UNH IOL SERIAL ATTACHED SCSI (SAS) CONSORTIUM

Clause 5
SAS 3.0 Speed Negotiation Test Suite
Version 1.4

Technical Document

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UNH IOL SAS Consortium
InterOperability Laboratory
University of New Hampshire

121 Technology Drive, Suite 2
Durham, NH 03824
Phone: (603) 862-0701
Fax: (603) 862-4181
http://www.iol.unh.edu/consortiums/sas

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MODIFICATION RECORD

Date	*Revision*	*Comments*
06-25-2007	0.1	Initial version
06-29-2007	0.2	Fixed References, Title, minor typographical changes.
07-20-2007	0.3	Added to discussions on selected tests. Expanded on procedures for all tests.
08-01-2007	0.4	Updated to reflect SAS2r11 Standard. Added several tests to Group 1. Adjusted Purpose and Discussion sections on tests in Group 1.
05/31/11	0.5	Fixed values in test 6.7.1.3
8/5/2011	0.6	Updated References
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09/02/14	0.8	Documented Change in Bit Range for Test 5.7.1.14
02/27/15	0.9	Updated Modification Records
09/21/15	1.4	Updated to spl03r07

The University of New Hampshire
InterOperability Laboratory

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Michael Davidson	UNH InterOperability Laboratory
Michael Klempa	UNH InterOperability Laboratory
Joshua Beaudet	UNH InterOperability Laboratory
Andy Baldman	UNH InterOperability Laboratory
Dave Woolf	UNH InterOperability Laboratory
Joel Nkounkou	UNH InterOperability Laboratory
Pat Kennedy	UNH InterOperability Laboratory

INTRODUCTION

The University of New Hampshire's InterOperability Laboratory (IOL) is an institution designed to improve the interoperability of standards based products by providing an environment where a product can be tested against other implementations of a standard. This particular suite of tests has been developed to help implementers evaluate the Physical Layer functionality of their Serial Attached SCSI (SAS) products.

These tests are designed to determine if a SAS product conforms to specifications defined in Clause 5 of ***T10/BSR INCITS 492 Revision 7 – SAS Protocol Layer (SPL).*** (hereafter referred to as the "SAS-3 Standard", or "the Standard"). Successful completion of all tests contained in this suite does not guarantee that the tested device will successfully operate with other SAS products. However, when combined with satisfactory operation in the IOL's interoperability test bed, these tests provide a reasonable level of confidence that the Device Under Test (DUT) will function properly in many SAS environments.

The tests contained in this document are organized in order to simplify the identification of information related to a test, and to facilitate in the actual testing process. Tests are separated into groups, primarily in order to reduce setup time in the lab environment, however the different groups typically also tend to focus on specific aspects of device functionality. A three-number, dot-notated naming system is used to catalog the tests, where the first number always indicates the specific clause of the reference standard on which the test suite is based. The second and third numbers indicate the test's group number and test number within that group, respectively. This format allows for the addition of future tests in the appropriate groups without requiring the renumbering of the subsequent tests.

The test definitions themselves are intended to provide a high-level description of the motivation, resources, procedures, and methodologies specific to each test. Formally, each test description contains the following sections:

Purpose

The purpose is a brief statement outlining what the test attempts to achieve. The test is written at the functional level.

References

This section specifies all reference material *external* to the test suite, including the specific sub-clauses references for the test in question, and any other references that might be helpful in understanding the test methodology and/or test results. External sources are always referenced by a bracketed number (e.g., [1]) when mentioned in the test description. Any other references in the test description that are not indicated in this manner refer to elements within the test suite document itself (e.g., "Appendix 5.A", or "Table 5.1.1-1")

Resource Requirements

The requirements section specifies the test hardware and/or software needed to perform the test. This is generally expressed in terms of minimum requirements, however in some cases specific equipment manufacturer/model information may be provided.

Last Modification

This specifies the date of the last modification to this test. Editorial modifications (e.g., updated table/figure numbers) and/or conformance limit changes due to an updated version of the standard will be denoted by a decimal increase in version number (e.g., 'version 1.1'). Modifications to the test procedure will be denoted by an integer number version increment (e.g., 'version 2.0').

Discussion

The discussion covers the assumptions made in the design or implementation of the test, as well as known limitations. Other items specific to the test are covered here as well.

Test Setup

The setup section describes the initial configuration of the test environment. Small changes in the configuration should not be included here, and are generally covered in the test procedure section (next).

Procedure

The procedure section of the test description contains the systematic instructions for carrying out the test. It provides a cookbook approach to testing, and may be interspersed with observable results.

Observable Results

This section lists the specific observables that can be examined by the tester in order to verify that the DUT is operating properly. When multiple values for an observable are possible, this section provides a short discussion on how to interpret them. The determination of a pass or fail outcome for a particular test is generally based on the successful (or unsuccessful) detection of a specific observable.

Possible Problems

This section contains a description of known issues with the test procedure, which may affect test results in certain situations. It may also refer the reader to test suite appendices and/or other external sources that may provide more detail regarding these issues.

GROUP 1: Speed Negotiation Window Three

Overview:

The following tests cover Speed Negotiation Window 3 (SNW-3).

Scope:

All of the tests described in this section are implemented and currently active through the UNH IOL SAS Consortium. Comments and questions are welcome, and may be forwarded to the SAS Lab (saslab@iol.unh.edu).

Test 5.7.1.1: Support for SNW-3

Purpose

To verify the DUT's support for SNW-3.

References

5.10.4.2.2 SAS SPL
5.10.4.2.3.3 SAS SPL

Resource Requirements

A Protocol Generator/Analyzer capable of transmitting and receiving SAS OOB signals and SAS 2.0 Speed Negotiation.

Discussion

If a phy supports SNW-3, then the phy:

a) transmits a 32-bit phy capabilities value describing the capabilities of they phy.
b) receives a 32-bit phy capabilities value from the attached phy. If the attached phy does not support SNW-3, they phy capabilities bits are all set to zero (i.e., D.C. Idle).

If a phy does not support SNW-3, then a phy:

a) transmits D.C. Idle.
b) ignores any SNW-3 phy capabilities bits received.

Test Setup

The DUT and the Testing Station are physically connected the the DUT is powered off.

Procedure

1. Power on the DUT.
2. The testing station is instructed to transmit COMINIT/COMRESET to the DUT.
3. The DUT is expected to respond with COMINIT/COMRESET.
4. The testing station is instructed to transmit COMSAS to the DUT.
5. The DUT is expected to respond with COMSAS.
6. Upon reception of COMSAS from the DUT, the Testing station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
7. Following RCDT, the testing station is instructed to transmit ALIGN(0) primitives at 1.5 Gbps for one SNTT. If the DUT supports 1.5 Gbps signaling, it is expected to do the same. If the DUT does not support 1.5 Gbps signaling, it should continue to transmit D.C. Idle.
8. The Testing station is then instructed to transmit D.C. Idle for one RCDT. If the DUT supports 3.0 Gbps. The DUT is expected to do the same.
9. Following RCDT, the testing station is instructed to transmit ALIGN(1) primitives at 3.0 Gbps for one SNTT. If the DUT supports 3.0 Gbps signaling, it is expected to the same.
10. The Testing Station is then instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
11. The Testing Station is the instructed to transmit its Phy Capabilities bits indicating support for all speeds and SSC settings. The DUT is expected to transmit it's Phy Capabilities Bits.

Observable Results

Verify that following the last ALIGN (1) primitive transmitted during SNW-2 by the DUT, there is 500.00 µs of D.C. Idle transmitted by the DUT followed by a COMWAKE signal.

Possible Problems

If the DUT does not support 3.0 Gbps signaling, then it will not participate in SNW-2. If this is the case, an alternative method of timing the first COMWAKE signal during SNW-3 will have to be found.

Test 5.7.1.2: SNTT: Total Time

Purpose

To verify that the DUT properly formats it's SNTT.

References

5.10.4.2.2 SAS SPL
5.10.4.2.3.3 SAS SPL

Resource Requirements

A Protocol Generator/Analyzer capable of transmitting and receiving SAS OOB signals and SAS 2.0 Speed Negotiation.

Discussion

If a phy supports SNW-3, then the phy:

a) transmits a 32-bit phy capabilities value describing the capabilities of the phy.
b) receives a 32-bit phy capabilities value from the attached phy. If the attached phy does not support SNW-3, the phy capabilities bits are all set to zero (i.e., D.C. Idle).
c) Note that TTIU is transmitted in 10 UI. Considering this, the totally allowed time with TTIU is 523ms.**********

If a phy does not support SNW-3, then a phy:

a) transmits D.C. Idle.
b) ignores any SNW-3 phy capabilities bits received.

The first bit of the phy capabilities value is the START bit and shall be transmitted as a one. Each of the remaining 31 bits are either a one or a zero.

Test Setup

The DUT and the Testing Station are physically connected the DUT is powered off.

Procedure

1. Power on the DUT.
2. The testing station is instructed to transmit COMINIT/COMRESET to the DUT.
3. The DUT is expected to respond with COMINIT/COMRESET.
4. The testing station is instructed to transmit COMSAS to the DUT.
5. The DUT is expected to respond with COMSAS.
6. Upon reception of COMSAS from the DUT, the Testing station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
7. Following RCDT, the testing station is instructed to transmit ALIGN(0) primitives at 1.5 Gbps for one SNTT. If the DUT supports 1.5 Gbps signaling, it is expected to do the same. If the DUT does not support 1.5 Gbps signaling, it should continue to transmit D.C. Idle.
8. The Testing station is then instructed to transmit D.C. Idle for one RCDT. If the DUT supports 3.0 Gbps. The DUT is expected to do the same.
9. Following RCDT, the testing station is instructed to transmit ALIGN(1) primitives at 3.0 Gbps for one SNTT. If the DUT supports 3.0 Gbps signaling, it is expected to the same.
10. The Testing Station is then instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
11. The Testing Station is the instructed to transmit its Phy Capabilities bits indicating support for all speeds and SSC settings. The DUT is expected to transmit it's Phy Capabilities Bits.

Observable Results

Verify that the time between the first COMWAKE signal transmitted in SNW-3 and the next transmitted dword to be approximately 609.23 µs. With the advent of transmitter training, total allowable speed negotiation time when connecting at 12 Gbps is 523ms.

Possible Problems

None.

Test 5.7.1.3: SNNT: Remainder Time

Purpose

To verify that the DUT properly formats it's SNTT.

References

5.10.4.2.2 SAS SPL
5.10.4.2.3.3 SAS SPL

Resource Requirements

A Protocol Generator/Analyzer capable of transmitting and receiving SAS OOB signals and SAS 2.0 Speed Negotiation.

Discussion

If a phy supports SNW-3, then the phy:

a) transmits a 32-bit phy capabilities value describing the capabilities of the phy.
b) receives a 32-bit phy capabilities value from the attached phy. If the attached phy does not support SNW-3, the phy capabilities bits are all set to zero (i.e., D.C. Idle).

If a phy does not support SNW-3, then a phy:

a) transmits D.C. Idle.
b) ignores any SNW-3 phy capabilities bits received.

The first bit of the phy capabilities value is the START bit and shall be transmitted as a one. Each of the remaining 31 bits are either a one or a zero. Assuming the PARITY bit of the of the 32-bit phy capabilities value is set, there should be a minimum of 62294.8 µs of idle transmitted before the start of the next RCDT.

Test Setup

The DUT and the Testing Station are physically connected the DUT is powered off.

Procedure

1. Power on the DUT.
2. The testing station is instructed to transmit COMINIT/COMRESET to the DUT.
3. The DUT is expected to respond with COMINIT/COMRESET.
4. The testing station is instructed to transmit COMSAS to the DUT.
5. The DUT is expected to respond with COMSAS.
6. Upon reception of COMSAS from the DUT, the Testing station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
7. Following RCDT, the testing station is instructed to transmit ALIGN(0) primitives at 1.5 Gbps for one SNTT. If the DUT supports 1.5 Gbps signaling, it is expected to do the same. If the DUT does not support 1.5 Gbps signaling, it should continue to transmit D.C. Idle.
8. The Testing station is then instructed to transmit D.C. Idle for one RCDT. If the DUT supports 3.0 Gbps. The DUT is expected to do the same.
9. Following RCDT, the testing station is instructed to transmit ALIGN(1) primitives at 3.0 Gbps for one SNTT. If the DUT supports 3.0 Gbps signaling, it is expected to the same.
10. The Testing Station is then instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
11. The Testing Station is the instructed to transmit its Phy Capabilities bits indicating support for all speeds and SSC settings. The DUT is expected to transmit its Phy Capabilities Bits.

Observable Results

Verify that following the last COMWAKE signal transmitted during SNW-3 by the DUT, there is at least 562 µs of D.C. Idle transmitted by the DUT.

Possible Problems

None.

Test 5.7.1.4: Rate Change Delay Time

Purpose

To verify that the DUT properly formats it's SNTT.

References

5.10.4.2.2 SAS SPL
5.10.4.2.3.3 SAS SPL

Resource Requirements

A Protocol Generator/Analyzer capable of transmitting and receiving SAS OOB signals and SAS 2.0 Speed Negotiation.

Discussion

If a phy supports SNW-3, then the phy:

a) transmits a 32-bit phy capabilities value describing the capabilities of the phy.
b) receives a 32-bit phy capabilities value from the attached phy. If the attached phy does not support SNW-3, they phy capabilities bits are all set to zero (i.e., D.C. Idle).

If a phy does not support SNW-3, then a phy:

a) transmits D.C. Idle.
b) ignores any SNW-3 phy capabilities bits received.

The transmitter shall:

a) transmit D.C. Idle for an RCDT.
b) transmit 32 phy capabilities bits.
c) transmit D.C. Idle for the remainder of SNTT.

Test Setup

The DUT and the Testing Station are physically connected the DUT is powered off.

Procedure

1. Power on the DUT.
2. The testing station is instructed to transmit COMINIT/COMRESET to the DUT.
3. The DUT is expected to respond with COMINIT/COMRESET.
4. The testing station is instructed to transmit COMSAS to the DUT.
5. The DUT is expected to respond with COMSAS.
6. Upon reception of COMSAS from the DUT, the Testing station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
7. Following RCDT, the testing station is instructed to transmit ALIGN(0) primitives at 1.5 Gbps for one SNTT. If the DUT supports 1.5 Gbps signaling, it is expected to do the same. If the DUT does not support 1.5 Gbps signaling, it should continue to transmit D.C. Idle.
8. The Testing station is then instructed to transmit D.C. Idle for one RCDT. If the DUT supports 3.0 Gbps. The DUT is expected to do the same.
9. Following RCDT, the testing station is instructed to transmit ALIGN(1) primitives at 3.0 Gbps for one SNTT. If the DUT supports 3.0 Gbps signaling, it is expected to the same.
10. The Testing Station is then instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
11. The Testing Station is the instructed to transmit its Phy Capabilities bits indicating support for all speeds and SSC settings. The DUT is expected to transmit its Phy Capabilities Bits.

Observable Results

Verify that prior to the transmission of the START bit of the of the phy capabilities bits in SNW-3, at least 500 µs of D.C. Idle is transmitted.

Possible Problems

None.

Test 5.7.1.5: Phy Capabilities Bits – Start Bit

Purpose

To verify that bit 0 of the phy capabilities bits is set to one.

References

5.10.4.2.3.3 SAS SPL

Resource Requirements

A Protocol Generator/Analyzer capable of transmitting and receiving SAS OOB signals and SAS 2.0 Speed Negotiation.

Discussion

The START bit shall be set to one. The phy's receiver shall use this bit to establish the timing for the subsequent bits.

Test Setup

The DUT and the Testing Station are physically connected the DUT is powered off.

Procedure

1. Power on the DUT.
2. The testing station is instructed to transmit COMINIT/COMRESET to the DUT.
3. The DUT is expected to respond with COMINIT/COMRESET.
4. The testing station is instructed to transmit COMSAS to the DUT.
5. The DUT is expected to respond with COMSAS.
6. Upon reception of COMSAS from the DUT, the Testing station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
7. Following RCDT, the testing station is instructed to transmit ALIGN(0) primitives at 1.5 Gbps for one SNTT. If the DUT supports 1.5 Gbps signaling, it is expected to do the same. If the DUT does not support 1.5 Gbps signaling, it should continue to transmit D.C. Idle.
8. The Testing station is then instructed to transmit D.C. Idle for one RCDT. If the DUT supports 3.0 Gbps. The DUT is expected to do the same.
9. Following RCDT, the testing station is instructed to transmit ALIGN(1) primitives at 3.0 Gbps for one SNTT. If the DUT supports 3.0 Gbps signaling, it is expected to the same.
10. The Testing Station is then instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
11. The Testing Station is the instructed to transmit its Phy Capabilities bits indicating support for all speeds and SSC settings. The DUT is expected to transmit its Phy Capabilities Bits.

Observable Results

Verify that prior to the transmission of the START bit of the of the phy capabilities bits in SNW-3, at least 500 µs of D.C. Idle is transmitted.

Possible Problems

None.

Test 5.7.1.6: Phy Capabilities Bits – TX SSC Type

Purpose

To verify that bit 1 of the phy capabilities bits correctly reflects the method of Spread Spectrum Clocking employed by the DUT.

References

5.10.4.2.3.3 SAS SPL

Resource Requirements

A Protocol Generator/Analyzer capable of transmitting and receiving SAS OOB signals and SAS 2.0 Speed Negotiation.

Discussion

A TX SSC TYPE bit set to one indicates that the phy's transmitter uses center-spreading SSC when the SSC is enabled. A TX SSC TYPE bit set to zero indicates that the phy's transmitter uses down-spreading SSC when SSC is enabled, or that the phy does not support SSC.

Test Setup

The DUT and the Testing Station are physically connected the DUT is powered off.

Procedure

1. Power on the DUT.
2. The testing station is instructed to transmit COMINIT/COMRESET to the DUT.
3. The DUT is expected to respond with COMINIT/COMRESET.
4. The testing station is instructed to transmit COMSAS to the DUT.
5. The DUT is expected to respond with COMSAS.
6. Upon reception of COMSAS from the DUT, the Testing station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
7. Following RCDT, the testing station is instructed to transmit ALIGN(0) primitives at 1.5 Gbps for one SNTT. If the DUT supports 1.5 Gbps signaling, it is expected to do the same. If the DUT does not support 1.5 Gbps signaling, it should continue to transmit D.C. Idle.
8. The Testing station is then instructed to transmit D.C. Idle for one RCDT. If the DUT supports 3.0 Gbps. The DUT is expected to do the same.
9. Following RCDT, the testing station is instructed to transmit ALIGN(1) primitives at 3.0 Gbps for one SNTT. If the DUT supports 3.0 Gbps signaling, it is expected to the same.
10. The Testing Station is then instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
11. The Testing Station is the instructed to transmit its Phy Capabilities bits indicating support for all speeds and SSC settings. The DUT is expected to transmit its Phy Capabilities Bits.

Observable Results

If the DUT employs center-spreading SSC when SSC is enabled, verify that 1.446 µs after the beginning of the first COMWAKE signal transmitted during SNW-3, a second COMWAKE signal is transmitted. Otherwise, verify that the DUT transmits at least 1.446 µs of D.C. Idle following the first COMWAKE signal transmitted during SNW-3.

Possible Problems

The method of SSC employed by the DUT will have to be determined by a lower level PHY test.

Test 5.7.1.7: Phy Capabilities Bits – Reserved Bits

Purpose

To verify that bits 2 and 3 of the phy capabilities bits are set to zero.

References

5.10.4.2.3.3 SAS SPL

Resource Requirements

A Protocol Generator/Analyzer capable of transmitting and receiving SAS OOB signals and SAS 2.0 Speed Negotiation.

Discussion

Bits 2 and 3 of the phy capabilities bits are reserved and shall be set to zero.

Test Setup

The DUT and the Testing Station are physically connected the DUT is powered off.

Procedure

1. Power on the DUT.
2. The testing station is instructed to transmit COMINIT/COMRESET to the DUT.
3. The DUT is expected to respond with COMINIT/COMRESET.
4. The testing station is instructed to transmit COMSAS to the DUT.
5. The DUT is expected to respond with COMSAS.
6. Upon reception of COMSAS from the DUT, the Testing station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
7. Following RCDT, the testing station is instructed to transmit ALIGN(0) primitives at 1.5 Gbps for one SNTT. If the DUT supports 1.5 Gbps signaling, it is expected to do the same. If the DUT does not support 1.5 Gbps signaling, it should continue to transmit D.C. Idle.
8. The Testing station is then instructed to transmit D.C. Idle for one RCDT. If the DUT supports 3.0 Gbps. The DUT is expected to do the same.
9. Following RCDT, the testing station is instructed to transmit ALIGN(1) primitives at 3.0 Gbps for one SNTT. If the DUT supports 3.0 Gbps signaling, it is expected to the same.
10. The Testing Station is then instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
11. The Testing Station is the instructed to transmit its Phy Capabilities bits indicating support for all speeds and SSC settings. The DUT is expected to transmit its Phy Capabilities Bits.

Observable Results

Verify that from 2.933 µs from the beginning of the first COMWAKE signal transmitted as part of SNW-3 to 5.866 µs from the beginning of the first COMWAKE signal transmitted as part of SNW-3, there are no COMWAKE signals transmitted.

Possible Problems

None.

Test 5.7.1.8: Phy Capabilities Bits – G1 WITHOUTs SSC

Purpose

To verify the contents of the DUT's Phy Capabilities G1 WITHOUT SSC bit.

References

5.10.4.2.3.3 SAS SPL

Resource Requirements

A Protocol Generator/Analyzer capable of transmitting and receiving SAS OOB signals and SAS 2.0 Speed Negotiation.

Discussion

A G1 WITHOUT SSC bit set to one indicated that the phy supports G1 (i.e., 1.5 Gbps) without SSC. A G1 WITHOUT SSC bit set to zero indicates that the phy does not support G1 without SSC. If the phy supports SNW-1 and supports SNW-3, then the G1 WITHOUT SSC bit shall be set to one.

Test Setup

The DUT and the Testing Station are physically connected the DUT is powered off.

Procedure

1. Power on the DUT.
2. The testing station is instructed to transmit COMINIT/COMRESET to the DUT.
3. The DUT is expected to respond with COMINIT/COMRESET.
4. The testing station is instructed to transmit COMSAS to the DUT.
5. The DUT is expected to respond with COMSAS.
6. Upon reception of COMSAS from the DUT, the Testing station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
7. Following RCDT, the testing station is instructed to transmit ALIGN(0) primitives at 1.5 Gbps for one SNTT. If the DUT supports 1.5 Gbps signaling, it is expected to do the same. If the DUT does not support 1.5 Gbps signaling, it should continue to transmit D.C. Idle.
8. The Testing station is then instructed to transmit D.C. Idle for one RCDT. If the DUT supports 3.0 Gbps. The DUT is expected to do the same.
9. Following RCDT, the testing station is instructed to transmit ALIGN(1) primitives at 3.0 Gbps for one SNTT. If the DUT supports 3.0 Gbps signaling, it is expected to the same.
10. The Testing Station is then instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
11. The Testing Station is the instructed to transmit its Phy Capabilities bits indicating support for all speeds and SSC settings. The DUT is expected to transmit its Phy Capabilities Bits.

Observable Results

If the DUT participated in SNW-1, then verify that 11.733 µs from the beginning of the first COMWAKE signal transmitted as part of SNW-3, a COMWAKE signal is transmitted, indicating support for G1 WITHOUT SSC .

Possible Problems

None.

Test 5.7.1.9: Phy Capabilities Bits – G1 WITH SSC

Purpose

To verify the contents of the DUT's Phy Capabilities G1 WITH SSC bit.

References

5.10.4.2.3.3 SAS SPL

Resource Requirements

A Protocol Generator/Analyzer capable of transmitting and receiving SAS OOB signals and SAS 2.0 Speed Negotiation.

Discussion

A G1 WITH SSC bit set to one indicated that the phy supports G2 (i.e., 1.5 Gbps) with SSC. A G1 WITH SSC bit set to zero indicates that the phy does not support G1 with SSC. This is an informative test and applies only if the DUT supports SSC signaling.

Test Setup

The DUT and the Testing Station are physically connected the the DUT is powered off.

Procedure

1. Power on the DUT.
2. The testing station is instructed to transmit COMINIT/COMRESET to the DUT.
3. The DUT is expected to respond with COMINIT/COMRESET.
4. The testing station is instructed to transmit COMSAS to the DUT.
5. The DUT is expected to respond with COMSAS.
6. Upon reception of COMSAS from the DUT, the Testing station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
7. Following RCDT, the testing station is instructed to transmit ALIGN(0) primitives at 1.5 Gbps for one SNTT. If the DUT supports 1.5 Gbps signaling, it is expected to do the same. If the DUT does not support 1.5 Gbps signaling, it should continue to transmit D.C. Idle.
8. The Testing station is then instructed to transmit D.C. Idle for one RCDT. If the DUT supports 3.0 Gbps. The DUT is expected to do the same.
9. Following RCDT, the testing station is instructed to transmit ALIGN(1) primitives at 3.0 Gbps for one SNTT. If the DUT supports 3.0 Gbps signaling, it is expected to the same.
10. The Testing Station is then instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
11. The Testing Station is the instructed to transmit its Phy Capabilities bits indicating support for all speeds and SSC settings. The DUT is expected to transmit its Phy Capabilities Bits.

Observable Results

Verify the contents of the G1 WITHOUT SSC bit from the DUT's Phy Capabilities bits.

Possible Problems

This is an informative test.

Test 5.7.1.10: Phy Capabilities Bits – G2 WITHOUT SSC

Purpose

To verify the contents of the DUT's Phy Capabilities G2 WITHOUT SSC bit.

References

5.10.4.2.3.3 SAS SPL

Resource Requirements

A Protocol Generator/Analyzer capable of transmitting and receiving SAS OOB signals and SAS 2.0 Speed Negotiation.

Discussion

A G2 WITHOUT SSC bit set to one indicated that the phy supports G2 (i.e., 3,0 Gbps) without SSC. A G2 WITHOUT SSC bit set to zero indicates that the phy does not support G2 without SSC. If the phy supports SNW-2 and supports SNW-3, then the G2 WITHOUT SSC bit shall be set to one.

Test Setup

The DUT and the Testing Station are physically connected the DUT is powered off.

Procedure

1. Power on the DUT.
2. The testing station is instructed to transmit COMINIT/COMRESET to the DUT.
3. The DUT is expected to respond with COMINIT/COMRESET.
4. The testing station is instructed to transmit COMSAS to the DUT.
5. The DUT is expected to respond with COMSAS.
6. Upon reception of COMSAS from the DUT, the Testing station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
7. Following RCDT, the testing station is instructed to transmit ALIGN(0) primitives at 1.5 Gbps for one SNTT. If the DUT supports 1.5 Gbps signaling, it is expected to do the same. If the DUT does not support 1.5 Gbps signaling, it should continue to transmit D.C. Idle.
8. The Testing station is then instructed to transmit D.C. Idle for one RCDT. If the DUT supports 3.0 Gbps. The DUT is expected to do the same.
9. Following RCDT, the testing station is instructed to transmit ALIGN(1) primitives at 3.0 Gbps for one SNTT. If the DUT supports 3.0 Gbps signaling, it is expected to the same.
10. The Testing Station is then instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
11. The Testing Station is the instructed to transmit its Phy Capabilities bits indicating support for all speeds and SSC settings. The DUT is expected to transmit its Phy Capabilities Bits.

Observable Results

If the DUT participated in SNW-2, then verify that 14.666 µs from the beginning of the first COMWAKE signal transmitted as part of SNW-3, a COMWAKE signal is transmitted, indicating support for G2 WITHOUT SSC .

Possible Problems

None.

Test 5.7.1.11: Phy Capabilities Bits – G2 WITH SSC

Purpose

To verify the contents of the DUT's Phy Capabilities G2 WITH SSC bit.

References

5.10.4.2.3.3 SAS SPL

Resource Requirements

A Protocol Generator/Analyzer capable of transmitting and receiving SAS OOB signals and SAS 2.0 Speed Negotiation.

Discussion

A G2 WITH SSC bit set to one indicated that the phy supports G2 (i.e., 3.0 Gbps) with SSC. A G2 WITH SSC bit set to zero indicates that the phy does not support G2 with SSC. This is an informative test and applies only if the DUT supports SSC signaling.

Test Setup

The DUT and the Testing Station are physically connected the the DUT is powered off.

Procedure

1. Power on the DUT.
2. The testing station is instructed to transmit COMINIT/COMRESET to the DUT.
3. The DUT is expected to respond with COMINIT/COMRESET.
4. The testing station is instructed to transmit COMSAS to the DUT.
5. The DUT is expected to respond with COMSAS.
6. Upon reception of COMSAS from the DUT, the Testing station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
7. Following RCDT, the testing station is instructed to transmit ALIGN(0) primitives at 1.5 Gbps for one SNTT. If the DUT supports 1.5 Gbps signaling, it is expected to do the same. If the DUT does not support 1.5 Gbps signaling, it should continue to transmit D.C. Idle.
8. The Testing station is then instructed to transmit D.C. Idle for one RCDT. If the DUT supports 3.0 Gbps. The DUT is expected to do the same.
9. Following RCDT, the testing station is instructed to transmit ALIGN(1) primitives at 3.0 Gbps for one SNTT. If the DUT supports 3.0 Gbps signaling, it is expected to the same.
10. The Testing Station is then instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
11. The Testing Station is the instructed to transmit its Phy Capabilities bits indicating support for all speeds and SSC settings. The DUT is expected to transmit its Phy Capabilities Bits.

Observable Results

Verify the contents of the G2 WITHOUT SSC bit from the DUT's Phy Capabilities bits.

Possible Problems

This is an informative test.

Test 5.7.1.12: Phy Capabilities Bits – G3 WITHOUT SSC

Purpose

To verify the contents of the DUT's Phy Capabilities G3 WITHOUT SSC bit.

References

5.10.4.2.3.3 SAS SPL

Resource Requirements

A Protocol Generator/Analyzer capable of transmitting and receiving SAS OOB signals and SAS 2.0 Speed Negotiation.

Discussion

A G3 WITHOUT SSC bit set to one indicated that the phy supports G3 (i.e., 6.0 Gbps) without SSC. A G3 WITHOUT SSC bit set to zero indicates that the phy does not support G3 without SSC. This is an informative test and applies only if the DUT supports 6.0 Gbps signaling.

Test Setup

The DUT and the Testing Station are physically connected the the DUT is powered off.

Procedure

1. Power on the DUT.
2. The testing station is instructed to transmit COMINIT/COMRESET to the DUT.
3. The DUT is expected to respond with COMINIT/COMRESET.
4. The testing station is instructed to transmit COMSAS to the DUT.
5. The DUT is expected to respond with COMSAS.
6. Upon reception of COMSAS from the DUT, the Testing station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
7. Following RCDT, the testing station is instructed to transmit ALIGN(0) primitives at 1.5 Gbps for one SNTT. If the DUT supports 1.5 Gbps signaling, it is expected to do the same. If the DUT does not support 1.5 Gbps signaling, it should continue to transmit D.C. Idle.
8. The Testing station is then instructed to transmit D.C. Idle for one RCDT. If the DUT supports 3.0 Gbps. The DUT is expected to do the same.
9. Following RCDT, the testing station is instructed to transmit ALIGN(1) primitives at 3.0 Gbps for one SNTT. If the DUT supports 3.0 Gbps signaling, it is expected to the same.
10. The Testing Station is then instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
11. The Testing Station is the instructed to transmit its Phy Capabilities bits indicating support for all speeds and SSC settings. The DUT is expected to transmit its Phy Capabilities Bits.

Observable Results

Verify the contents of the G3 WITHOUT SSC bit from the DUT's Phy Capabilities bits.

Possible Problems

This is an informative test.

Test 5.7.1.13: Phy Capabilities Bits – G3 WITH SSC

Purpose

To verify the contents of the DUT's Phy Capabilities G3 WITH SSC bit.

References

5.10.4.2.3.3 SAS SPL

Resource Requirements

A Protocol Generator/Analyzer capable of transmitting and receiving SAS OOB signals and SAS 2.0 Speed Negotiation.

Discussion

A G3 WITH SSC bit set to one indicated that the phy supports G3 (i.e., 6.0 Gbps) without SSC. A G3 WITH SSC bit set to zero indicates that the phy does not support G3 without SSC. This is an informative test and applies only if the DUT supports 6.0 Gbps signaling.

Test Setup

The DUT and the Testing Station are physically connected the DUT is powered off.

Procedure

1. Power on the DUT.
2. The testing station is instructed to transmit COMINIT/COMRESET to the DUT.
3. The DUT is expected to respond with COMINIT/COMRESET.
4. The testing station is instructed to transmit COMSAS to the DUT.
5. The DUT is expected to respond with COMSAS.
6. Upon reception of COMSAS from the DUT, the Testing station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
7. Following RCDT, the testing station is instructed to transmit ALIGN(0) primitives at 1.5 Gbps for one SNTT. If the DUT supports 1.5 Gbps signaling, it is expected to do the same. If the DUT does not support 1.5 Gbps signaling, it should continue to transmit D.C. Idle.
8. The Testing station is then instructed to transmit D.C. Idle for one RCDT. If the DUT supports 3.0 Gbps. The DUT is expected to do the same.
9. Following RCDT, the testing station is instructed to transmit ALIGN(1) primitives at 3.0 Gbps for one SNTT. If the DUT supports 3.0 Gbps signaling, it is expected to the same.
10. The Testing Station is then instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
11. The Testing Station is the instructed to transmit its Phy Capabilities bits indicating support for all speeds and SSC settings. The DUT is expected to transmit its Phy Capabilities Bits.

Observable Results

Verify the contents of the G3 WITH SSC bit from the DUT's Phy Capabilities bits.

Possible Problems

This is an informative test.

Test 5.7.1.14: Phy Capabilities Bits – Reserved Bits

Purpose

To verify that the Phy Capabilities Bits 16 through 30, excluding parity bit 24, are set to zero.

References

5.10.4.2.3.3 SAS SPL

Resource Requirements

A Protocol Generator/Analyzer capable of transmitting and receiving SAS OOB signals and SAS 2.0 Speed Negotiation.

Discussion

Table 88 defines the SNW-3 phy capabilities. For each bit defined as reserved, the phy shall transmit a zero (i.e., D.C. Idle) and shall ignore the received value. Byte 1, bits 1 and 0; and byte 2 are reserved.

Test Setup

The DUT and the Testing Station are physically connected the DUT is powered off.

Procedure

1. Power on the DUT.
2. The testing station is instructed to transmit COMINIT/COMRESET to the DUT.
3. The DUT is expected to respond with COMINIT/COMRESET.
4. The testing station is instructed to transmit COMSAS to the DUT.
5. The DUT is expected to respond with COMSAS.
6. Upon reception of COMSAS from the DUT, the Testing station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
7. Following RCDT, the testing station is instructed to transmit ALIGN(0) primitives at 1.5 Gbps for one SNTT. If the DUT supports 1.5 Gbps signaling, it is expected to do the same. If the DUT does not support 1.5 Gbps signaling, it should continue to transmit D.C. Idle.
8. The Testing station is then instructed to transmit D.C. Idle for one RCDT. If the DUT supports 3.0 Gbps. The DUT is expected to do the same.
9. Following RCDT, the testing station is instructed to transmit ALIGN(1) primitives at 3.0 Gbps for one SNTT. If the DUT supports 3.0 Gbps signaling, it is expected to the same.
10. The Testing Station is then instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
11. The Testing Station is the instructed to transmit its Phy Capabilities bits indicating support for all speeds and SSC settings. The DUT is expected to transmit it's Phy Capabilities Bits.

Observable Results

Verify that 20.5324 µs from the beginning of the first COMWAKE signal transmitted in SNW-3, that there is at least 23.4656 µs of D.C. Idle.

Possible Problems

None.

Test 5.7.1.15: Phy Capabilities – Parity Bit

Purpose

To verify that the Phy Capabilities Bit 31, the Parity Bit, is correctly set.

References

5.10.4.2.3.3 SAS SPL

Resource Requirements

A Protocol Generator/Analyzer capable of transmitting and receiving SAS OOB signals and SAS 2.0 Speed Negotiation.

Discussion

The PARITY bit provides for error detection of all the SNW-3 phy capabilities bits. The PARITY bit shall be set to one or zero such that the total number of SNW-3 phy capabilities bits that are set to one is even including the START bit and the PARITY bit. If the Parity bit received is incorrect based upon the received bits, then the parity is bad and the phy shall consider a phy reset problem.

Test Setup

The DUT and the Testing Station are physically connected the DUT is powered off.

Procedure

1. Power on the DUT.
2. The testing station is instructed to transmit COMINIT/COMRESET to the DUT.
3. The DUT is expected to respond with COMINIT/COMRESET.
4. The testing station is instructed to transmit COMSAS to the DUT.
5. The DUT is expected to respond with COMSAS.
6. Upon reception of COMSAS from the DUT, the Testing station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
7. Following RCDT, the testing station is instructed to transmit ALIGN(0) primitives at 1.5 Gbps for one SNTT. If the DUT supports 1.5 Gbps signaling, it is expected to do the same. If the DUT does not support 1.5 Gbps signaling, it should continue to transmit D.C. Idle.
8. The Testing station is then instructed to transmit D.C. Idle for one RCDT. If the DUT supports 3.0 Gbps. The DUT is expected to do the same.
9. Following RCDT, the testing station is instructed to transmit ALIGN(1) primitives at 3.0 Gbps for one SNTT. If the DUT supports 3.0 Gbps signaling, it is expected to the same.
10. The Testing Station is then instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
11. The Testing Station is the instructed to transmit its Phy Capabilities bits indicating support for all speeds and SSC settings. The DUT is expected to transmit its Phy Capabilities Bits.

Observable Results

If an odd number of Phy Capabilities Bits (excluding parity) has been transmitted, ensure that the parity bit has been set. If an even number of Phy Capabilities Bits (excluding parity) has been transmitted, ensure that the parity bit is not set.

Possible Problems

None.

Test 5.7.1.16: Receive Bad Parity

Purpose

To verify that the DUT properly handles reception of an improperly set parity bit during SNW-3.

References

5.10.4.2.3.3 SAS SPL

Resource Requirements

A Protocol Generator/Analyzer capable of transmitting and receiving SAS OOB signals and SAS 2.0 Speed Negotiation.

Discussion

The PARITY bit provides for error detection of all the SNW-3 phy capabilities bits. The PARITY bit shall be set to one or zero such that the total number of SNW-3 phy capabilities bits that are set to one is even including the START bit and the PARITY bit. If the Parity bit received is incorrect based upon the received bits, then the parity is bad and the phy shall consider a phy reset problem.

Test Setup

The DUT and the Testing Station are physically connected the DUT is powered off.

Procedure

1. Power on the DUT.
2. The testing station is instructed to transmit COMINIT/COMRESET to the DUT.
3. The DUT is expected to respond with COMINIT/COMRESET.
4. The testing station is instructed to transmit COMSAS to the DUT.
5. The DUT is expected to respond with COMSAS.
6. Upon reception of COMSAS from the DUT, the Testing station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
7. Following RCDT, the testing station is instructed to transmit ALIGN(0) primitives at 1.5 Gbps for one SNTT. If the DUT supports 1.5 Gbps signaling, it is expected to do the same. If the DUT does not support 1.5 Gbps signaling, it should continue to transmit D.C. Idle.
8. The Testing station is then instructed to transmit D.C. Idle for one RCDT. If the DUT supports 3.0 Gbps. The DUT is expected to do the same.
9. Following RCDT, the testing station is instructed to transmit ALIGN(1) primitives at 3.0 Gbps for one SNTT. If the DUT supports 3.0 Gbps signaling, it is expected to the same.
10. The Testing Station is then instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
11. The Testing Station is the instructed to transmit its Phy Capabilities bits indicating support for all speeds and SSC settings. The Testing Station is instructed to transmit an incorrect parity bit. The DUT is expected to transmit its Phy Capabilities Bits.

Observable Results

The DUT should wait 1 Hot-plug timeout period and then transmit COMINIT to the testing station.

Possible Problems

None.

Test 5.7.1.17: No Common Speeds

Purpose

To verify that the DUT behaves properly when it does not share any common speeds with the link partner.

References

5.10.4.2.3.3 SAS SPL

Resource Requirements

A Protocol Generator/Analyzer capable of transmitting and receiving SAS OOB signals and SAS 2.0 Speed Negotiation.

Discussion

If a phy participates in a valid SNW-3 and parity is good, then the phy shall participate in a Train-SNW utilizing the highest commonly settings based on the outgoing and incoming SNW-3 settings bits.

They phy shall consider SNW-3 to be valid if it supports SNW-3 and receive at least one phy capabilities bit set to one. If the phy does not support SNW-3 or does not receive at least one phy capabilities bit set one tone, it shall consider SNW-3 to be invalid.

Test Setup

The DUT and the Testing Station are physically connected the DUT is powered off.

Procedure

1. Power on the DUT.
2. The testing station is instructed to transmit COMINIT/COMRESET to the DUT.
3. The DUT is expected to respond with COMINIT/COMRESET.
4. The testing station is instructed to transmit COMSAS to the DUT.
5. The DUT is expected to respond with COMSAS.
6. Upon reception of COMSAS from the DUT, the Testing station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
7. Following RCDT, the testing station is instructed to transmit ALIGN(0) primitives at 1.5 Gbps for one SNTT. If the DUT supports 1.5 Gbps signaling, it is expected to do the same. If the DUT does not support 1.5 Gbps signaling, it should continue to transmit D.C. Idle.
8. The Testing station is then instructed to transmit D.C. Idle for one RCDT. If the DUT supports 3.0 Gbps. The DUT is expected to do the same.
9. Following RCDT, the testing station is instructed to transmit ALIGN(1) primitives at 3.0 Gbps for one SNTT. If the DUT supports 3.0 Gbps signaling, it is expected to the same.
10. The Testing Station is then instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
11. The Testing Station is the instructed to transmit its Phy Capabilities bits indicating no support for any speeds or SSC settings. The DUT is expected to transmit its Phy Capabilities Bits.

Observable Results

The DUT should wait 1 Hot-plug timeout period and then transmit COMINIT to the testing station.

Possible Problems

None.

GROUP 2: Train Speed Negotiation Window

Overview:

The following tests cover the Train Speed Negotiation Window.

Scope:

All of the tests described in this section are implemented and currently active through the UNH IOL SAS Consortium. Comments and questions are welcome, and may be forwarded to the SAS Lab (saslab@iol.unh.edu).

Test 5.7.2.1: TRAIN Pattern

Purpose

To verify that the DUT sends the proper TRAIN pattern.

References

5.10.4.2.3.4 SAS SPL

Resource Requirements

A Protocol Generator/Analyzer capable of transmitting and receiving SAS OOB signals and SAS 2.0 Speed Negotiation.

Discussion

The Train-SNW utilizes TRAIN and TRAIN_DONE primitives to create training patterns. There are two training patterns:

a) the TRAIN pattern; and
b) the TRAIN_DONE pattern.

The TRAIN pattern consists of:

a) TRAIN; and
b) 58 dwords set to 0000_0000h that are transmitted scrambled and 8b10b encoded.

The phy shall start transmitting TRAIN patterns at the end of RCDT. The first TRAIN pattern may have either starting disparity. The Number of TRAIN patters transmitted is determined by the time required for the phy's receiver to complete training. The phy shall transmit at least one TRAIN pattern.

Test Setup

The DUT and the Testing Station are physically connected the DUT is powered off.

Procedure

1. Power on the DUT.
2. The testing station is instructed to transmit COMINIT/COMRESET to the DUT.
3. The DUT is expected to respond with COMINIT/COMRESET.
4. The testing station is instructed to transmit COMSAS to the DUT.
5. The DUT is expected to respond with COMSAS.
6. Upon reception of COMSAS from the DUT, the Testing station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
7. Following RCDT, the testing station is instructed to transmit ALIGN(0) primitives at 1.5 Gbps for one SNTT. If the DUT supports 1.5 Gbps signaling, it is expected to do the same. If the DUT does not support 1.5 Gbps signaling, it should continue to transmit D.C. Idle.
8. The Testing station is then instructed to transmit D.C. Idle for one RCDT. If the DUT supports 3.0 Gbps. The DUT is expected to do the same.
9. Following RCDT, the testing station is instructed to transmit ALIGN(1) primitives at 3.0 Gbps for one SNTT. If the DUT supports 3.0 Gbps signaling, it is expected to the same.
10. The Testing Station is then instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
11. The Testing Station is the instructed to transmit its Phy Capabilities bits indicating support for all speeds and SSC settings. The DUT is expected to transmit its Phy Capabilities Bits.
12. The Testing Station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
13. The Testing Station is instructed to then transmit properly formatted TRAIN patterns at the highest mutually speed. The DUT is expected to do the same.

Observable Results

Verify that the DUT first transmits properly formatted TRAIN patterns at the highest mutually speed. A properly formatted TRAIN pattern consists of:

TRAIN; and
58 dwords set to 0000_0000h that are transmitted scrambled and 8b10b encoded.

Possible Problems

None.

Test 5.7.2.2: TRAIN_DONE Pattern

Purpose

To verify that the DUT sends the proper TRAIN_DONE pattern.

References

5.10.4.2.3.4 SAS SPL

Resource Requirements

A Protocol Generator/Analyzer capable of transmitting and receiving SAS OOB signals and SAS 2.0 Speed Negotiation.

Discussion

The Train-SNW utilizes TRAIN and TRAIN_DONE primitives to create training patterns. There are two training patterns:

a) the TRAIN pattern; and
b) the TRAIN_DONE pattern.

The TRAIN_DONE pattern consists of:

a) TRAIN_DONE; and
b) 58 dwords set to 0000_0000h that are transmitted scrambled and 8b10b encoded.

The phy shall start transmitting TRAIN patterns at the end of RCDT. The first TRAIN pattern may have either starting disparity. The Number of TRAIN patters transmitted is determined by the time required for the phy's receiver to complete training. The phy shall transmit at least one TRAIN pattern.

If the phy's receiver is trained and acquires synchronization before TLT, then the phy shall stop transmitting TRAIN patters and start transmitting TRAIN_DONE patters. The Phy shall transmit a minimum of four TRAIN_DONE patterns.

Test Setup

The DUT and the Testing Station are physically connected the DUT is powered off.

Procedure

1. Power on the DUT.
2. The testing station is instructed to transmit COMINIT/COMRESET to the DUT.
3. The DUT is expected to respond with COMINIT/COMRESET.
4. The testing station is instructed to transmit COMSAS to the DUT.
5. The DUT is expected to respond with COMSAS.
6. Upon reception of COMSAS from the DUT, the Testing station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
7. Following RCDT, the testing station is instructed to transmit ALIGN(0) primitives at 1.5 Gbps for one SNTT. If the DUT supports 1.5 Gbps signaling, it is expected to do the same. If the DUT does not support 1.5 Gbps signaling, it should continue to transmit D.C. Idle.
8. The Testing station is then instructed to transmit D.C. Idle for one RCDT. If the DUT supports 3.0 Gbps. The DUT is expected to do the same.
9. Following RCDT, the testing station is instructed to transmit ALIGN(1) primitives at 3.0 Gbps for one SNTT. If the DUT supports 3.0 Gbps signaling, it is expected to the same.
10. The Testing Station is then instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
11. The Testing Station is the instructed to transmit its Phy Capabilities bits indicating support for all speeds and SSC settings. The DUT is expected to transmit its Phy Capabilities Bits.
12. The Testing Station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
13. The Testing Station is instructed to then transmit properly formatted TRAIN patterns at the highest mutually speed. The DUT is expected to do the same.
14. Upon successful reception of a properly formatted TRAIN pattern from the DUT, the testing station is instructed to transmit a properly formatted TRAIN_DONE pattern to the DUT for the

remainder MTT. The DUT is expected to do the same upon successful reception of a TRAIN pattern from the testing station.

Observable Results

After transmitting at least one TRAIN pattern, the DUT should then transmit four properly formatted TRAIN_DONE patterns to the testing station.

A properly formatted TRAIN_DONE pattern consists of:

TRAIN_DONE; and

58 dwords set to 0000_0000h that are transmitted scrambled and 8b10b encoded.

Possible Problems

None.

Test 5.7.2.3: Negotiate to 6G, SSC

Purpose

To verify that the DUT negotiates to 6G signaling with no SSC.

References

5.10.4.2.3.4 SAS SPL

Resource Requirements

A Protocol Generator/Analyzer capable of transmitting and receiving SAS OOB signals and SAS 2.0 Speed Negotiation.

Discussion

Actual Training Time starts after RCDT and ends when receiver dword synchronization is obtained. The phy transmits the TRAIN pattern starting after RCDT. A minimum of one TRAIN pattern shall be transmitted. When Actual Training Time ends, the phy transitions to transmitting TRAIN_DONE patterns. If Actual Training Time does not end before Training Lock Time, then the phy does not transition to transmitting the TRAIN_DONE pattern.

The phy transitions to transmitting Link Layer dwords after transmitting a minimum of four TRAIN_DONE patterns and receiving one TRAIN_DONE pattern. This represents the valid end of Train-SNW and the beginning of normal link layer operation. If a phy has not transmitted at least four TRAIN_DONE patterns and received at least one TRAIN_DONE within Maximum Training Time, then the Train-SNW is invalid. This test only applies to devices that support 6.0 Gbps signaling with SSC.

Test Setup

The DUT and the Testing Station are physically connected the DUT is powered off.

Procedure

1. Power on the DUT.
2. The testing station is instructed to transmit COMINIT/COMRESET to the DUT.
3. The DUT is expected to respond with COMINIT/COMRESET.
4. The testing station is instructed to transmit COMSAS to the DUT.
5. The DUT is expected to respond with COMSAS.
6. Upon reception of COMSAS from the DUT, the Testing station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
7. Following RCDT, the testing station is instructed to transmit ALIGN(0) primitives at 1.5 Gbps for one SNTT. If the DUT supports 1.5 Gbps signaling, it is expected to do the same. If the DUT does not support 1.5 Gbps signaling, it should continue to transmit D.C. Idle.
8. The Testing station is then instructed to transmit D.C. Idle for one RCDT. If the DUT supports 3.0 Gbps. The DUT is expected to do the same.
9. Following RCDT, the testing station is instructed to transmit ALIGN(1) primitives at 3.0 Gbps for one SNTT. If the DUT supports 3.0 Gbps signaling, it is expected to the same.
10. The Testing Station is then instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
11. The Testing Station is the instructed to transmit its Phy Capabilities bits indicating support for all speeds. The Testing Station is instructed to indicate that it does **not** support 6.0 Gbps signaling without SSC. The DUT is expected to transmit its Phy Capabilities Bits.
12. The Testing Station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
13. The Testing Station is instructed to then transmit properly formatted TRAIN patterns at the highest mutually speed. The DUT is expected to do the same.
14. Upon successful reception of a properly formatted TRAIN pattern from the DUT, the testing station is instructed to transmit a properly formatted TRAIN_DONE pattern to the DUT for the remainder MTT. The DUT is expected to do the same upon successful reception of a TRAIN pattern from the testing station.

Observable Results

Verify that the DUT transmits at least one TRAIN pattern and at least four TRAIN_DONE patterns at 6G with SSC before MTT has expired.

Possible Problems

Lower level testing will have to be used to verify that the DUT enabled SSC properly.

Test 5.7.2.4: Negotiate to 6G, No SSC

Purpose

To verify that the DUT negotiates to 6G signaling with no SSC.

References

5.10.4.2.3.4 SAS SPL

Resource Requirements

A Protocol Generator/Analyzer capable of transmitting and receiving SAS OOB signals and SAS 2.0 Speed Negotiation.

Discussion

Actual Training Time starts after RCDT and ends when receiver dword synchronization is obtained. The phy transmits the TRAIN pattern starting after RCDT. A minimum of one TRAIN pattern shall be transmitted. When Actual Training Time ends, the phy transitions to transmitting TRAIN_DONE patterns. If Actual Training Time does not end before Training Lock Time, then the phy does not transition to transmitting the TRAIN_DONE pattern.

The phy transitions to transmitting Link Layer dwords after transmitting a minimum of four TRAIN_DONE patterns and receiving one TRAIN_DONE pattern. This represents the valid end of Train-SNW and the beginning of normal link layer operation. If a phy has not transmitted at least four TRAIN_DONE patterns and received at least one TRAIN_DONE within Maximum Training Time, then the Train-SNW is invalid. This test only applies to devices that support 6.0 Gbps signaling.

Test Setup

The DUT and the Testing Station are physically connected the DUT is powered off.

Procedure

1. Power on the DUT.
2. The testing station is instructed to transmit COMINIT/COMRESET to the DUT.
3. The DUT is expected to respond with COMINIT/COMRESET.
4. The testing station is instructed to transmit COMSAS to the DUT.
5. The DUT is expected to respond with COMSAS.
6. Upon reception of COMSAS from the DUT, the Testing station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
7. Following RCDT, the testing station is instructed to transmit ALIGN(0) primitives at 1.5 Gbps for one SNTT. If the DUT supports 1.5 Gbps signaling, it is expected to do the same. If the DUT does not support 1.5 Gbps signaling, it should continue to transmit D.C. Idle.
8. The Testing station is then instructed to transmit D.C. Idle for one RCDT. If the DUT supports 3.0 Gbps. The DUT is expected to do the same.
9. Following RCDT, the testing station is instructed to transmit ALIGN(1) primitives at 3.0 Gbps for one SNTT. If the DUT supports 3.0 Gbps signaling, it is expected to the same.
10. The Testing Station is then instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
11. The Testing Station is the instructed to transmit its Phy Capabilities bits indicating support for all speeds. The Testing Station is instructed to indicate that it does **not** support 6.0 Gbps signaling with SSC. The DUT is expected to transmit its Phy Capabilities Bits.
12. The Testing Station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
13. The Testing Station is instructed to then transmit properly formatted TRAIN patterns at the highest mutually speed. The DUT is expected to do the same.
14. Upon successful reception of a properly formatted TRAIN pattern from the DUT, the testing station is instructed to transmit a properly formatted TRAIN_DONE pattern to the DUT for the remainder MTT. The DUT is expected to do the same upon successful reception of a TRAIN pattern from the testing station.

Observable Results

Verify that the DUT transmits at least one TRAIN pattern and at least four TRAIN_DONE patterns at 6G without any SSC before MTT has expired.

Possible Problems

Lower level testing will have to be used to verify that the DUT did not enable SSC.

Test 5.7.2.5: Negotiate to 6G, Fail SSC

Purpose

To verify that the DUT negotiates to 6G signaling with no SSC.

References

5.10.4.2.3.4 SAS SPL

Resource Requirements

A Protocol Generator/Analyzer capable of transmitting and receiving SAS OOB signals and SAS 2.0 Speed Negotiation.

Discussion

Actual Training Time starts after RCDT and ends when receiver dword synchronization is obtained. The phy transmits the TRAIN pattern starting after RCDT. A minimum of one TRAIN pattern shall be transmitted. When Actual Training Time ends, the phy transitions to transmitting TRAIN_DONE patterns. If Actual Training Time does not end before Training Lock Time, then the phy does not transition to transmitting the TRAIN_DONE pattern.

The phy transitions to transmitting Link Layer dwords after transmitting a minimum of four TRAIN_DONE patterns and receiving one TRAIN_DONE pattern. This represents the valid end of Train-SNW and the beginning of normal link layer operation. If a phy has not transmitted at least four TRAIN_DONE patterns and received at least one TRAIN_DONE within Maximum Training Time, then the Train-SNW is invalid.

If a Train-SNW is invalid and there are additional, untried, commonly settings exchanged during SNW-3, then a new Train-SNW shall be performed at the next highest, untried, commonly capability. This test only applies to devices that support 6.0 Gbps signaling.

Test Setup

The DUT and the Testing Station are physically connected the DUT is powered off.

Procedure

1. Power on the DUT.
2. The testing station is instructed to transmit COMINIT/COMRESET to the DUT.
3. The DUT is expected to respond with COMINIT/COMRESET.
4. The testing station is instructed to transmit COMSAS to the DUT.
5. The DUT is expected to respond with COMSAS.
6. Upon reception of COMSAS from the DUT, the Testing station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
7. Following RCDT, the testing station is instructed to transmit ALIGN(0) primitives at 1.5 Gbps for one SNTT. If the DUT supports 1.5 Gbps signaling, it is expected to do the same. If the DUT does not support 1.5 Gbps signaling, it should continue to transmit D.C. Idle.
8. The Testing station is then instructed to transmit D.C. Idle for one RCDT. If the DUT supports 3.0 Gbps. The DUT is expected to do the same.
9. Following RCDT, the testing station is instructed to transmit ALIGN(1) primitives at 3.0 Gbps for one SNTT. If the DUT supports 3.0 Gbps signaling, it is expected to the same.
10. The Testing Station is then instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
11. The Testing Station is the instructed to transmit its Phy Capabilities bits indicating support for all speeds. The Testing Station is instructed to indicate that it supports all speeds and SSC settings. The DUT is expected to transmit its Phy Capabilities Bits.
12. The Testing Station is instructed to transmit D.C. Idle for one RCDT. The DUT is expected to do the same.
13. The Testing Station is instructed to then transmit properly formatted TRAIN patterns at the highest mutually speed (6.0 Gbps, SSC). The DUT is expected to do the same.
14. Upon successful reception of a properly formatted TRAIN pattern from the DUT, the testing

station is instructed to **not** transmit a TRAIN_DONE pattern. The DUT is expected to receive the properly formatted TRAIN pattern and being transmitting TRAIN_DONE patterns.

15. Upon expiration of the MTWT timer, the Testing station is instructed to stop transmitting TRAIN patterns and begin Transmitting D.C. Idle for one RCDT. The DUT is expected to do the same.
16. After RCDT, the testing station is instructed to transmit properly formatted TRAIN patters at the next highest mutually speed (6.0 Gbps, No SSC). The DUT is expected to do the same.
17. Upon successful reception of a properly formatted TRAIN pattern from the DUT, the testing station is instructed to transmit TRAIN_DONE patterns. The DUT is expected to do the same upon reception of a properly formatted TRAIN pattern received from the testing station.

Observable Results

Verify that the DUT transmits at least one TRAIN pattern and at least four TRAIN_DONE patterns at 6G with SSC before MTT has expired. Verify that the DUT waits one RCDT and participates in the second Train-SNW with the testing station.

Verify that the DUT transmits at least one TRAIN pattern and at least four TRAIN_DONE patterns at 6G with no SSC before MTT has expired.

Possible Problems

Lower level testing will have to be used to verify that the DUT enabled SSC properly.