewire®)

  ◦ LAN

  ◦ depending on configuration: GPIB or Agilent 82357A USB/GPIB interface

Measurement Requirements

Computer bus test

PCI Express
To run the N5990A PCI Express receiver tests (Option 101), the DUT must support loopback mode. A CBB or CLB might be required to connect to the DUT.

SATA
The N5990A RSG/Rcvr tests require the far end retimed loopback mode (BIST-L). Control software is available for example from ULINK Technology (**www.ulinktech.com**). For the full equipment list, refer to the latest Agilent "method of implementation" (MOI) at **www.sata-io.org or www.agilent.com.**

USB
See the "Recommended Test Equipment" sections in the N5416A data sheet (5989-4044EN). Note that N5990A currently only supports the 81134A pulse pattern generator. In case you need support for your 81130A, contact Agilent. In addition the following accessories are needed:

- (2) 15433B 500 ps TTCs

- (1) matched pair SMA cables

- (2) SMA cables

Consumer electronics and video test

HDMI
Depending on the test (sink, source or cable test), accessories such as cable emulators, TPAs (test point access assemblies), transition time converters or bias tee-kits are required. For details, see the E4887A data sheet (5989-5537EN) or **www.bitifeye.com.**

DisplayPort
A W2641A test point access adaptor is required. For automated receiver jitter tolerance testing a DisplayPort test controller (DPTC) W2642A is mandatory, and the DUT must support the register access indicated in CTS 1.1, chapter 4. For the calibration of the receiver test setup, a receptacle fixture is needed (see below).

- (1) W2641A test adaptor

- (1) W2642A DPTC

- (1) N4915-006 cable emulator

- (2) 11636B power divider

- (4) E4809-61603 matched pair cables

- (4) N5460A matched pair cables

- (6) N9398C blocking capacitors (E4887A: alternatively bias tee kit, BIT-HDMI-BTK-xxxx)

- (6) 15435A 156 ps TTCs

- (1) BIT-DP-RTF-0001; receptacle test fixture kit (for Rx tests) or 1 x BIT-DP-CBL-0001 cable test kit, see **www.bitifeye.com**.

For the full list of accessories, contact Agilent.

MIPI
DUT configuration and frame error rate counting via the PPI (PHY protocol interface) are required. Note that the PPI definition is still only informative.

See the configuration guide (5989-8379EN).

Configuration Examples

Table 8. N5990A example configurations

	Application	Mandatory[1, 2]	Recommended
PCI Express®	Receiver test (up to 4 channels) Receiver test (> 4 channels)	N5990A Option 010 N5990A Option 101 N5990A Option 003	N5990A Option 001
	Transmitter test	N5990A Option 201 N5393A E2688A N5400A	
USB	Receiver test	N5990A Option 010 N5990A Option 102	N5990A Option 001
	Transmitter test	N5990A Option 202 N5416A	
SATA	RSG/Rcvr. tests	N5990A Option 010 N5990A Option 103	N5990A Option 001
	Transmitter test	N5990A Option 203 N5411A N5400A	
HDMI	Sink test, cable test (5 - 3)	N5990A Option 010 N5990A Option 150 N5399A	N5990A Option 001
	Source test	N5990A Option 250 N5399A	
	EDID, CEC, video and HDCP tests	N5990A Option 350	
DisplayPort	Receiver tests	N5990A Option 010 N5990A Option 155 N5384A N5400A N5403A	N5990A Option 001
	Transmitter test	N5990A Option 255 U7232A	
MIPI	Receiver tests	N5990A Option 010 N5990A Option 160 N5990A Option 361 N5384A	N5990A Option 001 N5990A Option 362
	Transmitter tests	N5990A Option 260 U7238A	
Multi-bus test	Receiver and transmitter tests	Configure as above for the individual bus, N5990A Option 002	N5990A Option 001
Legacy code integration, user programming	Communication and interaction with e.g. C, C++, C#, Visual Basic, VEE or LabView code	Configure as above for the individual bus, N5990A Option 500	N5990A Option 001
	User programming	Templates for custom calibration and test procedures and instrument drivers	

1. For Transmitter Test with DSO90000 Series oscilloscopes, DSO90000A-011 or N5452A required

2. Some transmitter test software options may be available as options of oscilloscope digital signal analyzer configurations

Ordering Information

To meet your requirements, please select the models and options for your application from the following table.

Table 9. Ordering information

Model number	Description
N5990A-010	Test automation software platform, required for all other options
N5990A-001	Interfaces to databases (Microsoft SQL and MySQL) and web browsers
N5990A-002	Multi-bus support, required if you want to test more than one bus standard on the same platform
N5990A-003	PCI Express® high-lane count (> 4) option, required to test more than 4 lanes in parallel
N5990A-500	User programming (API including templates)
Option class high-speed electrical receiver / sink test libraries	
N5990A-101	PCI Express for ParBERT 3.3 Gb/s and J-BERT N4903A
N5990A-102	USB 2.0 for 81134A
N5990A-103	SATA RSG/Rcvr. for 81134A
N5990A-150	HDMI for ParBERT
N5990A-155	DisplayPort for ParBERT and J-BERT N4903A
N5990A-160	MIPI D-PHY for ParBERT
Option class interfaces to high-speed electrical transmitter / source tests (on Infiniium oscilloscopes)	
N5990A-201	Interface to N5393A PCI Express software (N5393A not included)
N5990A-202	Interface to N5416A USB software (N5416A not included)
N5990A-203	Interface to N5411A SATA software (N5411A not included)
N5990A-250	Interface to N5399A HDMI software (N5399A not included)
N5990A-255	Interface to U7232A DisplayPort software (U7232A not included)
N5990A-260	Interface to U7238A MIPI D-PHY software (U7238A not included)
Option class protocol, content protection test and control libraries	
N5990A-350	HDMI EDID, CEC, video and HDCP tests with Quantum Data 882EA
N5990A-361	MIPI D-PHY PPI control
N5990A-362	MIPI D-PHY Frame Generator (for semi-automatic signal generation)

Related literature

Table 10 . Related literature

	Publication number
Automated PCI Express Receiver Test Application Note	5989-5500EN
HDMI Sink and Source Compliance Test and Characterization Data Sheet	5989-4959EN
ParBERT 81250A Product Overview	5968-9188E
J-BERT N4903A High-Performance Serial BERT Data Sheet	5989-2899EN
81134A Pulse Pattern Generator Data Sheet	5988-5549EN
N5393A PCI Express Electrical Performance Validation and Compliance Software Data Sheet	5989-1240EN
N5399A HDMI Electrical Performance Validation and Compliance Software Data Sheet	5989-3047EN
81150A Pulse Function Arbitrary Noise Generator Data Sheet	5989-6433EN
N5416A Infiniium USB Test Option Data Sheet	5989-4044EN
N5411A Serial ATA Software Data Sheet	5989-3662EN
U7232A DisplayPort Electrical Performance Validation and Compliance Software Data Sheet	5989-7198EN
U7238A MIPI D-PHY Compliance Test Software for Infiniium Oscilloscopes Data Sheet	5989-9337EN

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