Agilent Technologies N5411B SATA 6Gb/s Compliance Test Software

Data sheet

Gen1, Gen2 and Gen3 SATA and eSATA PHY, TSG and OOB compliance test software for Infiniium oscilloscopes

The N5411B SATA 6Gb/s compliance test software for Infiniium oscilloscopes provides you with a fast and easy way to validate and debug your SATA 1.5-Gb/s (Gen1), 3.0Gb/s (Gen2) and 6.0Gb/s (Gen3) silicon, host bus adapters, port multipliers, high-density disk drives, solid-state disk drives and optical disk drives. The N5411B software provides automated compliance test support for the i (internal), m (eSATA) and x (SAS attachment) interface points, and displays the results in a flexible report format. In addition to the measurement data, the report provides a margin analysis that shows how closely your device passed or failed each test.

To make measurements with the N5411B SATA compliance test software, you will also need a test fixture for signal access to make measurements. Wilder Technologies' SATA Gen3 test fixtures are recommended for compliance testing. The product information is available at http://www.wilder-tech.com/sata.htm. The ICT-Lanto TF-1R31 and TF-2R11 fixtures are also recommended for all host and device compliance testing. You can find more information on the required test fixtures at http://www.ict-lanto.com/product.

Features

The N5411B software offers several features to simplify the validation of SATA designs:

- Setup and measurement wizard with guided connection
- Support for BIST-T,A,S (transmit only) and BIST-L (far-end retimed loopback) test modes
- Intelligent test selection and margin analysis specific to interface selection
- Spread-spectrum clock modulation depth and frequency accuracy measurements
- Complete SATA-IO logo validation tests for PHY general, transmit signal and OOB requirements per Unified Test Document 1.4
- Automated out-of-band (OOB) burst and gap margin analysis and tests for detect/reject on COMRESET, COMINIT and COMWAKE bursts that are in/out of specified ranges

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The N5411B SATA 6Gb/s compliance software performs a wide range of tests required to meet the physical layer transmitter test requirements of the Serial ATA International Organization: Serial ATA Revision 3.1 specification. The Serial ATA Revision 3.1, or SATA 6Gb/s, specification requires that an oscilloscope with a minimum bandwidth of 12 GHz be used for validating the 6 Gb/s physical layer transmitter. Agilent's DSA91204A and 90000 X-Series Infiniium oscilloscopes, combined with the N5411B software, provides the necessary bandwidth and analysis capability for validating SATA 6Gb/s transmitters, as well as control of the 81134A pattern generator or N4903B J-BERT with Option 002 for performing automated out-of-band (OOB) signal parametric and timing tests. The 81134A pattern generator or N4903B J-BERT with Option 002 can be configured and used for SATA 6 Gb/s testing as well.

The SATA-IO sponsors an official certified logo program, which requires that SATA products be tested at official interoperability workshops or at a certified independent test lab, in order for that product to be included on the SATA-IO integrators' list and to use its certified logo. Agilent's SATA physical layer test solutions, which provide complete coverage for PHY, TSG and OOB test categories, are used for gold suite testing at SATA-IO interoperability workshops as well as in several independent SATA test labs.

N5411B saves you time

The N5411B software saves you time by setting the stage for automatic execution of SATA electrical tests. Part of the difficulty of performing electrical tests for SATA is connecting the oscilloscope to the target device, configuring the scope's measurement system for compliance testing, issuing the proper commands to perform the tests and then analyzing the measured results by comparing them to limits published in the specification. The SATA electrical test software does much of this work for you. In addition, if you discover a problem with your device, debug tools in the scope are available to aid in root-cause analysis.

The N5411B SATA electrical test software offers the required tests to verify compliance with the physical layer requirements tables, Serial ATA Revision 3.1 specification. The software automatically configures the oscilloscope for each test and provides an informative results report that includes margin analysis relative to the specified conformance limits. See Table 2 for a complete list of the measurements made by the N5411B SATA electrical test software.

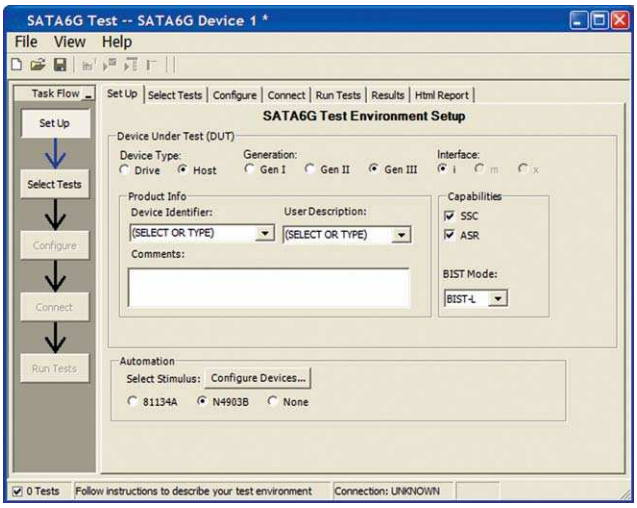


Figure 1. The Agilent N5411B setup tab allows you to choose the interface type of your product and the relevant test speed, then automatically configures the measurements and limits appropriately for your specific product per the specification requirements..

Intelligent test selection

The N5411B software extends the ease-of-use advantages of Agilent's Infiniium Series oscilloscopes to testing SATA designs. The Agilent automated test engine walks you quickly through the steps required to select and perform required tests for the interface you have selected (Gen3i Host, for example). You can select a category of tests or specify individual tests. The user interface is oriented to minimize unnecessary reconnections, which saves time and minimizes potential for measurement error. You can save tests and configurations as project files and recall them later for additional testing and review of previous test results. Straightforward menus let you perform tests with a minimum of mouse clicks.

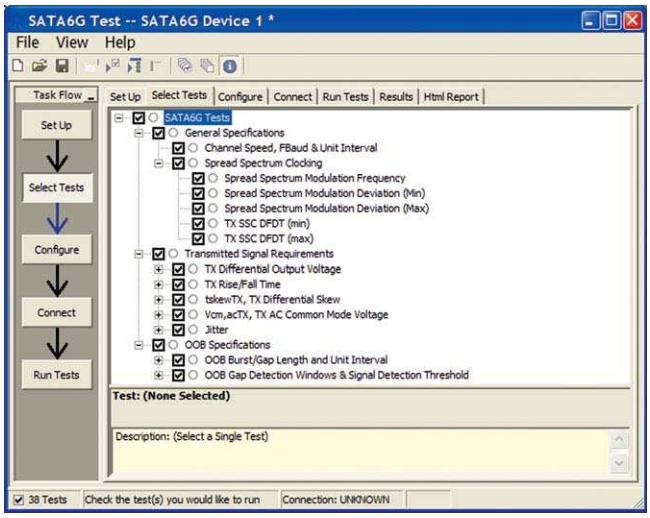


Figure 2. The Agilent automated test engine guides you quickly through selecting and configuring tests, setting up the connection, running the tests, and viewing the results. You can easily select individual tests or groups of tests with a mouse-click and customize your output report based on the test results you want to see.

Configurability and guided connections

The N5411B software provides flexibility in your test setup. The SATA test software provides you with user-defined controls for critical test parameters, such as test pattern source selection and number of unit intervals (UI) desired for the test group.

After configuring the tests according to your needs, the test software guides you to make connection changes with diagrams. This includes the oscilloscope channels used for the test and the routing of any necessary SMA cabling, power dividers, DC blocking capacitors and test fixtures needed to perform the tests.

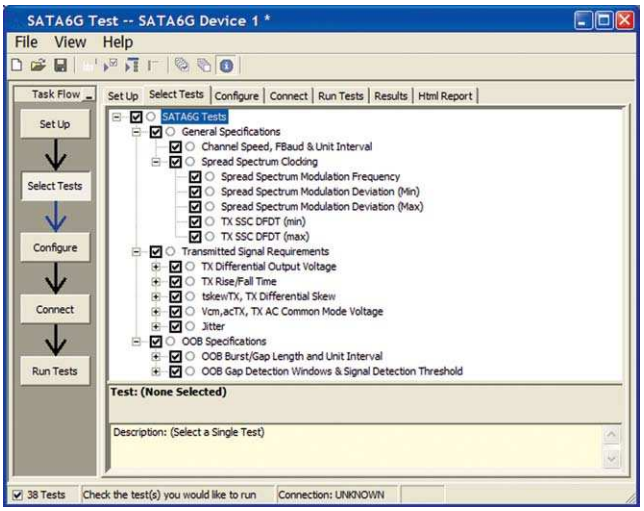


Figure 3. In configuring the tests, you define the test mode and define which pattern will be used for each test.

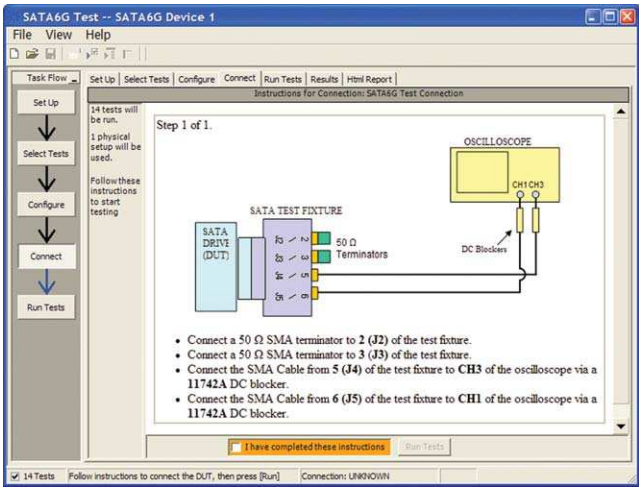


Figure 4. When you make multiple tests where the connections must be changed, the software prompts you with connection diagrams.

Repetitive Run & Results Filtering

Agilent's automated test framework allows you to choose the number of repetitive iterations to be performed for each test. This is useful for obtaining statistical information about the stability of your product across a larger data sample, or for comparing measurement results differences among different product environmental settings such as transmit voltage, de-emphasis levels or temperature. Once all runs are completed, you can filter the data and statistics chronologically or by specification margin for viewing and including in the final report.

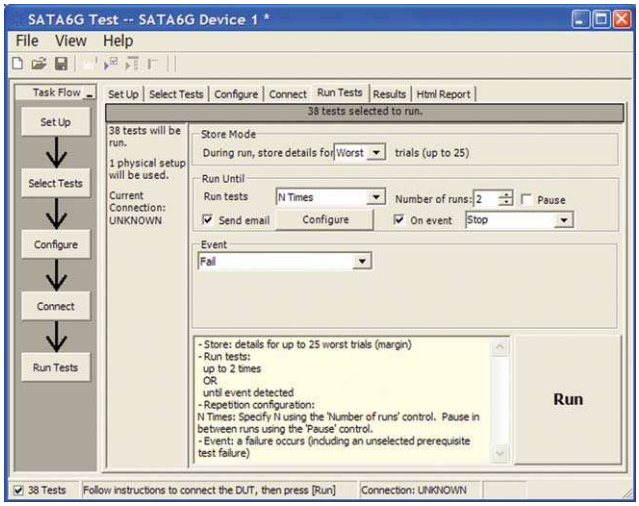


Figure 5. The Agilent N5411B allows for user-selectable repetitive test execution.

Reports with margin analysis

In addition to providing you with measurement results, the N5411B software provides a report format that shows you not only where your product passes or fails, but also reports how close you are to the limits specified for a particular test parameter. You can specify the level at which warnings are issued to alert you to the electrical tests where your product is operating close to the official test limit defined by the specification or your own requirements for a given test parameter.

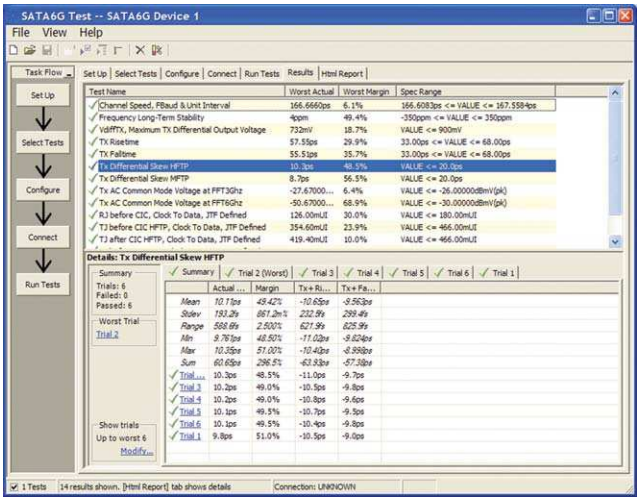
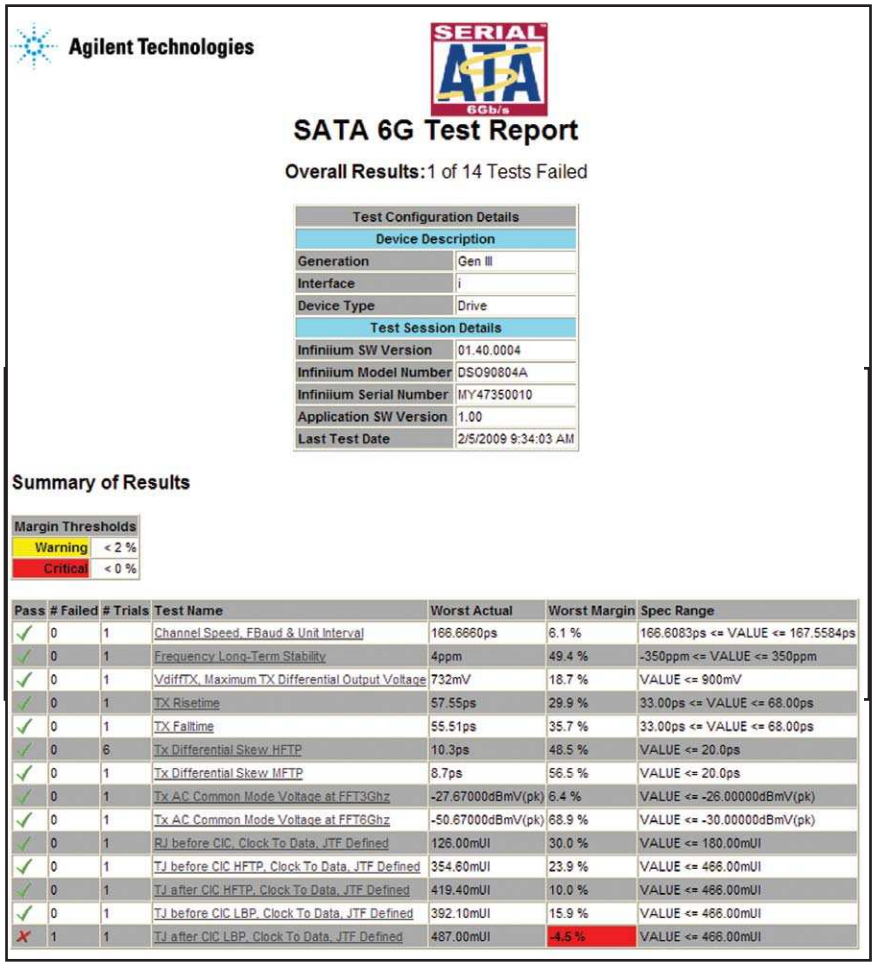


Figure 6. The Agilent N5411B report can be customized with user-selectable repetitive run data, and filtered to show only the relevant data and statistics desired in the final report.

Thorough performance reporting

The N5411B SATA compliance and validation software generates thorough HTML reports that clearly identify passing and failing conformance tests in a summary table along with relevant screen images and interim data values for complex measurements. The HTML report provides you with a complete report of your testing summary, references to the specification and requirements tables where each measurement is defined for traceability to the official test requirements for your SATA interface.



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SERIAL ATA 6Gb/s

SATA 6G Test Report

Overall Results: 1 of 14 Tests Failed

Test Configuration Details	
Device Description	
Generation	Gen III
Interface	i
Device Type	Drive
Test Session Details	
Infiniium SW Version	01.40.0004
Infiniium Model Number	DSO90804A
Infiniium Serial Number	MY47350010
Application SW Version	1.00
Last Test Date	2/5/2009 9:34:03 AM

Summary of Results

Margin Thresholds	
Warning	< 2 %
Critical	< 0 %

Pass	# Failed	# Trials	Test Name	Worst Actual	Worst Margin	Spec Range
✓	0	1	Channel Speed, FBaud & Unit Interval	166.6660ps	6.1 %	166.6083ps <= VALUE <= 167.5584ps
✓	0	1	Frequency Long-Term Stability	4ppm	49.4 %	-350ppm <= VALUE <= 350ppm
✓	0	1	VdiffTX, Maximum TX Differential Output Voltage	732mV	18.7 %	VALUE <= 900mV
✓	0	1	TX Risetime	57.55ps	29.9 %	33.00ps <= VALUE <= 68.00ps
✓	0	1	TX Falltime	55.51ps	35.7 %	33.00ps <= VALUE <= 68.00ps
✓	0	6	Tx Differential Skew HFTP	10.3ps	48.5 %	VALUE <= 20.0ps
✓	0	1	Tx Differential Skew MFTP	8.7ps	56.5 %	VALUE <= 20.0ps
✓	0	1	Tx AC Common Mode Voltage at FFT3Ghz	-27.67000dBmV(pk)	6.4 %	VALUE <= -26.00000dBmV(pk)
✓	0	1	Tx AC Common Mode Voltage at FFT6Ghz	-50.67000dBmV(pk)	68.9 %	VALUE <= -30.00000dBmV(pk)
✓	0	1	RJ before CIC, Clock To Data, JTF Defined	126.00mUI	30.0 %	VALUE <= 180.00mUI
✓	0	1	TJ before CIC HFTP, Clock To Data, JTF Defined	354.60mUI	23.9 %	VALUE <= 466.00mUI
✓	0	1	TJ after CIC HFTP, Clock To Data, JTF Defined	419.40mUI	10.0 %	VALUE <= 466.00mUI
✓	0	1	TJ before CIC LBP, Clock To Data, JTF Defined	392.10mUI	15.9 %	VALUE <= 466.00mUI
✗	1	1	TJ after CIC LBP, Clock To Data, JTF Defined	487.00mUI	-4.5 %	VALUE <= 466.00mUI

Figure 7. Automated and consolidated HTML report quickly documents the results of all completed tests, including screen images from the oscilloscope taken after each measurement is completed.

Extensibility

You may add additional custom tests or steps to your application using the N5467A User Defined Application (UDA) development tool (www.agilent.com/find/uda). Use UDA to develop functional "Add-Ins" that you can plug into your application.

Add-ins may be designed as:

- Complete custom tests (with configuration variables and connection prompts)
- Any custom steps such as pre or post processing scripts, external instrument control and your own device control

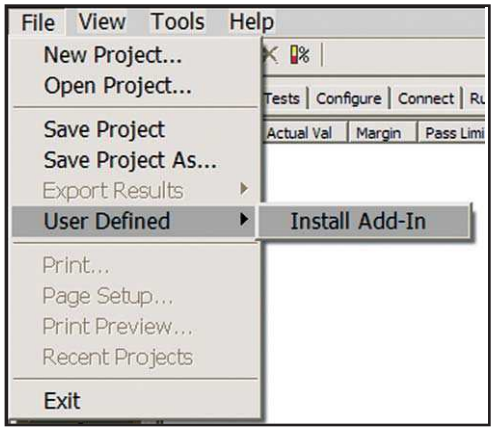

Figure 8. Importing a UDA Add-In into your test application.

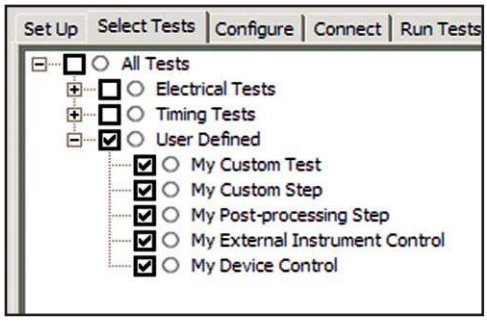

Figure 9. UDA Add-In tests and utilities in your test application.

Automation

You can completely automate execution of your application's tests and Add-Ins from a separate PC using the included N5452A Remote Interface feature (download free toolkit from www.agilent.com/find/scope-apps-sw). You can even create and execute automation scripts right inside the application using a convenient built-in client.

The commands required for each task may be created using a command wizard or from "remote hints" accessible throughout the user interface.

Using automation, you can accelerate complex testing scenarios and even automate manual tasks such as:

- Opening projects, executing tests and saving results
- Executing tests repeatedly while changing configurations
- Sending commands to external instruments
- Executing tests out of order

Combine the power of built-in automation and extensibility to transform your application into a complete test suite executive:

- Interact with your device controller to place it into desired states or test modes before test execution.
- Configure additional instruments used in your test suite such as a pattern generator and probe switch matrix.
- Export data generated by your tests and post-process it using your favorite environment, such as MATLAB, Python, LabVIEW, C, C++, Visual Basic etc.
- Sequence or repeat the tests and "Add-In" custom steps execution in any order for complete test coverage of the test plan.

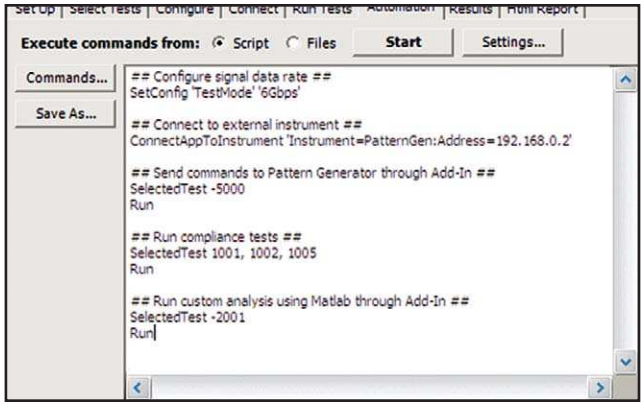

Figure 10. Remote Programming script in the Automation tab.

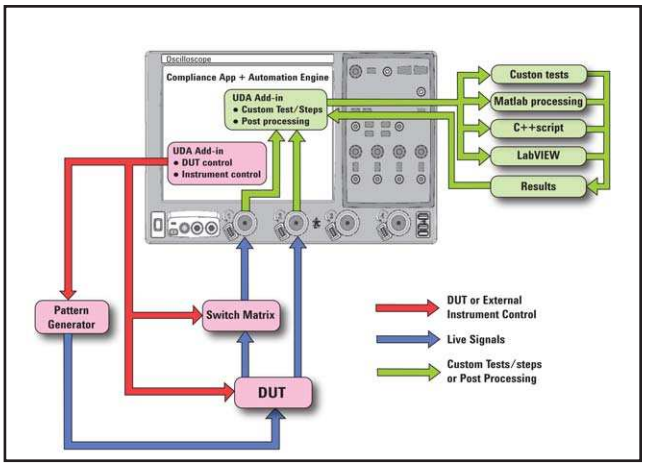

Figure 11. Combine the power of built-in automation and extensibility to transform your application into a complete test suite executive.

Measurement requirements

To use the N5411B software you will need an Agilent 90000A or 90000 X-Series oscilloscope with at least 12 GHz of analog, real-time bandwidth. You will also need the N5400A EZJIT Plus jitter analysis software option (Option 004 on new scopes) and the E2688A serial data analysis/mask testing with clock recovery software option (Option 003 on new scopes). In order to use the software with BIST-T,A,S test mode, your SATA chipset will need to be able to source the required compliance test patterns as defined in the Serial ATA Revision 3.0 specification (HFTP, MFTP, LBP and LFTP). If you are using far-end re-timed loopback mode, then the Agilent 81134A 3.35 Gbps pulse/pattern generator or N4903B J-BERT with option 002 can be automatically programmed by the N5411B to provide the necessary test stimulus signals to be retimed by your chipset for 1.5 Gb/s, 3.0 Gb/s and 6.0 Gb/s signaling. The 81134A or N4903B are also used for OOB signal testing.

Ordering information

To purchase the N5411B software with a new or existing Infiniium Series oscilloscope, order the model numbers shown:

General specifications and transmitted signal requirements tests only with BIST-T,A,S support

Model number	Description
DSA91204A	Infiniium 90000 Series oscilloscope
DSO/DSAX91604A DSO/DSAX92004A DSO/DSAX92504A DSO/DSAX92804A DSO/DSAX93204A	Infiniium 90000 X-Series oscilloscope
N2810A-050	50 Mpts/ch memory (option 050 on new oscilloscopes; included with DSA models)
N5400A	EZJIT Plus jitter analysis software (Option 004 on new oscilloscopes; included with DSA models)
E2688A	Serial data analysis with clock recovery software (Option 003 on new oscilloscopes; included with DSA models)
N5411B	SATA 6 Gb/s compliance test software (option 038 on new oscilloscopes)
Wilder Technologies test fixture or ICT Lanto test fixture	SATA Gen3 Receptacle Adapter **(http://www.wilder-tech.com/sata.htm)** TF-1R31 or TF-2R11 (**http://www.ict-lanto.com/product**)
15443A	Matched cable pair, two 90-cm (36-in) SMA (m-m) cables, propagation delay within 25 ps (or equivalent)
11742A	DC blocking capacitor, 0.045 to 26.5 GHz, 3.5-mm (m-f) connectors (need qty. 2)

General specifications, transmitted signal requirements and OOB tests (also supports BIST-L automation)

Model number	Description
DSA91204A	Infiniium 90000 Series oscilloscope
DSO/DSAX91604A DSO/DSAX92004A DSO/DSAX92504A DSO/DSAX92804A DSO/DSAX93204A	Infiniium 90000 X-Series oscilloscope
N2810A-050	50 Mpts/ch memory (option 080 on new oscilloscopes; included with DSA models)
N5400A	EZJIT Plus jitter analysis software option (Option 004 on new oscilloscopes)
E2688A	Serial data analysis/mask testing with clock recovery software option (Option 003 on new oscilloscopes)
N5411B	SATA 6 Gb/s compliance test software (option 038 on new oscilloscopes)
Wilder Technologies test fixture or ICT-Lanto test fixture	SATA Gen3 Receptacle Adapter **(http://www.wilder-tech.com/sata.htm)** TF-1R31 or TF-2R11 (**http://www.ict-lanto.com/product**)
81134A or N4903B	3.35 Gbps pulse/pattern generator J-BERT high-performance serial BERT 7 Gb/s or 12.5 Gb/s (with option 002)
11636B	Power divider, DC to 26.5 GHz, 3.5-mm (f) connectors (need qty. 2)
11742A	DC blocking capacitor, 0.045 to 26.5 GHz, 3.5-mm (m-f) connectors (need qty. 2)
15442A	Cable kit, four 90-cm (35-in) SMA (m-m) cables or (4 equivalent SMA cables 24-in or 36-in each)
5062-6681	Cable assembly 6-in SMA (m-m) cables or equivalent; (need qty. 4)
8493C	Coaxial fixed attenuator 8493C-010 or 8493C-020 (Need qty. 2)

Accessories and compatibility

Optional test accessories

To complete your test setup, Agilent provides a wide range of cables, adapters, terminations, etc. Please note that the required equipment is listed in the Ordering Information summary. This list is provided for your convenience to accommodate necessary mating switches or additional debug capability.

Model number	Description
11667B	Power splitter, DC to 26.5 GHz, 3.5-mm (f) connectors
11636B	Power divider, DC to 26.5 GHz, 3.5-mm (f) connectors
1250-1158	SMA (f-f) adapter, DC to 18 GHz
1250-1159	SMA (m-m) adapter, DC to 18 GHz
1250-1694	SMA (m) to SMA (f) adapter
15442A	Cable kit, four 90-cm (36-in) SMA (m-m) cables
15443A	Matched cable pair, two 90-cm (36-in) SMA (m-m) cables, propagation delay within 25 ps
1810-0118	SMA (m) 50-ohm termination
5062-6681	Cable assembly 6 in. SMA (need qty. 4)
11742A	DC blocking capacitor, 0.045 to 26.5 GHz, 3.5-mm (m-f) connectors
15435A	Transition time convertor, 150ps for SATA Gen 1/2 (need qty 2)
Picosecond pulse labs	Risetime filter, 100ps for SATA Gen 3, 5915-110-100ps (need qty 2) (http://www.picosecond.com)

Table 1. Optional test accessories

The N5411B software is compatible with Agilent 90000A or 90000 X Series oscilloscopes operating software revision 3.03, or higher. For oscilloscopes with earlier software revisions, free upgrade software is available at **www.agilent.com/find/scope-apps-sw**

Oscilloscope compatibility

Data rate	Recommended new purchase	Bandwidth of recommended oscilloscope
1.5 Gbps only	DSO/DSA90804A	8 GHz
1.5 Gbps and 3 Gbps	DSO/DSA91204A DSO/DSA91304A	12 GHz 13 GHz
1.5 Gbps, 3 Gbps and 6 Gbps	DSO/DSA91204A DSO/DSA91304A DSO/DSAX91604A DSO/DSAX92004A DSO/DSAX92504A DSO/DSAX92804A DSO/DSAX93204A	12 GHz 13 GHz 16 GHz 20 GHz 25 GHz 28 GHz 32 GHz

Note: While 10 GHz of bandwidth is recommended by the Serial ATA Revision 3.1 specification for testing 1.5Gbps SATA links, the DSA90804A will provide accurate measurement results for signals with rising and falling edges of 70ps (20%-80%) or slower.

Tests performed

The N5411B software performs these transmitter physical layer compliance tests per the requirements of the Serial ATA Revision 3.1 specification.

Test parameter	Test interfaces						
General specifications	**Gen1i**	**Gen1m**	**Gen1x**	**Gen2i**	**Gen2m**	**Gen2x**	**Gen3i**
Channel speed	✔	✔	✔	✔	✔	✔	✔
Tui, unit interval	✔	✔	✔	✔	✔	✔	✔
Ftol, TX frequency long term stability	✔	✔	✔	✔	✔	✔	✔
Fssc, spread-spectrum modulation frequency	✔	✔	✔	✔	✔	✔	✔
SSCtol, spread-spectrum modulation deviation	✔	✔	✔	✔	✔	✔	✔
Transmitted signal requirements	**Gen1i**	**Gen1m**	**Gen1x**	**Gen2i**	**Gen2m**	**Gen2x**	**Gen3i**
VdiffTX, TX differential output voltage	✔	✔	✔	✔	✔	✔	✔
T20-80TX, TX rise/fall time	✔	✔	✔	✔	✔	✔	✔
tskewTX, TX differential skew	✔	✔	✔	✔	✔	✔	✔
R/Fbal, TX rise/fall iImbalance	n/r	n/r	n/r	✔	✔	n/r	n/r
Ampbal, TX amplitude imbalance	n/r	n/r	✔	✔	✔	n/r	n/r
Vcm, ac, TX AC common mode voltage	n/r	n/r	n/r	✔	✔	n/r	✔
TJ after CIC, Clk-Data, fBAUD/1667	n/r	n/r	✔	n/r	n/r	✔	n/r
DJ after CIC, Clk-Data, fBAUD/1667	n/r	n/r	✔	n/r	n/r	✔	n/r
TJ at Connector, Clk-Data, fBAUD/500 (JTF defined)	✔	✔	n/r	n/r	✔	✔	n/r
DJ at Connector, Clk-Data, fBAUD/500 (JTF defined)	✔	✔	n/r	n/r	✔	✔	n/r
RJ before CIC, Clk-Data (JTF defined)	n/r	n/r	n/r	n/r	n/r	n/r	✔
TJ before CIC, Clk-Data (JTF defined)	n/r	n/r	n/r	n/r	n/r	n/r	✔
TJ after CIC, Clk-data (JTF defined)	n/r	n/r	n/r	n/r	n/r	n/r	✔
OOB Specifications	**Gen1i**	**Gen1m**	**Gen1x**	**Gen2i**	**Gen2m**	**Gen2x**	**Gen3i**
Vthresh, OOB signal detection threshold	✔	✔	✔	✔	✔	✔	✔
UIOOB, UI during OOB signaling	✔	✔	✔	✔	✔	✔	✔
COMINIT/COMRESET/COMWAKE burst length	✔	✔	✔	✔	✔	✔	✔
COMINIT/COMRESET transmit gap length	✔	✔	✔	✔	✔	✔	✔
COMWAKE transmit gap length	✔	✔	✔	✔	✔	✔	✔
COMWAKE gap detection windows	✔	✔	✔	✔	✔	✔	✔
COMINIT/COMRESET gap detection windows	✔	✔	✔	✔	✔	✔	✔

✔ = covered test

n/r = not required by specification

Table 2. SATA electrical tests performed by the N5411B software

Related literature

Publication title	Publication type	Publication number
Infiniium DSO/DSA 90000A Series	Data sheet	5989-7819EN
Infiniium 90000 X-Series Oscilloscope	Data sheet	5990-5271EN
N5400A EZJIT Plus and EZJIT Jitter Analysis Software for Infiniium Series Oscilloscopes	Data sheet	5989-0109EN
N5436A Infiniium Protocol Viewer and Packet Decode for Infiniium 90000 Oscilloscopes	Data sheet	5989-8438EN

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www.pxisa.org
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