# D9040SASC Serial Attached SCSI-4 (SAS-4) Compliance Test Software

Keysight Technologies, Inc. Serial Attached SCSI-4 (SAS-4) compliance test software for Infiniium Series oscilloscopes provides you with a fast and easy way to validate and debug your SAS 1.5, 3.0, 6.0, 12.0 and 22.5 Gbps silicon, host bus adapter, initiator, high-density disk drive or enclosure backplane. It also supports automated SAS out-of-band (OOB) and loop back signal tests with the 81134A pattern generator, N4903B JBERT with Option 002 and M8020A JBERT. The SAS test software allows you to automatically execute SAS electrical checklist tests at each of the IT and CT 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 SAS-4 test software, you also will need a method of connecting to the SAS interface on the electrical mating surfaces of your SAS connector.

Wilder Technologies (www.wilder-tech.com) provides test fixtures for SFF-8482, SAS-3 and SAS-4 x2 internal drive/backplane connector interfaces for SAS 1.5, 3.0, 6.0, 12.0 and 22.5 Gbps. In addition, the Mini-SAS HD test fixtures for SAS-3 and SAS-4 plug and receptacle interfaces are available from Wilder Technologies.

The SAS-4 test software performs a wide range of tests required to meet the physical layer requirements. The SAS-4 test software helps you execute the most difficult physical layer tests for transmitters (TX tests only), at the near-end (IT/CT interfaces) of a SAS link, that can be measured with a combination of a 33-GHz or higher real-time oscilloscope and the 81134A, N4903B or M8020A programmable pulse/pattern generator. The SCSI Trade Association currently sponsors at least one interoperability plugfests annually for member companies to test their products' operational capability and margins with other member companies' products.

With the SAS-4 test software, you can use the same oscilloscope you use for everyday debugging to perform automated testing and margin analysis based on the requirements in the SAS-4 specification.

## Features

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

- Test definitions based on T10 SAS-4 specification and UNH-IOL SAS Physical Layer Test Suite
- Support SAS 1.5, 3.0, 6.0, 12.0 and 22.5 Gbps data rates
- Support transmitter tests that require SAS3_EYEOPENING and WDP scripts
- Easily select tests and configure IT/CT interfaces for C testing
- Automated setup and programming of scope measurements
- Graphical HTML test results report format for documentation and sharing
- Trials test reporting capability to allow quick comparison of test results with multiple test patterns or device configurations
- Wilder Technologies SAS IT/IR Test Fixtures for SFF-8482 SAS-3 and SAS-4 x2 Internal Plug/ Receptacle Interfaces
- Wilder Technologies Mini-SAS HD Test Fixtures for SAS-3 and SAS-4 Plug/Receptacle Interfaces

## Saves you Time

The SAS-4 test software saves you time by setting the stage for automatic execution of SAS electrical tests. Part of the difficulty of performing electrical tests for SAS is connecting the oscilloscope to the target device, configuring the scope's measurement system for 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 SAS 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 SAS-4 test software offers the required tests to verify conformance with the physical layer parameters. The software automatically configures the oscilloscope for each test, and it provides an informative results report that includes margin analysis indicating how close your product is to passing or failing that specification. See Table 1 for a complete list of the measurements made by the SAS-4 test software.
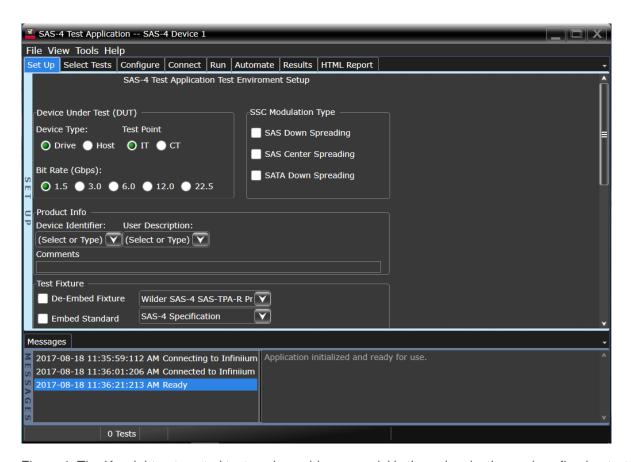
Figure 1. The Keysight automated test engine guides you quickly through selecting and configuring tests, setting up the connection, running the tests, and viewing the results. You can easily select individual tests or groups of test with a mouse-click and customize your output report based on the test results you want to see.

## Comprehensive Tests

The SAS-4 test software extends the ease-of-use advantages of Keysight's Infiniium Series oscilloscopes to testing SAS designs. The Keysight automated test engine walks you quickly through the steps required to define the tests, set up the tests, perform the tests, and view the test results. You can select a category of tests all at once or specify individual tests. The user interface is oriented to minimize unnecessary reconnections, which saves time and minimizes the potential for operator error. You can save tests and configurations as project files and recall them later for quick testing and review of previous test results. Straightforward menus let you perform tests with a minimum of mouse clicks.

SAS-4 specification has a new recommendation of the insertion loss profile of the test fixture being used for testing. The intents are to more accurately test the 22.5 Gbps signal without the effect of test fixtures so the industry can get more consistent results and avoid marginal design from passing using better test fixtures, but not meet the actual performance in real world. The SAS-4 test software includes the capability to embed and de-embed loss to the test fixture to ensure it meets the insertion loss requirement.

## Configurability and Guided Connection

The SAS-4 test software provides flexibility in your test setup. When the tests you select require it, the software guides you to make connection changes with hookup diagrams. The SAS electrical test software provides you with user-defined controls for critical test parameters, such as interface, line baud rate and number of unit intervals (UI) desired for the test group.

After configuring the tests according to your needs, the user interface displays the connection screen that is specific to the configuration data you have selected. This includes the oscilloscope channels used for the test and the routing of any necessary SMA cabling, power dividers and test fixtures needed to perform the tests.
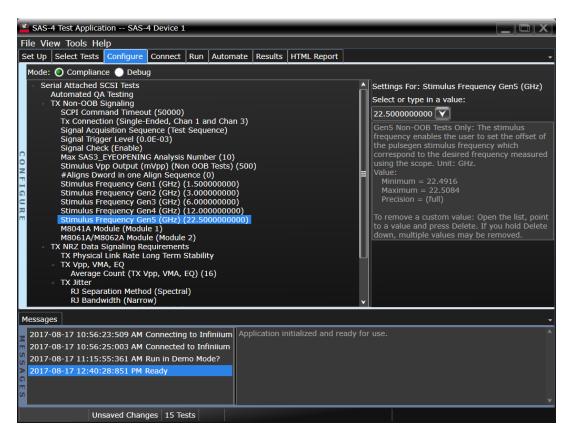


Figure 2. In configuring the tests, you define the number of UI to test, whether a TCTF load is being used and how the differential inputs and transient test probe are connected to the oscillosope.

## Comprehensive Result Analysis

In addition to providing you with measurement results, the SAS-4 test 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 test assertion. You select the margin test report parameter, which means you can specify the level at which warnings are issued to alert you to the electrical tests where your product is operation close to the official test limit defined by the specification for a given test assertion.

The SAS-4 test software generates thorough reports that not only capture the performance and status of the device under test but capture the screen shots of your most significant measurements for your documentation and evaluation.
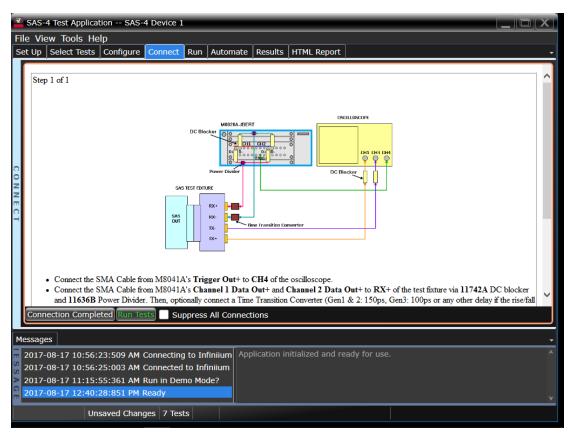


Figure 3. When you make multiple tests where the connections must be changed, the software prompts you with connection diagrams.
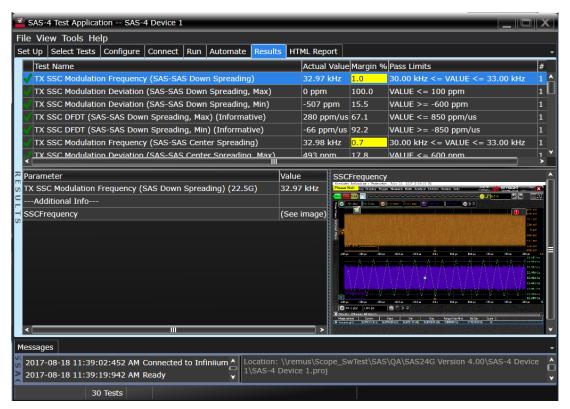
Figure 4. The SAS electrical test software results report documents you test, indicates the pass/fail status, the test specification range, the measured values and the margin.

## Measurement Requirements

To use the SAS-4 test software you will need a Keysight Infiniium Series oscilloscope with at least 12-GHz of analog, real-time bandwidth. MATLAB license is required to run the WDP tests. In order to use the SAS-4 test software for validation, your SAS chipset will need to be able to source the required compliance jitter tolerance pattern (CJTPAT), SCRAMBLE_0 pattern and long random pattern (e.g. IDLE Dwords, PRBS 9, PRBS 15, etc.).

## Recommended Oscilloscopes

The SAS-4 software is compatible with Keysight Infiniium Series oscilloscopes with operating software revision 6.00 or higher. For oscilloscopes with earlier revisions, free upgrade software is available at www.keysight.com/find/scope-apps-sw.

| Data rate | Minimum Bandwidth | Minimum Channels | Description |
|---|---|---|---|
| 6 Gb/s | 12 GHz | 2 | Infiniium 90000A, V-series, Z-series |
| 12 Gbps | 20 GHz | 2 | Infiniium 90000A, V-series, Z-series |

| 22.5 Gbps | 33 GHz | 2 | Infiniium 90000A, V-series, Z-series |
|---|---|---|---|

## Ordering Information

### Software

| Model number | Description | Note |
|---|---|---|
| D9040SASC | SAS-4 Compliance Test Software | Required |
| D9010JITA | Timing jitter, vertical noise and phase noise analysis | Required |
| D9020ASIA | Advanced Signal Integrity Software (EQ, InfiniiSim Advanced) | Recommended |
| N8831A | MATLAB | Required |

### Hardware

| Model number | Description | Quantity |
|---|---|---|
| SAS-TPA | Wilder Technologies SAS IT/IR test fixtures for SFF-8482 SAS-3 x2 internal plug/receptacle interfaces (www.wilder-tech.com) | 1 |
| MSASHD-TPA | Wilder Technologies Mini-SAS HD test fixtures for SAS-3 plug/receptacle interfaces (www.wilder-tech.com) | 1 |
| 11742A | DC blocking capacitor, 0.045 to 26.5 GHz, 3.5-mm (m-f) connectors | 2 |
| 15443A | Matched cable pair, two 90-cm (36-in) SMA (m-m) cables, propagation delay within 25 ps (or equivalent) | 3 |
| 81134A | 3.35 Gbps pulse generator | 1 |
| M8020A | J-BERT high-performance serial BERT 32 or 16 Gb/s | 1 |
| 11636B | Power divider, DC to 26.5 GHz, 3.5-mm (f) connectors | 2 |
| 5062-6681 | Cable assembly 6-in SMA (m-m) cables or equivalent | 4 |

## Recommended Test Accessories

To complete your test setup, Keysight 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 |
|---|---|
| SAS-TPA | Wilder Technologies SAS IT/IR test fixtures for SFF-8482 SAS-3 x2 internal plug/receptacle interfaces (www.wilder-tech.com) |
| MSASHD-TPA | Wilder Technologies Mini-SAS HD test fixtures for SAS-3 plug/receptacle interfaces (www.wilder-tech.com) |
| 11742A | DC blocking capacitor, 0.045 to 26.5 GHz, 3.5-mm (m-f) connectors |
| 15443A | Matched cable pair, two 90-cm (36-in) SMA (m-m) cables, propagation delay within 25 ps (or equivalent) |
| 15442A | Cable kit, four 90-cm (36-in) SMA (m-m) cables |
| 1250-1694 | SMA (m) to SMA (f) adapter |
| 1250-1159 | SMA (m-m) adapter, DC to 18 GHz |
| 1250-1158 | SMA (f-f) adapter, DC to 18 GHz |
| 11636B | Power divider, DC to 26.5 GHz, 3.5-mm (f) connectors |
| 11667B | Power splitter, DC to 26.5 GHz, 3.5-mm (f) connectors |
| 1810-0118 | SMA (m) 50 ohm termination |

## Flexible Software Licensing and KeysightCare Software Support Subscriptions

Keysight offers a variety of flexible licensing options to fit your needs and budget. Choose your license term, license type, and KeysightCare software support subscription.

### License Terms

**Perpetual** – Perpetual licenses can be used indefinitely.

**Time-based** – Time-based licenses can be used through the term of the license only (6, 12, 24, or 36 months).

### License Types

**Node-locked** – License can be used on one specified instrument/computer.

**Transportable** – License can be used on one instrument/computer at a time but may be transferred to another using Keysight Software Manager (internet connection required).

**USB Portable** – License can be used on one instrument/computer at a time but may be transferred to another using a certified USB dongle (available for additional purchase with Keysight part number E8900-D10).

**Floating (single site)** – Networked instruments/computers can access a license from a server one at a time. Multiple licenses can be purchased for concurrent usage.

### KeysightCare Software Support Subscriptions

Perpetual licenses are sold with a 12 (default), 24, 36, or 60-month software support subscription. Support subscriptions can be renewed for a fee after that.

Time-based licenses include a software support subscription through the term of the license.

**KeysightCare Software Support Subscription provides peace of mind amid evolving technologies.**

- Ensure your software is always current with the latest enhancements and measurement standards.
- Gain additional insight into your problems with live access to our team of technical experts.
- Stay on schedule with fast turnaround times and priority escalations when you need support.

### Selecting your license:

**Step 1.** Choose your software product (eg. S1234567A).
**Step 2.** Choose your license term: perpetual or time-based.
**Step 3.** Choose your license type: node-locked, transportable, USB portable, or floating.
**Step 4.** Depending on the license term, choose your support subscription duration.

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