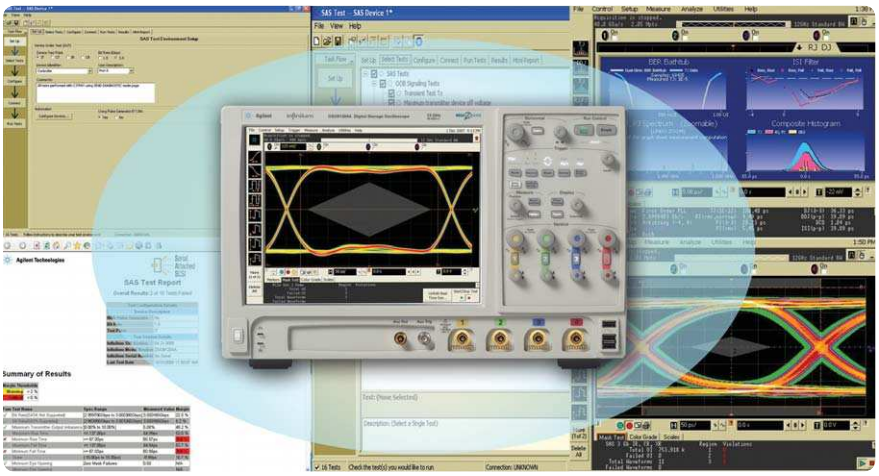
# Agilent N5412A Serial Attached SCSI (SAS) Electrical Performance Validation and Compliance Software for Infiniium Series Oscilloscopes

## N5421A SAS IT/IR Test Fixtures for SFF-8482 SAS x2 Internal Plug/Receptacle Interfaces

Data Sheet

**Features**
The N5412A SAS electrical test software simplifies the validation of SAS designs:

- Support SAS 1.5 Gb/s and 3.0 Gb/s (OOB signaling tests only for 6.0 Gb/s)
- Easily select tests and configure SAS IT/CT/IR/CR interfaces for compliance testing
- Automated setup and programming of scope measurements
- Test definitions based on UNH-IOL standard
- 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 (TX drive strength, pre-emphasis ratios, slew rates, etc.)



**Verify and debug your SAS devices faster and more easily**

Agilent Technologies' N5412A serial attached SCSI (SAS) electrical performance validation and compliance software for Infiniium oscilloscopes provides you with a fast and easy way to validate and debug your SAS 1.5-Gbps, 3.0 Gb/s and 6.0 Gb/s silicon, host bus adapter, initiator, high-density disk drive or enclosure backplane. The SAS electrical test software allows you to automatically execute SAS electrical checklist tests at each of the IT, CT, IR and CR 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.

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To make measurements with the N5412A SAS electrical test software, you also will need a method of connecting to the SAS compliance interface on the electrical mating surfaces of your SAS connector. Agilent currently provides a full set of compliance test fixtures for the SFF-8482, SAS x2 internal drive/backplane connector interfaces for SAS 1.5 Gb/s, 3.0 Gb/s and 6.0 Gb/s. The fixtures do meet the zero-length test load requirement for testing transmitter device compliance point per section 5. 7. 2 of the SAS-2.1 specification[1]. The N5421A SAS SFF-8482 compliance test fixture kit offers connectivity from the SFF-8482 primary and secondary transmitter and receiver differential ports to SMA for connection to Agilent Infiniium Series ultra-high-performance oscilloscopes. The N5421A kit also includes the necessary TX and RX transient circuit test loads.

The N5412A SAS electrical test software performs a wide range of tests required to meet the physical layer requirements per section 5.8, Tables 29-43 of the SAS-2.1 specification. The N5412A SAS electrical test software helps you execute the most difficult physical layer tests for transmitters (TX tests only), both at the near-end (IT/CT interfaces) and far-end (IR/CR interfaces) of a SAS link, that can be measured with a combination of a 12-GHz or higher real-time oscilloscope and a 3.0-Gbps programmable pulse/pattern generator. The SCSI Trade Association currently sponsors at least two compliance and interoperability plugfests annually for member companies to test their products' operational capability and margins with other member companies' products.

With the N5412A SAS electrical 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-2.1 specification.

[1] The test circuits and parameters are defined in the "Project TID/2125-D: Serial Attached SCSI-2.1 (SAS-2.1) working draft, Revision 4, September 17, 2009 hereinafter referred to as "the SAS-2.1 specification."

## N5412A saves you time

The N5412A SAS electrical 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 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 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 N5412A SAS electrical test software offers the required tests to verify compliance with the physical layer parameters defined per section 5.8, Tables 29-43 of the SAS-2.1 specification. 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 2 for a complete list of the measurements made by the N5412A SAS electrical test software.

## Easy test definition

The N5412A SAS electrical test software extends the ease-of-use advantages of Agilent's Infiniium Series oscilloscopes to testing SAS designs. The Agilent 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.

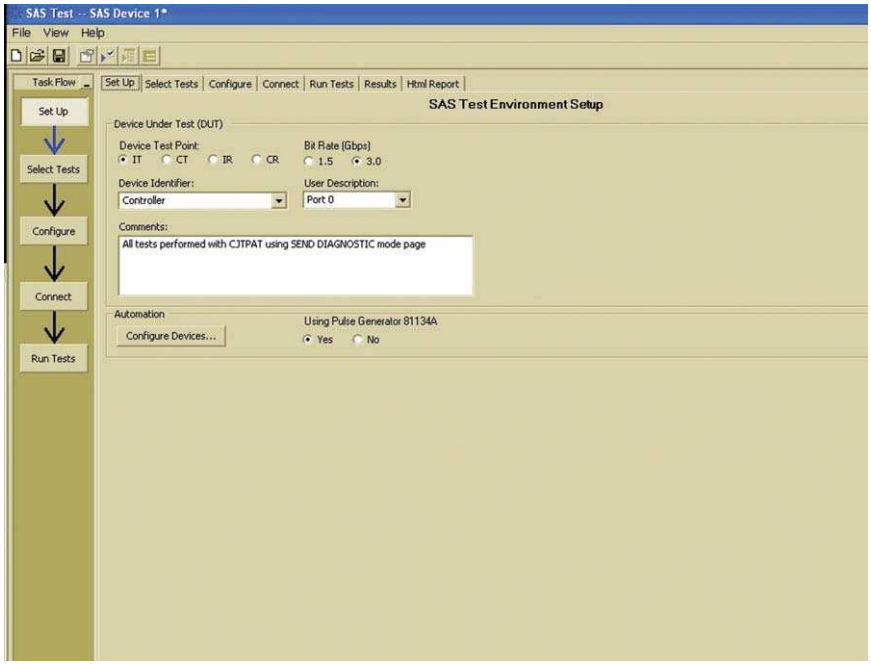



**Figure 1. The Agilent automated test engine guides you quickly through selecting and configuring tests, setting up the connection, running the tests, and viewing the results. You can easily select individual tests or groups of test with a mouse-click and customize your output report based on the test results you want to see.**

## Configurability and guided connections

The N5412A SAS electrical 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 N5412A 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.

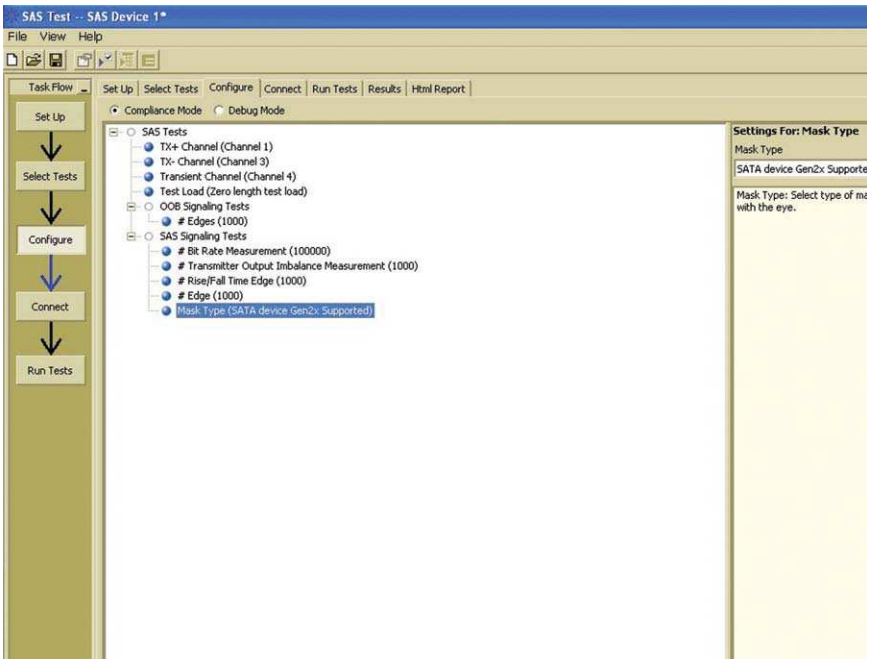



**Figure 2. In configuring the tests, you define the number of UI to test, whether or not a TCTF load is being used and how the differential inputs and transient test probe are connected to the oscilloscope.**

## Reports with margin analysis

In addition to providing you with measurement results, the N5412A SAS electrical 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 particular 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.

## Thorough performance reporting

The N5412A SAS compliance and validation 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.

## Measurement requirements

To use the N5412A SATA electrical performance validation and compliance software you will need an Agilent Infiniium Series oscilloscope with at least 12-GHz of analog, real-time bandwidth. You also will need N5400A EZJIT Plus jitter analysis software (Option 004 on new scopes) and E2688A serial data analysis/mask testing with clock recovery software (Option 003 on new scopes). In order to use the N5412A SAS electrical test software for compliance validation, your SAS chipset will need to be able to source the required compliance jitter tolerance pattern (CJTPAT) or jitter tolerance pattern (JTPAT) as defined in the SAS-2.1 specification, Annex A. The SCSI software command language provides a method for enabling these PHY test patterns in most chipsets by sending a "send diagnostic" command through a protocol-specific diagnostic page (see "Section 4.2 Phy test functions" of the SAS-2.1 Specification for details).

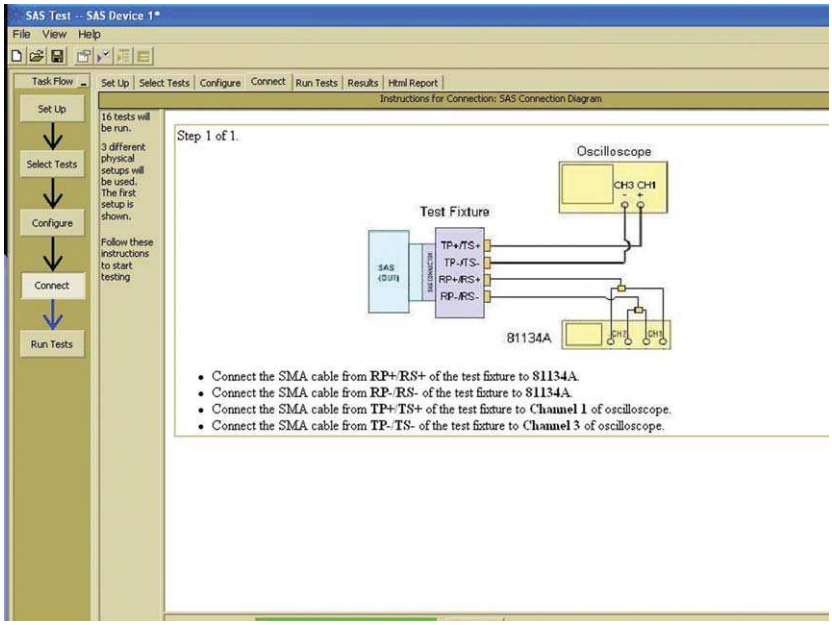



**Figure 3. When you make multiple tests where the connections must be changed, the software prompts you with connection diagrams.**

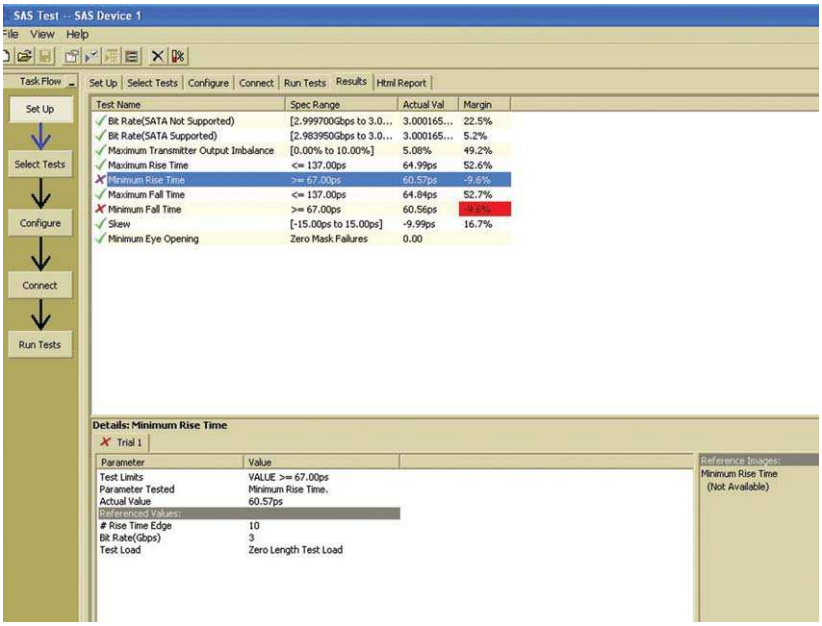



**Figure 4. The SAS electrical test software results report documents you test, indicates the pass/fail status, the test specification range, the measured values and the margin.**

## Recommended 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 |
| 11742A | DC blocking capacitor, 0.045 to 26.5 GHz, 3.5-mm (m-f) connectors |
| N5421A | Serial attached SCSI IT/IR test fixtures for SFF-8482 SAS x2 internal plug/receptacle interfaces |
| IBNTST4X | Gore SMA breakout cable for SFF-8470 SAS x4 external receptacle interface tests (CT interface) (visit **www.gore.com** for purchasing information) |
| TCTF-SAS | Molex SFF-8470 SAS x4 external transmitter compliance transfer function (TCTF) for CR interface tests (contact **scsi@molex.com** for purchasing information) |

**Table 1. Recommended test accessories**

## Oscilloscope compatibility

The N5412A SAS electrical performance validation and compliance software is compatible with Agilent 80000 Series oscilloscopes with operating software revision 5.71 or higher (Windows® XP Pro),90000 or 90000 X Series with version 2.1 or higher. For oscilloscopes with earlier software revisions, free upgrade software is available at **www.agilent.com/find/scope-apps-sw**

| Data rate | Recommended oscilloscope | Bandwidth of recommended oscilloscope |
|---|---|---|
| 1.5 Gb/s ONLY | DSO80804A | 8 GHz |
| | DSO/DSA90804A | 8 GHz |
| 1.5 Gb/s or 3.0 Gb/s or 6.0 Gb/s | DSO81204A | 12 GHz |
| | DSO81304A | 13 GHz |
| | DSO/DSA91204A | 12 GHz |
| | DSO/DSA91304A | 13 GHz |
| | DSO/DSAX91604A | 16 GHz |
| | DSO/DSAX92004A | 20 GHz |
| | DSO/DSAX92504A | 25 GHz |
| | DSO/DSAX92804A | 28 GHz |
| | DSO/DSAX93204A | 32 Ghz |

Note:

A 12 GHz real-time oscilloscope is recommended to accurately measure the 67ps minimum risetime for 3.0Gbps SAS signals and to provide full compliance to the specification.

## Tests performed

The N5412A SAS electrical performance validation and compliance software performs the following tests as per section 5.8, Tables 29-43 of the SAS-2.1 specification, by the T10/2125-0.

| Test parameter | Test interfaces IT | CT | IR | CR |
|---|---|---|---|---|
| OOB signaling test | | | | |
| Maximum Transmitter transients | Table 33 | Table 33 | | |
| Maximum Receiver transients | | | Table 41 | Table 41 |
| Maximum Transmitter device off voltage | Table 33 | Table 33 | | |
| OOB Offset Delta | Table 40 | Table 40 | | |
| OOB Common Mode Delta | Table 40 | Table 40 | | |
| Minimum OOB Burst amplitude (SATA supported) | Table 40 | Table 40 | | |
| Minimum OOB Burst amplitude (SATA not supported) | Table 40 | Table 40 | Table 40 | Table 40 |
| Maximum Noise during OOB idle time | | | Table 29 | Table 29 |
| SAS signaling tests | | | | |
| Bit rate | Table 31 | Table 31 | | |
| Bit rate (SATA supported) | | | Table 41 | Table 41 |
| Bit rate (SATA not supported) | | | Table 41 | Table 41 |
| Maximum Transmitter Output Imbalance | Table 33 | Table 33 | | |
| Maximum Rise Time | Table 33 | Table 33 | | |
| Minimum Rise Time | Table 33 | Table 33 | | |
| Maximum Fall time | Table 33 | Table 33 | | |
| Minimum Fall time | Table 33 | Table 33 | | |
| Skew | Table 34 | Table 34 | Table 43 | Table 43 |
| Minimum Eye Opening | Table 34 | Table 34 | Table 43 | Table 43 |
| TJ | Table 34 | Table 34 | Table 43 | Table 43 |
| DJ | Table 34 | Table 34 | Table 43 | Table 43 |

**Table 2. SAS transmitted signal electrical characterization tests performed by the N5412A software**

## Ordering information

To purchase the N5412A SAS electrical performance validation and compliance software with a new or existing Infiniium Series oscilloscope, order the model numbers shown:

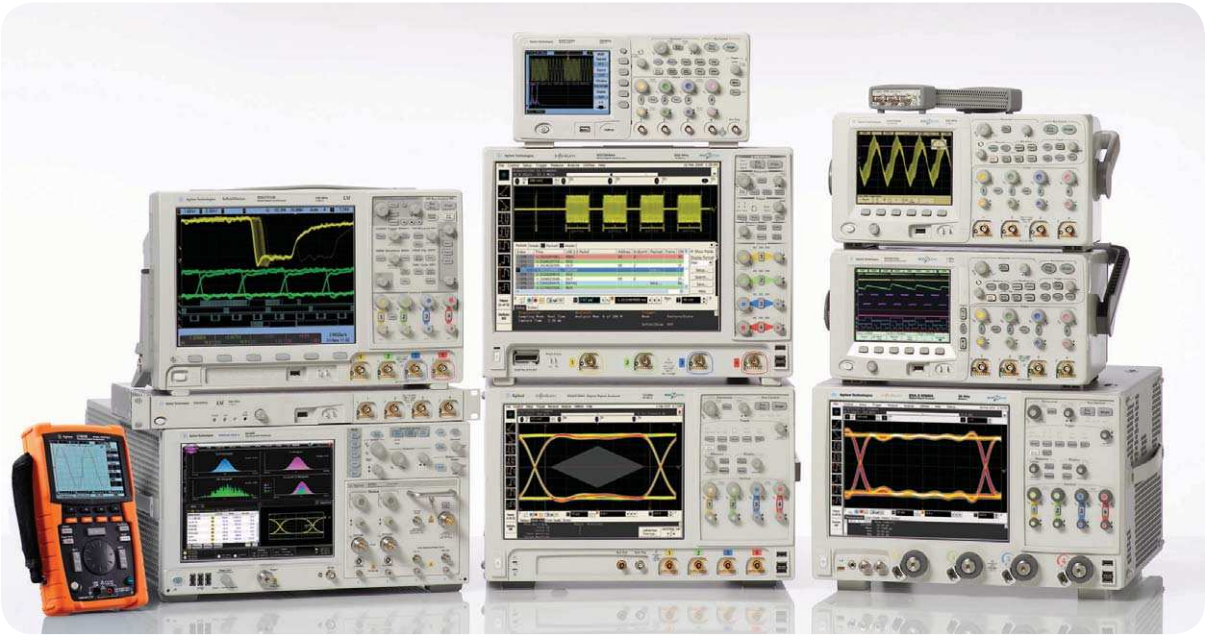
| Model number | Description |
|---|---|
| N5400A | EZJIT Plus jitter analysis software (Option 004 on new oscillo scopes) |
| E2688A | Serial data analysis/mask testing with clock recovery software (Option 003 on new oscilloscopes) |
| N5412A | Serial attached SCSI electrical performance validation and compliance software for Infiniium 80000, 90000 and 90000 X Series oscilloscopes |

For complete electrical performance validation and compliance you will also need to order the following accessories

| | |
|---|---|
| 11636B | Power divider, DC to 26.5 GHz, 3.5-mm (f) connectors (need qty. 2) |
| 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 (need qty. 2) |
| N5421A | Serial attached SCSI IT/CT test fixtures for SFF-8482 SAS x2 internal plug/receptacle interfaces |
| 15442A | Cable kit, four 90-cm (35-in) SMA (m-m) cables (or equivalent SMA cables 24-in or 36-in; need qty. 4) |
| 1169A | InfiniiMax II 12-GHz differential active voltage probe amplifier (probe head purchased separately) |
| E2678A | InfiniiMax differential socketed probe head (with socketed header adapter for 25-mil square pins; probe amplifier pur chased separately) |

## Related Literature

| Publication Title | Publication Type | Publication Number |
|---|---|---|
| *Infiniium 90000 Series Oscilloscopes* | 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 |



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