UNH IOL SERIAL ATTACHED SCSI (SAS) CONSORTIUM

Clause 5
SAS Phy Layer OOB Test Suite
Version 3.04

Technical Document

Last Updated July 25, 2011

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MODIFICATION RECORD

[1]Oct 30, 2003 (Version 1.0) DRAFT RELEASE
David Woolf: Initial draft release
[2]Nov 13, 2003 (Version 1.1) DRAFT RELEASE
David Woolf: Added test cases 6.2.8 – 6.2.19
[3]May 4, 2004 (Version 1.2) DRAFT RELEASE
David Woolf Added test cases 6.1.6 – 6.1.9
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David Woolf Adjusted test procedures to reflect UNH-IOL test capabilities.
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David Woolf Adjusted test procedures to reflect UNH-IOL test capabilities.
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David Woolf Modified Synchronization tests, Adjusted test procedures to reflect UNH-IOL test capabilities.
[7]Dec 6, 2004 (Version 1.6) FINAL RELEASE
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Michael Davidson Removed Research Computing Center References.
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Joshua Beaudet Updated all test refernces

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David Woolf	UNH InterOperability Laboratory (UNH – IOL)
Leon Cyril	UNH InterOperability Laboratory (UNH – IOL)
Michael Davidson	UNH InterOperability Laboratory (UNH – IOL)
Joshua Beaudet	UNH InterOperability Laboratory (UNH – IOL)

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 Phy Layer functionality of their Serial Attached SCSI (SAS) products. Specifically this Test Suite is directed at verifying the 8B/10B encoding, Out of Band sequences, Speed Negotiation, and synchronization of the Phy Layer of SAS products in support of the work being directed by the SCSI Trade Association SAS Plugfest Committee.

These tests are designed to determine if a SAS product conforms to specifications defined in Clause 6 of **T10/Project 1601-D/Rev 10 – Serial Attached SCSI 1.1 – (SAS – 1.1)** (hereafter referred to as the "SAS 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 subclauses 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.

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.

REFERENCES

The following document is referenced in this text:

[1] T10/Project 2125-D/Rev 07 – Serial Attached SCSI 2.1 – (SAS – 2.1)
[2] T10/Project 2124-D/Rev 07 – SAS Protocol Layer – (SPL)

GROUP 1: OUT OF BAND (OOB) SIGNALS

Overview:

This group of tests verifies the SAS OOB signals defined in Clause 5 of the SAS Standard and SAS SPL. Comments and questions regarding the implementation of these tests are welcome, and may be forwarded to David Woolf, UNH InterOperability Lab (djwoolf@iol.unh.edu).

The following test cases refer to the OOB signals COMWAKE, COMSAS, and COMINIT. Unless otherwise noted, it is expected that the Testing Station and the DUT will transmit these signals using the prescribed Idle and Burst times listed in Tables 59, 61, and 62 of the SAS Standard. Additionally it is expected that each time COMWAKE, COMSAS, or COMINIT is transmitted, the Testing Station or DUT will transmit 6 cycles of the Idle and Burst times for that signal unless noted otherwise.

Test 5.1.1 - Transmit and Receive COMWAKE

Purpose: To determine that the DUT transmits the OOB signal COMWAKE using the defined idle and burst times correctly.

References:

[1] Table 59, 61, 62 SAS Standard
[2] 5.9.2, 5.9.3 SAS Standard
[3] Figure 121 SAS Standard

Resource Requirements: SAS Test System capable of generating and analyzing OOB signals.

Last Modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the Nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. The OOB signal COMWAKE is defined as having a burst time of 160 OOBI (~106 ns), and Idle time of 160 OOBI, and a negation time of 280 (~186 ns) OOBI. Tables 32, 33 and 34 of the SAS Standard define how an OOB signal receiver must detect OOB signals. An OOB signal receiver receiving a COMWAKE signal shall detect that signal if the Tburst is greater than 100 ns and the Tidle is greater than 101,3 ns and less than 112 ns. Receiver detection of negation time for COMWAKE is defined to be greater than 175 ns.

Test Setup: The DUT and Testing Station are not connected.

Test Procedure:

1. Connect the DUT and the Testing Station.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should ignore the received COMSAS. After 13,65 μs the DUT is expected to transmit COMWAKE.
5. The Testing Station should transmit COMWAKE to the DUT with Tburst = 101 ns and Tidle = 105 ns followed by a negation time of 176 ns.

Observable Results: Verify that the COMWAKE signal is made of six cycles of Idle time of 160 OOBI (~106 ns) and Burst time of 160 OOBI (~106 ns) followed by 280 OOBI (~186 ns) of negation time. Verify that the DUT detects the received COMWAKE signal and moves on to perform SATA speed negotiation.

Possible Problems: This test is only applicable to devices that support SATA.

Test 5.1.2 - Transmit and Receive COMINIT

Purpose: To determine that the DUT transmits and receives the OOB signal COMINIT using the defined idle and burst times correctly.

References:

[1] Table 59, 61, 82 SAS Standard
[2] 5.9.2, 5.9.3 SAS Standard
[3] Figure 121 SAS Standard

Resource Requirements: SAS Test System capable of generating and analyzing OOB signals.

Last Modification: August 15, 2007

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the Nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. The OOB signal COMINIT is defined as having a burst time of 160 OOBI (~106 ns), and Idle time of 480 OOBI (~319 ns), and a negation time of 800 OOBI (~533 ns) . Tables 59, 61, and 62 of the SAS Standard define how an OOB signal receiver must detect OOB signals. An OOB signal receiver receiving a COMINIT signal shall detect that signal if the Tburst is greater than 100 ns and the Tidle is greater than 304 ns and less than 336 ns. Receiver detection of negation time for COMINIT is defined to be greater than 525 ns.

Test Setup: The DUT is not connected to the Testing Station.

Test Procedure:

1. Connect the Testing Station to the DUT.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT with Tburst = 101 ns and Tidle = 320 ns followed by a negation time of 526 ns.

Observable Results: Verify that the COMINIT signal is made of six cycles of Idle time of 160 OOBI (~106 ns) and Burst time of 480 OOBI (~319 ns) followed by 800 OOBI (~533 ns) of negation time. Verify that the DUT responds to the received COMINIT signal by transmitting COMSAS.

Possible Problems: None.

Test 5.1.3 - Transmit and Receive COMSAS

Purpose: To determine that the DUT transmits the OOB signal COMSAS using the defined idle and burst times correctly.

References:

[1] Table 59, 61, 62 SAS Standard
[2] 5.9.2, 5.9.3 SAS Standard
[3] Figure 121 SAS Standard

Resource Requirements: SAS Test System capable of generating and analyzing OOB signals.

Last Modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the Nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. The OOB signal COMSAS is defined as having a burst time of 160 OOBI (~106 ns), and Idle time of 1440 OOBI (~959 ns), and a negation time of 2400 OOBI (~1599 ns). Receiver detection of negation time for COMSAS is defined to be greater than 1575 ns.

Test Setup: The DUT is not connected to the Testing Station.

Test Procedure:

1. Connect the DUT to the Testing Station.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should transmit COMSAS to the DUT with Tburst = 101 ns and Tidle = 950 ns followed by a negation time of 1580 ns.

Observable Results: Verify that the COMSAS signal is made of six cycles of Burst time of 160 OOBI (~106 ns) and Idle time of 1440 OOBI (~959 ns) followed by 2400 OOBI (~1599 ns) of negation time. Verify that the DUT properly detects the received COMSAS and moves on to SAS Speed Negotiation.

Possible Problems: None.

Test 5.1.4 - Receive COMWAKE Incorrect Idle Time

Purpose: To determine that the DUT uses the defined idle, burst, and negation times correctly when determining if an OOB signal was received.

References:

[1] Table 59, 61, 62 SAS Standard
[2] 5.9.2, 5.9.3 SAS Standard
[3] Figure 121 SAS Standard

Resource Requirements: SAS Test System capable of generating and analyzing OOB signals.

Last Modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the Nominal OOBI is 666,6 ps. To transmit an OOBI signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. The OOB signal COMWAKE is defined as having a burst time of 160 OOBI, and Idle time of 160 OOBI, and a negation time of 280 OOBI. Tables 59, 61, and 62 of the SAS Standard define how an OOB signal receiver must detect OOB signals. An OOB signal receiver receiving a COMWAKE signal shall detect that signal if the Tburst is greater than 100 ns and the Tidle is greater than 101,3 ns and less than 112 ns. Receiver detection of negation time for COMWAKE is defined to be greater than 175 ns.

Test Setup: The DUT is connected to the Testing Station.

Test Procedure 1:

1. Power on the DUT.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should ignore the received COMSAS. After 13,65 μs the DUT is expected to transmit COMWAKE.
5. The Testing Station should transmit COMWAKE to the DUT with Tburst = 101 ns and Tidle = 30 ns (~45 OOBI) followed by a negation time of 176 ns.

Test Procedure 2:

1. Power on the DUT.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should ignore the received COMSAS. After 13,65 μs the DUT is expected to transmit COMWAKE.
5. The Testing Station should transmit COMWAKE to the DUT with Tburst = 101 ns and Tidle =180 ns (270 OOBI) followed by a negation time of 176 ns.

Observable Results: In each case verify that the DUT does not detect the received COMWAKE signal and does not move on to perform SATA speed negotiation.

Possible Problems: If the DUT fails this test, it may be useful to determine what value for Tidle the DUT uses. This can be accomplished by incrementally increasing or decreasing the Tidle value used by the Testing Station. This test is only applicable to devices that support SATA.

Test 5.1.5 - Receive COMINIT Incorrect Idle Time

Purpose: To determine that the DUT uses the defined idle, burst, and negation times correctly when determining if an OOB signal was received.

References:

[1] Table 59, 61, 62 SAS Standard
[2] 5.9.2, 5.9.3 SAS Standard
[3] Figure 121 SAS Standard

Resource Requirements: SAS Test System capable of generating and analyzing OOB signals.

Last Modification: August 15, 2007

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the Nominal OOBI is 666,6 ps. To transmit an OOBI signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. The OOB signal COMINIT is defined as having a burst time of 160 OOBI, and Idle time of 480 OOBI, and a negation time of 800 OOBI. Tables 59, 61, and 62 of the SAS Standard define how an OOB signal receiver must detect OOB signals. An OOB signal receiver receiving a COMINIT signal shall detect that signal if the Tburst is greater than 100 ns and the Tidle is greater than 304 ns and less than 336 ns. Receiver detection of negation time for COMINIT is defined to be greater than 525 ns.

Test Setup: The Test Station and the DUT are not connected.

Test Procedure 1:

1. Connect the DUT to the Test Station.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT with Tburst = 101 ns (160 OOBI) and Tidle = 170 ns (255 OOBI) followed by a negation time of 530 ns (800 OOBI).

Test Procedure 2:

1. Connect the DUT to the Test Station.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT with Tburst = 101 ns (160 OOBI) and Tidle = 530 ns (800 OOBI) followed by a negation time of 530 ns (800 OOBI).

Observable Results: Verify that the DUT does not respond to the received COMINIT signal by transmitting COMSAS. The DUT may misinterpret the incorrect COMINIT signal as a COMWAKE signal.

Possible Problems: If the DUT fails this test, it may be useful to determine what value for Tidle the DUT uses. This can be accomplished by incrementally increasing or decreasing the Tidle value used by the Testing Station. A COMINIT signal with Tidle >= 530 ns (800 OOBI) *may* be interpreted as a COMSAS signal by the DUT, in which case it should respond correctly with COMSAS.

Test 5.1.6 - Receive COMSAS Incorrect Idle Time

Purpose: To determine that the DUT uses the defined idle, burst, and negation times correctly when determining if an OOB signal was received.

References:

[1] Tables 32, 33 and 34 SAS Standard
[2] 5.9.3 SAS Standard
[3] Figure 121 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last Modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the Nominal OOBI is 666,6 ps. To transmit an OOBI signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. The OOB signal COMSAS is defined as having a burst time of 1440 OOBI, and Idle time of 2400 OOBI, and a negation time of 280 OOBI. Receiver detection of negation time for COMSAS is defined to be greater than 1575 ns.

Test Setup: The Testing Station is not connected to the DUT

Test Procedure 1:

1. Connect the DUT to the Testing Station
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should transmit COMSAS to the DUT with Tburst = 101 ns (152 OOBI) and Tidle = 520 ns (800 OOBI) followed by a negation time of 1580 ns (2400 OOBI). The Testing Station should not begin SAS Speed Negotiation.

Test Procedure 2:

1. Connect the DUT to the Testing Station
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should transmit COMSAS to the DUT with Tburst = 101 ns (152 OOBI) and Tidle = 1580 ns (2400 OOBI) followed by a negation time of 1580 ns (2400 OOBI). The Testing Station should not begin SAS Speed Negotiation.

Observable Results: Verify that the DUT does not detect the received COMSAS and does not move on to SAS Speed Negotiation. It is expected that the DUT will be in the SP7 state when the invalid COMSAS signal is received from the Testing Station. The DUT is expected to transition to the SP2 state after the COMSAS Detect Timeout Timer (13.65 μsec) expires if SATA is not supported, and the SP16 state if SATA is supported. In SP16 the DUT is expected to transmit COMWAKE. In SP2, if the Hot-Plug Timeout (500 msec) timer is implemented, the DUT is expected to start the Hot-Plug Timeout timer, wait for it to expire, then transition to SPO and transmit COMINIT. In SP2, if the Hot-Plug Timeout timer is not implemented, the DUT is expected to wait for COMINIT to be detected, then transition to SP4 and transmit COMSAS.

Possible Problems: When performing this test, it may be useful to use a SAS analyzer capable of triggering on a COMINIT signal coming from the Testing Station. If the DUT fails this test, it may be useful to determine what value for Tidle the DUT uses. This can be accomplished by incrementally increasing or decreasing the Tidle value used by the Testing Station.

Test 5.1.7 - Receive OOB Signals at all Supported Speeds

Purpose: To determine that the DUT can detect OOB signals at all supported speeds.

References:

[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last Modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. A SAS device should be able to detect OOB signals transmitted at all speeds up to its highest supported physical link rate. A SAS device must be able to detect OOB signals transmitted at a rate lower than its own lowest supported physical link rate.

Test Setup: The DUT is physically connected to the testing station.

Test Procedure 1:

1. Power on the DUT.
2. Configure the Testing Station to send all ALIGNs at 1.5 Gbps.
3. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
4. The DUT should transmit COMSAS.
5. The Testing Station should transmit COMSAS to the DUT.

Test Procedure 2:

1. Power on the DUT.
2. Configure the Testing Station to send all ALIGNs at 3.0 Gbps.
3. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
4. The DUT should transmit COMSAS.
5. The Testing Station should transmit COMSAS to the DUT.

Observable Results: Verify that the DUT detects the received COMSAS in each case and moves on to SAS Speed Negotiation.

Possible Problems: None.

Test 5.1.8 - Receive 3 Cycles COMWAKE

Purpose: To determine that the DUT responds correctly when receiving a shortened COMWAKE signal.

References:
[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last Modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the Nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and a negation time has been detected.

Test Setup: The DUT is physically connected to the Testing station

Test Procedure:
1. Power on the DUT.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should ignore the received COMSAS. After 13,65 μs the DUT is expected to transmit COMWAKE.
5. The Testing Station should transmit 3 cycles of COMWAKE to the DUT with Tburst = 101 ns and Tidle = 105 ns followed by a negation time of 176 ns.

Observable Results: Verify that the DUT does not detect the shortened COMWAKE signal and does not perform SATA speed negotiation.

Possible Problems: This test is only applicable to devices that support SATA.

Test 5.1.9 - Receive 3 Cycles COMSAS

Purpose: To determine that the DUT responds correctly when receiving a shortened COMSAS signal.

References:
[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last Modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the Nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and a negation time has been detected.

Test Setup: The DUT and Testing Station are not connected.

Test Procedure:
1. Connect the Testing Station to the DUT.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should transmit 3 cycles of COMSAS to the DUT with Tburst = 101 ns (160 OOBI) and Tidle = 950 ns (1440 OOBI) followed by a negation time of 1580 ns (2400 OOBI).

Observable Results: Verify that the DUT does not detect the received COMSAS and does not move on to SAS Speed Negotiation. It is expected that the DUT will be in the SP7 state when the invalid COMSAS signal is received from the Testing Station. The DUT is expected to transition to the SP2 state after the COMSAS Detect Timeout Timer (13.65 μsec) expires if SATA is not supported, and the SP16 state if SATA is supported. In SP16 the DUT is expected to transmit COMWAKE. In SP2, if the Hot-Plug Timeout (500 msec) timer is implemented, the DUT is expected to start the Hot-Plug Timeout timer, wait for it to expire, then transition to SPO and transmit COMINIT. In SP2, if the Hot-Plug Timeout timer is not implemented, the DUT is expected to wait for COMINIT to be detected, then transition to SP4 and transmit COMSAS.

Possible Problems: When performing this test, it may be useful to use a SAS analyzer capable of triggering on a COMINIT signal coming from the Testing Station.

Test 5.1.10 - Receive 3 Cycles COMINIT

Purpose: To determine that the DUT responds correctly when receiving a shortened COMINIT signal.

References:

[1] 5.9.3 SAS Standard

Resource Requirements: A SAS Test System capable of generating and analyzing OOB signals.

Last Modification: February 26, 2006

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the Nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and a negation time has been detected.

Test Setup: The DUT and Test Station are not connected.

Test Procedure:

1. Connect the DUT to the Test Station.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit 3 cycles of COMINIT with Tburst = 101 ns (160 OOBI) and Tidle = 320 ns (480 OOBI) followed by a negation time of 526 ns (800 OOBI). The Testing Station should not transmit COMSAS.

Observable Results: Verify that the DUT does not respond to the received COMINIT signal by transmitting COMSAS.

Possible Problems: None.

Test 5.1.11 - Receive 4 Cycles COMWAKE

Purpose: To determine that the DUT responds correctly when receiving a shortened COMWAKE signal.

References:
[1] 5.9.3 SAS Standard

Resource Requirements: A SAS Test System capable of generating and analyzing OOB signals.

Last Modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the Nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and a negation time has been detected.

Test Setup: The DUT and Test Station are physically connected.

Test Procedure:
1. Power on the DUT.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should ignore the received COMSAS. After 13,65 µs the DUT is expected to transmit COMWAKE.
5. The Testing Station should transmit 5 cycles of COMWAKE to the DUT with Tburst = 101 ns and Tidle = 105 ns followed by a negation time of 176 ns. This will create 4 idle times between 5 bursts.

Observable Results: Verify that the DUT detects the shortened COMWAKE signal and then performs SATA speed negotiation.

Possible Problems: This test is only applicable to devices that support SATA.

Test 5.1.12 - Receive 4 Cycles COMSAS

Purpose: To determine that the DUT responds correctly when receiving a shortened COMSAS signal.

References:

[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last Modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the Nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and a negation time has been detected.

Test Setup: The DUT and Test Station are not connected.

Test Procedure:

1. Connect the DUT to the Test Station.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should transmit 5 cycles of COMSAS to the DUT with Tburst = 101 ns and Tidle = 950 ns followed by a negation time of 1580 ns. This will create 4 idle times between 5 bursts.

Observable Results: Verify that the DUT detects the received COMSAS and then moves on to SAS Speed Negotiation.

Possible Problems: When performing this test it may be useful use an analyzer capable of triggering on COMSAS from the DUT.

Test 5.1.13 - Receive 4 Cycles COMINIT

Purpose: To determine that the DUT responds correctly when receiving a shortened COMINIT signal.

References:

[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last Modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the Nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and a negation time has been detected.

Test Setup: The DUT and the Testing Station are not connected.

Test Procedure:

1. Connect the DUT to the Testing Station.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit 5 cycles of COMINIT with Tburst = 101 ns and Tidle = 320 ns followed by a negation time of 526 ns. The Testing Station should not transmit COMSAS. This will create 4 idle times between 5 bursts.

Observable Results: Verify that the DUT responds to the received COMINIT signal by transmitting COMSAS.

Possible Problems: When performing this test it may be useful to use an analyzer capable of triggering on COMSAS from the DUT.

Test 5.1.14 - Receive 8 Cycles COMWAKE

Purpose: To determine that the DUT responds correctly when receiving a lengthened COMWAKE signal.

References:

[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last Modification: February 26, 2006

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the Nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and a negation time has been detected.

Test Setup: The DUT and the testing station are physically connected.

Test Procedure:

1. Power on the DUT.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should ignore the received COMSAS. After 13,65 μs the DUT is expected to transmit COMWAKE.
5. Upon receiving COMWAKE from the DUT, the Testing Station should transmit 8 cycles of COMWAKE to the DUT with Tburst = 101 ns and Tidle = 105 ns followed by a negation time of 176 ns.

Observable Results: Verify that the DUT detects the lengthened COMWAKE signal and then performs SATA speed negotiation.

Possible Problems: This test is only applicable to devices that support SATA.

Test 5.1.15 - Receive 8 Cycles COMSAS

Purpose: To determine that the DUT responds correctly when receiving a lengthened COMSAS signal.

References:

[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last Modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the Nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and a negation time has been detected.

Test Setup: The DUT and Test Station are not connected.

Test Procedure:

1. Connect the DUT to the Testing Station.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should transmit 8 cycles of COMSAS to the DUT with Tburst = 101 ns and Tidle = 950 ns followed by a negation time of 1580 ns.

Observable Results: Verify that the DUT detects the received COMSAS signal and then moves on to SAS Speed Negotiation.

Possible Problems: When performing this test it may be useful to use an analyzer capable of triggering on COMSAS from the DUT.

Test 5.1.16 - Receive 8 Cycles COMINIT

Purpose: To determine that the DUT responds correctly when receiving a lengthened COMINIT signal.

References:
[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last Modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the Nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and a negation time has been detected.

Test Setup: The DUT and Testing Station are not connected.

Test Procedure:
1. Connect the DUT to the Testing Station.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit 8 cycles of COMINIT with Tburst = 101 ns and Tidle = 320 ns followed by a negation time of 526 ns.

Observable Results: Verify that the DUT responds to the received COMINIT signal by transmitting COMSAS.

Possible Problems: When performing this test it may be useful to use an analyzer capable of triggering on COMSAS from the DUT.

Test 5.1.17 - Receive 100 Cycles COMWAKE

Purpose: To determine that the DUT responds correctly when receiving a lengthened COMWAKE signal.

References:

[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last Modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the Nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and a negation time has been detected.

Test Setup: The DUT and the testing station are physically connected.

Test Procedure:

1. Power on the DUT.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should ignore the received COMSAS. After 13,65 μs the DUT is expected to transmit COMWAKE.
5. Upon receiving COMWAKE from the DUT, the Testing Station should transmit 100 cycles of COMWAKE to the DUT with Tburst = 101 ns and Tidle = 105 ns followed by a negation time of 176 ns.

Observable Results: Verify that the DUT detects the lengthened COMWAKE signal and then transmits D10.2 data words only after the COMWAKE negation time.

Possible Problems: This test is only applicable to devices that support SATA.

Test 5.1.18 - Receive 100 Cycles COMSAS

Purpose: To determine that the DUT responds correctly when receiving a lengthened COMSAS signal.

References:
[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last Modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the Nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and a negation time has been detected.

Test Setup: The DUT and Testing Station are not connected.

Test Procedure:
1. Connect the Testing Station to the DUT.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should transmit 100 cycles of COMSAS to the DUT with Tburst = 101 ns and Tidle = 950 ns followed by a negation time of 1580 ns.

Observable Results: Verify that the DUT detects the received COMSAS signal and then moves on to SAS Speed Negotiation only after the COMSAS negation period.

Possible Problems: None

Test 5.1.19 – 5 Cycles of 1.5G COMINIT

Purpose: To determine that the DUT responds correctly when receiving a shortened and slowed COMINIT signal.

References:

[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and negation time has been detected.

Test Setup: The DUT and the Testing Station are not connected.

Test Procedure:

1. Connect the DUT and the Testing Station.
2. Power on the DUT.
3. The DUT should transmit COMINIT to the testing station. The Testing Station should transmit 5 cycles of COMINIT at 1.5G speed with Tburst = 106 ns and Tidle = 318 ns followed by a negation time of 530 ns. The Testing Station should not transmit COMSAS. This will create 4 idle times between 5 bursts.

Observable Results: Verify that the DUT responds to the received shortened and slowed COMINIT signal by transmitting COMSAS.

Possible Problems: None

Test 5.1.20 – 5 Cycles of 1.5G COMWAKE

Purpose: To determine that the DUT responds correctly when receiving a shortened and slowed COMWAKE signal.

References:

[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and negation time has been detected.

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:

1. Power on the DUT.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should ignore the received COMSAS. After 13.65 μs the DUT is expected to transmit COMWAKE.
5. The Testing Station should transmit 5 cycles of COMWAKE at 1.5G speed with Tburst = 106 ns and Tidle = 06 ns followed by a negation time of 185.5 ns. The Testing Station should not transmit COMSAS. This will create 4 idle times between 5 bursts.

Observable Results: Verify that the DUT detects the shortened and slowed COMWAKE signal and moves on to SATA speed negotiation.

Possible Problems: None

Test 5.1.21 – 5 Cycles of 1.5G COMSAS

Purpose: To determine that the DUT responds correctly when receiving a shortened and slowed COMSAS signal.

References:

[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and negation time has been detected.

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:

1. Power on the DUT.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should transmit 5 cycles of COMSAS to the DUT with Tburst = 106 ns and Tidle = 954 ns followed by a negation time of 1.590 μs. This will create 4 idle times between 5 bursts.

Observable Results: Verify that the DUT detects the received shortened and slowed COMSAS signal and then moves on to SAS Speed Negotiation.

Possible Problems: None.

Test 5.1.22 – 5 Cycles of 3G COMINIT

Purpose: To determine that the DUT responds correctly when receiving a shortened COMINIT signal.

References:
[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and negation time has been detected.

Test Setup: The DUT and the Testing Station are not connected.

Test Procedure:
1. Connect the DUT and the Testing Station.
2. Power on the DUT.
3. The DUT should transmit COMINIT to the testing station. The Testing Station should transmit 5 cycles of COMINIT at 3G speed with Tburst = 106 ns and Tidle = 318 ns followed by a negation time of 530 ns. The Testing Station should not transmit COMSAS. This will create 4 idle times between 5 bursts.

Observable Results: Verify that the DUT responds to the received shortened COMINIT signal by transmitting COMSAS.

Possible Problems: None

Test 5.1.23 – 5 Cycles of 3G COMWAKE

Purpose: To determine that the DUT responds correctly when receiving a shortened and slowed COMWAKE signal.

References:

[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and negation time has been detected.

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:

1. Power on the DUT.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should ignore the received COMSAS. After 13.65 μs the DUT is expected to transmit COMWAKE.
5. The Testing Station should transmit 5 cycles of COMWAKE at 3G speed with Tburst = 106 ns and Tidle = 06 ns followed by a negation time of 185.5 ns. The Testing Station should not transmit COMSAS. This will create 4 idle times between 5 bursts.

Observable Results: Verify that the DUT detects the shortened and slowed COMWAKE signal and moves on to SATA speed negotiation.

Possible Problems: None

Test 5.1.24 – 5 Cycles of 3G COMSAS

Purpose: To determine that the DUT responds correctly when receiving a shortened COMSAS signal.

References:

[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and negation time has been detected.

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:

1. Power on the DUT.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should transmit 5 cycles of COMSAS to the DUT with Tburst = 106 ns and Tidle = 954 ns followed by a negation time of 1.590 μs. This will create 4 idle times between 5 bursts.

Observable Results: Verify that the DUT detects the received shortened COMSAS signal and then moves on to SAS Speed Negotiation.

Possible Problems: None.

Test 5.1.25 – 6 Cycles of 1.5G COMINIT starting with –D24.3

Purpose: To determine that the DUT responds correctly when receiving a shortened and slowed COMINIT signal comprised of D24.3 primitives starting with negative running disparity.

References:

[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and negation time has been detected.

A SAS Receiver device shall detect OOB Bursts formed from any of the following: A) D24.3 Characters at 1,5 Gbps; B) ALIGN (0) primitives at 1,5 Gbps; or C) ALIGN (0) primitives at 3,0 Gbps. A SAS Receiver shall not qualify the OOB burst based on the characters received.

Test Setup: The DUT and the Testing Station are not connected.

Test Procedure:

1. Connect the DUT and the Testing Station.
2. Power on the DUT.
3. The DUT should transmit COMINIT to the testing station. The Testing Station should transmit 5 cycles of COMINIT comprised of D24.3 dwords starting with negative running disparity at 1.5G speed with Tburst = 106 ns and Tidle = 318 ns followed by a negation time of 530 ns. The Testing Station should not transmit COMSAS. This will create 5 idle times between 6 bursts.

Observable Results: Verify that the DUT detects the shortened and slowed COMINIT signal comprised of D24.3 dwords starting with negative running disparity and transmits COMSAS to the Testing Station.

Possible Problems: None.

Test 5.1.26 – 6 Cycles of 1.5G COMWAKE starting with –D24.3

Purpose: To determine that the DUT responds correctly when receiving a shortened and slowed COMINIT signal comprised of D24.3 primitives starting with negative running disparity.

References:

[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and negation time has been detected.

A SAS Receiver device shall detect OOB Bursts formed from any of the following: A) D24.3 Characters at 1,5 Gbps; B) ALIGN (0) primitives at 1,5 Gbps; or C) ALIGN (0) primitives at 3,0 Gbps. A SAS Receiver shall not qualify the OOB burst based on the characters received.

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:

1. Power on the DUT.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should ignore the received COMSAS. After 13.65 μs the DUT is expected to transmit COMWAKE.
5. The Testing Station should transmit 5 cycles of COMWAKE comprised of D24.3 dwords starting with negative running disparity at 1.5G speed with Tburst = 106 ns and Tidle = 06 ns followed by a negation time of 185.5 ns. The Testing Station should not transmit COMSAS. This will create 5 idle times between 6 bursts.

Observable Results: Verify that the DUT detects the shortened and slowed COMWAKE signal comprised of D24.3 dwords starting with negative running disparity and moves on to SATA speed negotiation.

Possible Problems: None

Test 5.1.27 – 6 Cycles of 1.5G COMSAS starting with –D24.3

Purpose: To determine that the DUT responds correctly when receiving a shortened and slowed COMSAS signal comprised of D24.3 dwords starting negative running disparity.

References:

[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and negation time has been detected.

A SAS Receiver device shall detect OOB Bursts formed from any of the following: A) D24.3 Characters at 1,5 Gbps; B) ALIGN (0) primitives at 1,5 Gbps; or C) ALIGN (0) primitives at 3,0 Gbps. A SAS Receiver shall not qualify the OOB burst based on the characters received.

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:

1. Power on the DUT.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should transmit 6 Cycles of COMSAS comprised of D24.3 dwords starting with negative running disparity at 1.5G speed to the DUT with Tburst = 106 ns and Tidle = 954 ns followed by a negation time of 1.590 µs. This will create 5 idle times between 6 bursts.

Observable Results: Verify that the DUT detects the received shortened and slowed COMSAS signal comprised of D24.3 dwords starting with negative running disparity and then moves on to SAS Speed Negotiation.

Possible Problems: None.

Test 5.1.28 – 6 Cycles of 3G COMINIT starting with –D24.3

Purpose: To determine that the DUT responds correctly when receiving a shortened COMINIT signal comprised of D24.3 dwords starting with negative running disparity.

References:

[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and negation time has been detected.

A SAS Receiver device shall detect OOB Bursts formed from any of the following: A) D24.3 Characters at 1,5 Gbps; B) ALIGN (0) primitives at 1,5 Gbps; or C) ALIGN (0) primitives at 3,0 Gbps. A SAS Receiver shall not qualify the OOB burst based on the characters received.

Test Setup: The DUT and the Testing Station are not connected.

Test Procedure:

1. Connect the DUT and the Testing Station.
2. Power on the DUT.
3. The DUT should transmit COMINIT to the testing station. The Testing Station should transmit 6 Cycles of COMINIT comprised of D24.3 dwords starting with negative running disparity at 3G speed with Tburst = 106 ns and Tidle = 318 ns followed by a negation time of 530 ns. The Testing Station should not transmit COMSAS. This will create 5 idle times between 6 bursts.

Observable Results: Verify that the DUT detects the shortened COMINIT signal comprised of D24.3 dwords starting with negative running disparity and transmits COMSAS to the Testing Station.

Possible Problems: None.

Test 5.1.29 – 6 Cycles of 3G COMWAKE starting with –D24.3

Purpose: To determine that the DUT responds correctly when receiving a shortened COMINIT signal comprised of D24.3 dwords starting with negative running disparity.

References:
[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and negation time has been detected.

A SAS Receiver device shall detect OOB Bursts formed from any of the following: A) D24.3 Characters at 1,5 Gbps; B) ALIGN (0) primitives at 1,5 Gbps; or C) ALIGN (0) primitives at 3,0 Gbps. A SAS Receiver shall not qualify the OOB burst based on the characters received.

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:
1. Power on the DUT.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should ignore the received COMSAS. After 13.65 μs the DUT is expected to transmit COMWAKE.
5. The Testing Station should transmit 6 Cycles of COMWAKE comprised of D24.3 dwords starting with negative running disparity at 3G speed with Tburst = 106 ns and Tidle = 06 ns followed by a negation time of 185.5 ns. The Testing Station should not transmit COMSAS. This will create 5 idle times between 6 bursts.

Observable Results: Verify that the DUT detects the shortened COMWAKE signal comprised of D24.3 dwords starting with negative running disparity and moves on to SATA speed negotiation.

Possible Problems: None

Test 5.1.30 – 6 Cycles of 3G COMSAS starting with –D24.3

Purpose: To determine that the DUT responds correctly when receiving a shortened COMSAS signal comprised of D24.3 dwords starting negative running disparity.

References:

[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and negation time has been detected.

A SAS Receiver device shall detect OOB Bursts formed from any of the following: A) D24.3 Characters at 1,5 Gbps; B) ALIGN (0) primitives at 1,5 Gbps; or C) ALIGN (0) primitives at 3,0 Gbps. A SAS Receiver shall not qualify the OOB burst based on the characters received.

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:

1. Power on the DUT.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should transmit 6 Cycles of COMSAS comprised of D24.3 dwords starting with negative running disparity at 3G speed to the DUT with Tburst = 106 ns and Tidle = 954 ns followed by a negation time of 1.590 µs. This will create 5 idle times between 6 bursts.

Observable Results: Verify that the DUT detects the received shortened COMSAS signal comprised of D24.3 dwords starting with negative running disparity and then moves on to SAS Speed Negotiation.

Possible Problems: None.

Test 5.1.31 – 6 Cycles of 1.5G COMINIT starting with +D24.3

Purpose: To determine that the DUT responds correctly when receiving a shortened and slowed COMINIT signal comprised of D24.3 primitives starting with positive running disparity.

References:

[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and negation time has been detected.

A SAS Receiver device shall detect OOB Bursts formed from any of the following: A) D24.3 Characters at 1,5 Gbps; B) ALIGN (0) primitives at 1,5 Gbps; or C) ALIGN (0) primitives at 3,0 Gbps. A SAS Receiver shall not qualify the OOB burst based on the characters received.

Test Setup: The DUT and the Testing Station are not connected.

Test Procedure:

1. Connect the DUT and the Testing Station.
2. Power on the DUT.
3. The DUT should transmit COMINIT to the testing station. The Testing Station should transmit 6 Cycles of COMINIT comprised of D24.3 dwords starting with positive running disparity at 1.5G speed with Tburst = 106 ns and Tidle = 318 ns followed by a negation time of 530 ns. The Testing Station should not transmit COMSAS. This will create 5 idle times between 6 bursts.

Observable Results: Verify that the DUT detects the shortened and slowed COMINIT signal comprised of D24.3 dwords starting with positive running disparity and transmits COMSAS to the Testing Station.

Possible Problems: None.

Test 5.1.32 – 6 Cycles of 1.5G COMWAKE starting with +D24.3

Purpose: To determine that the DUT responds correctly when receiving a shortened and slowed COMINIT signal comprised of D24.3 primitives starting with positive running disparity.

References:

[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and negation time has been detected.

A SAS Receiver device shall detect OOB Bursts formed from any of the following: A) D24.3 Characters at 1,5 Gbps; B) ALIGN (0) primitives at 1,5 Gbps; or C) ALIGN (0) primitives at 3,0 Gbps. A SAS Receiver shall not qualify the OOB burst based on the characters received.

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:

1. Power on the DUT.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should ignore the received COMSAS. After 13.65 μs the DUT is expected to transmit COMWAKE.
5. The Testing Station should transmit 6 Cycles of COMWAKE comprised of D24.3 dwords starting with positive running disparity at 1.5G speed with Tburst = 106 ns and Tidle = 06 ns followed by a negation time of 185.5 ns. The Testing Station should not transmit COMSAS. This will create 5 idle times between 6 bursts.

Observable Results: Verify that the DUT detects the shortened and slowed COMWAKE signal comprised of D24.3 dwords starting with positive running disparity and moves on to SATA speed negotiation.

Possible Problems: None

Test 5.1.33 – 6 Cycles of 1.5G COMSAS starting with +D24.3

Purpose: To determine that the DUT responds correctly when receiving a shortened and slowed COMSAS signal comprised of D24.3 dwords starting positive running disparity.

References:

[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and negation time has been detected.

A SAS Receiver device shall detect OOB Bursts formed from any of the following: A) D24.3 Characters at 1,5 Gbps; B) ALIGN (0) primitives at 1,5 Gbps; or C) ALIGN (0) primitives at 3,0 Gbps. A SAS Receiver shall not qualify the OOB burst based on the characters received.

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:

1. Power on the DUT.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should transmit 6 Cycles of COMSAS comprised of D24.3 dwords starting with positive running disparity at 1.5G speed to the DUT with Tburst = 106 ns and Tidle = 954 ns followed by a negation time of 1.590 µs. This will create 5 idle times between 6 bursts.

Observable Results: Verify that the DUT detects the received shortened and slowed COMSAS signal comprised of D24.3 dwords starting with positive running disparity and then moves on to SAS Speed Negotiation.

Possible Problems: None.

Test 5.1.34 – 6 Cycles of 3G COMINIT starting with +D24.3

Purpose: To determine that the DUT responds correctly when receiving a shortened COMINIT signal comprised of D24.3 dwords starting with positive running disparity.

References:

[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and negation time has been detected.

A SAS Receiver device shall detect OOB Bursts formed from any of the following: A) D24.3 Characters at 1,5 Gbps; B) ALIGN (0) primitives at 1,5 Gbps; or C) ALIGN (0) primitives at 3,0 Gbps. A SAS Receiver shall not qualify the OOB burst based on the characters received.

Test Setup: The DUT and the Testing Station are not connected.

Test Procedure:

1. Connect the DUT and the Testing Station.
2. Power on the DUT.
3. The DUT should transmit COMINIT to the testing station. The Testing Station should transmit 6 Cycles of COMINIT comprised of D24.3 dwords starting with positive running disparity at 3G speed with Tburst = 106 ns and Tidle = 318 ns followed by a negation time of 530 ns. The Testing Station should not transmit COMSAS. This will create 5 idle times between 6 bursts.

Observable Results: Verify that the DUT detects the shortened COMINIT signal comprised of D24.3 dwords starting with positive running disparity and transmits COMSAS to the Testing Station.

Possible Problems: None.

Test 5.1.35 – 6 Cycles of 3G COMWAKE starting with +D24.3

Purpose: To determine that the DUT responds correctly when receiving a shortened COMINIT signal comprised of D24.3 dwords starting with positive running disparity.

References:

[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and negation time has been detected.

A SAS Receiver device shall detect OOB Bursts formed from any of the following: A) D24.3 Characters at 1,5 Gbps; B) ALIGN (0) primitives at 1,5 Gbps; or C) ALIGN (0) primitives at 3,0 Gbps. A SAS Receiver shall not qualify the OOB burst based on the characters received.

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:

1. Power on the DUT.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should ignore the received COMSAS. After 13.65 μs the DUT is expected to transmit COMWAKE.
5. The Testing Station should transmit 6 Cycles of COMWAKE comprised of D24.3 dwords starting with positive running disparity at 3G speed with Tburst = 106 ns and Tidle = 06 ns followed by a negation time of 185.5 ns. The Testing Station should not transmit COMSAS. This will create 5 idle times between 6 bursts.

Observable Results: Verify that the DUT detects the shortened COMWAKE signal comprised of D24.3 dwords starting with positive running disparity and moves on to SATA speed negotiation.

Possible Problems: None

Test 5.1.36 – 6 Cycles of 3G COMSAS starting with +D24.3

Purpose: To determine that the DUT responds correctly when receiving a shortened COMSAS signal comprised of D24.3 dwords starting positive running disparity.

References:

[1] 5.9.3 SAS Standard

Resource Requirements: SAS Generator capable of transmitting incorrect OOB sequences, and a SAS analyzer capable of capturing and displaying incorrect OOB sequences.

Last modification: July 25, 2011

Discussion: Out of Band (OOB) signals are low speed signal patterns made up of bursts of ALIGN primitives and bursts of D.C. Idle. By varying the length of an idle burst a different signal is created. OOB burst, idle, and negation times are defined in terms of OOB Intervals. For SAS the nominal OOBI is 666,6 ps. To transmit an OOB signal a transmitter will perform six cycles of Idle time and Burst time. The transmitter will then transmit 1 negation time. OOB signal receivers are expected to detect a given OOB signal after 4 cycles of Idle and Burst times, and to consider that signal complete after the signal has been detected, and negation time has been detected.

A SAS Receiver device shall detect OOB Bursts formed from any of the following: A) D24.3 Characters at 1,5 Gbps; B) ALIGN (0) primitives at 1,5 Gbps; or C) ALIGN (0) primitives at 3,0 Gbps. A SAS Receiver shall not qualify the OOB burst based on the characters received.

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:

1. Power on the DUT.
2. The DUT should transmit COMINIT to the Testing Station. The Testing Station should transmit COMINIT in response.
3. The DUT should transmit COMSAS.
4. The Testing Station should transmit 6 Cycles of COMSAS comprised of D24.3 dwords starting with positive running disparity at 3G speed to the DUT with Tburst = 106 ns and Tidle = 954 ns followed by a negation time of 1.590 µs. This will create 5 idle times between 6 bursts.

Observable Results: Verify that the DUT detects the received shortened COMSAS signal comprised of D24.3 dwords starting with positive running disparity and then moves on to SAS Speed Negotiation.

Possible Problems: None.

GROUP 2: SP STATE MACHINE

Overview:

This group of tests verifies the SAS SP state machine specifications regarding OOB and Speed Negotiation defined in Clause 5 of the SAS Standard and SAS SPL. The tests defined in this group pertain to the SAS 1.1 Speed Negotiation Sequence. Please see the SAS 2.0 Speed Negotiation Document for a detailed test suite pertaining to the SAS 2.0 specific portions of SAS Speed Negotiation. Comments and questions regarding the implementation of these tests are welcome, and may be forwarded to David Woolf, UNH InterOperability Lab (djwoolf@iol.unh.edu).

Test 5.2.1 - SP0:OOB_COMINIT state

Purpose: To determine that the DUT performs the proper actions when entering the SP0 state.

References:

[1] 4.4 SAS SPL
[2] 5.9.3 SAS SPL

Resource Requirements: SAS Analyzer capable of capturing SAS OOB sequences.

Last Modification: July 25, 2011

Discussion: The SP state machine defines the operation of the SAS Phy layer. A SAS Phy, which has been powered on, or has undergone a Hard Reset will go directly to the SP0:OOB_COMINIT state. In this state the SP state machine will send a Transmit COMINIT message to the SP Transmitter.

Test Setup: The DUT and Testing Station are physically connected, but the DUT is not powered on.

Test Procedure:

1. Power on the DUT.
2. Wait for the DUT to transmit COMINIT, then the Testing Station should transmit COMINIT in response and complete the OOB Sequence with the DUT.
3. Complete the Speed Negotiation Sequence with the DUT
4. When Speed Negotiation is complete, the Testing Station should transmit 6 consecutive HARD_RESET primitives to the DUT to start a Hard Reset sequence. The Testing Station must transmit the HARD_RESET primitives before an Identification Sequence can occur.

Observable Results: Verify that the DUT transmits a COMINIT signal after powering on and after receiving the HARD_RESET primitive.

Possible Problems: SAS Standard states that SAS Initiators and Targets will wait for a COMINIT detected messages in states SP0, 1, 2, or 4. However since SP0 is the initial state of the state machine, and SP0 requires SAS devices to transmit COMINIT, the DUT must transmit COMINIT.

Test 5.2.2 -Transition SP0:OOB_COMINIT to SP1:OOB_AwaitCOMX and back

Purpose: To determine that the DUT performs the proper actions when transitioning from the SP0 state to the SP1 state.

References:

[1] 5.9.3.4.1, 5.9.3.2.2 SAS SPL
[2] 5.9.1 SAS Standard

Resource Requirements: SAS Analyzer capable of capturing SAS OOB sequences.

Last Modification: July 25, 2011

Discussion: The SP state machine defines the operation of the SAS Phy layer. A SAS Phy which is in the SP0:OOB_COMINIT will transition to the SP1:OOB_AwaitCOMX state upon receiving a COMINIT Transmitted message from the SP Transmitter. Once in the SP1 state the SP state machine will start the 500 ms Hot Plug Timeout timer, if supported. If the timer expires the state machine will transition back to SP0.

Test Setup: The DUT and Testing Station are physically connected, but the DUT is not powered on.

Test Procedure:

1. Power on the DUT.
2. Wait for the DUT to transmit COMINIT
3. The Testing Station should transmit only DC Idle.

Observable Results: Verify that the DUT transmits a second COMINIT signal approximately 500 ms after the initial COMINIT signal sent at power on.

Possible Problems: SAS Initiators and Targets are not required to support the Hot Plug Timeout timer. Only SAS Expander phys are required to implement the Hot Plug timeout.

Test 5.2.3 -Transition SP1:OOB_AwaitCOMX to SP4:OOB_COMSAS COMINIT or COMSAS Detected

Purpose: To determine that the DUT performs the proper actions when transitioning from the SP1 state to the SP4 state.

References:

[1] 5.9.3.3 SAS SPL

Resource Requirements: SAS Analyzer capable of capturing SAS OOB sequences.

Last Modification: July 25, 2011

Discussion: The SP state machine defines the operation of the SAS Phy layer. A SAS Phy which is in the SP1:AwaitCOMX state will transition to the SP4:OOB_COMSAS state upon receiving a COMINIT Detected or a COMSAS Detected message from the SP Receiver. Once in the SP4 state the SP state machine will transmit a Transmit COMSAS message to the SP Transmitter.

Test Setup: The DUT and Testing Station are not connected.

Test Procedure 1:

1. Connect the DUT to the Testing Station.
2. The Testing Station should wait for the DUT to transmit COMINIT
3. The Testing Station should transmit only DC Idle for 300 ms.
4. The Testing Station should transmit a COMINIT signal to the DUT.

Observable Results: Verify that the DUT transmits a COMSAS signal after receiving the COMINIT signal from the DUT.

Test Procedure 2:

1. Connect the DUT to the Testing Station.
2. The Testing Station should wait for the DUT to transmit COMINIT
3. The Testing Station should transmit only DC Idle for 300 ms.
4. The Testing Station should transmit a COMSAS signal to the DUT.

Observable Results: Verify that the DUT transmits a COMSAS signal after receiving the first OOB signal (COMINIT or COMSAS) from the DUT.

Possible Problems: None.

Test 5.2.4 -Transition SP4:OOB_COMSAS to SP6:OOB_AwaitNoCOMSAS

Purpose: To determine that the DUT performs the proper actions when transitioning from the SP4 state to the SP6 state.

References:

[1] 5.9.3, 5.9.3.6.3 SAS SPL

Resource Requirements: SAS Analyzer capable of capturing SAS OOB sequences. A SAS Generator capable of generating custom OOB sequences.

Last Modification: July 25, 2011

Discussion: The SP state machine defines the operation of the SAS Phy layer. A SAS Phy which is in the SP1:AwaitCOMX state will transition to the SP4:OOB_COMSAS state upon receiving a COMSAS Detected message from the SP Receiver. Once in the SP4 state the SP state machine will transmit a Transmit COMSAS message to the SP Transmitter. Once the SP state machine receives a COMSAS Transmitted message from the SP Transmitter it will transition to SP6:OOB_AwaitNoCOMSAS since it already received a COMSAS Detected message in SP4. When COMSAS Completed is received the DUT will transition to SP8 and begin SAS Speed Negotiation.

Test Setup: The DUT and Testing Station are not connected.

Test Procedure:

1. Connect the DUT to the Testing Station.
2. The Testing Station should wait for the DUT to transmit COMINIT
3. The Testing Station should transmit only DC Idle for 300 ms.
4. The Testing Station should transmit a COMSAS signal to the DUT.

Observable Results: Verify that the DUT transmits a COMSAS signal after receiving the COMSAS from the Testing Station. Verify that the DUT then begins SAS Speed Negotiation. This can be verified if the DUT transmitted a period of DC Idle of RCDT (500 microseconds)

Possible Problems: None.

Test 5.2.5 -Transition SP4:OOB_COMSAS to SP7:OOB_AwaitCOMSAS COMSAS Detected

Purpose: To determine that the DUT performs the proper actions when transitioning from the SP4 state to the SP7 state.

References:

[1] 5.9.3, 5.9.3.6.4 SAS SPL

Resource Requirements: SAS Analyzer capable of capturing SAS OOB sequences. A SAS Generator capable of generating custom OOB sequences.

Last Modification: July 25, 2011

Discussion: The SP state machine defines the operation of the SAS Phy layer. A SAS Phy which is in the SP1:AwaitCOMX state will transition to the SP4:OOB_COMSAS state upon receiving a COMINIT Detected message from the SP Receiver. Once in the SP4 state the SP state machine will transmit a Transmit COMSAS message to the SP Transmitter. Once the SP state machine receives a COMSAS Transmitted message from the SP Transmitter it will transition to SP7:OOB_AwaitCOMSAS since it has not already received a COMSAS Detected message. In SP7 the DUT will initialize and start the COMSAS Detect Timeout timer.

Test Setup: The DUT and the Testing Station are not connected.

Test Procedure:

1. Connect the DUT to the Testing Station.
2. Wait for the DUT to transmit COMINIT
3. The Testing Station should transmit only DC Idle for 300 ms.
4. The Testing Station should transmit a COMINIT signal to the DUT.
5. The DUT should respond by transmitting COMSAS.
6. The DUT will start its COMSAS Detect Timeout timer.
7. The Testing Station should transmit 12 µsec of DC Idle followed by a COMSAS signal.

Observable Results: After transmitting the COMSAS signal the DUT should wait for a COMSAS Completed message from the SP Transmitter. After this the DUT should begin SAS Speed Negotiation.

Possible Problems: None.

Test 5.2.6 -Transition SP4:OOB_COMSAS to SP7:OOB_AwaitCOMSAS COMSAS Not Detected

Purpose: To determine that the DUT performs the proper actions when transitioning from the SP4 state to the SP7 state.

References:

[1] 5.9.3 SAS SPL

Resource Requirements: SAS Analyzer capable of capturing SAS OOB sequences. A SAS Generator capable of generating custom OOB sequences.

Last Modification: July 25, 2011

Discussion: The SP state machine defines the operation of the SAS Phy layer. A SAS Phy which is in the SP1:AwaitCOMX state will transition to the SP4:OOB_COMSAS state upon receiving a COMINIT Detected message from the SP Receiver. Once in the SP4 state the SP state machine will transmit a Transmit COMSAS message to the SP Transmitter. Once the SP state machine receives a COMSAS Transmitted message from the SP Transmitter it will transition to SP7:OOB_AwaitCOMSAS since it has not already received a COMSAS Detected message. In SP7 the DUT will initialize and start the COMSAS Detect Timeout timer.

Test Setup: The DUT and Testing Station are not connected.

Test Procedure:

1. Connect the DUT to the Testing Station.
2. The Testing Station should wait for the DUT to transmit COMINIT
3. The Testing Station should transmit only DC Idle for 300 ms.
4. The Testing Station should transmit a COMINIT signal to the DUT.
5. The DUT should respond by transmitting COMSAS.
6. The DUT will start its COMSAS Detect Timeout timer.
7. After 13,65 µsec of DC Idle from the Testing Station, the DUT should transition to SP16 if it supports SATA and SP2 if it does not support SATA.

Observable Results if the DUT supports SATA (no targets, some initiators): The DUT should transition to SP16 and transmit a COMWAKE signal.

Observable Results if the DUT does not support SATA (all targets, some initiators): The DUT should transition to SP2:OOB_NoCOMSASTimeout and start the Hot Plug timeout timer. After 500 ms the DUT should transition to SP0 and transmit a COMINIT signal.

Possible Problems: SAS Initiators and Targets are not required to implement the 500 msec Hot Plug timeout timer.

Test 5.2.7 - SNTT

Purpose: To determine that the DUT correctly implements Speed Negotiation Transmit Time (SNTT) properly.

References:

[1] 5.7.4.2 SAS SPL
[2] Table 46 SAS SPL

Resource Requirements: SAS Analyzer capable of capturing SAS OOB sequences. A SAS Generator capable of generating custom OOB sequences.

Last Modification: July 25, 2011

Discussion: SAS standard defines the Speed Negotiation Transmit Time (SNTT) as 163840 OOBI or approximately 109 µsec. During speed negotiation devices are expected to transmit ALIGN(0) followed by ALIGN(1) at the current rate for SNTT.

Test Setup: Connect the DUT and Testing Station to a SAS Analyzer capable of capturing at 3G.

Test Procedure:

1. Power on the DUT.
2. Wait for the DUT to transmit COMINIT, perform the OOB sequence with the DUT.
3. When OOB is complete the DUT should transition to SP8 and begin Speed Negotiation. The Testing Station should perform a normal Speed Negotiation with the DUT.

Observable Results: Verify that the DUT uses SNTT correctly. It is expected that the DUT transmit ALIGN(0) and ALIGN(1) for 109 µsec during Speed Negotiation.

Possible Problems: None.

Test 5.2.8 - RCDT

Purpose: To determine that the DUT correctly implements Rate Change Delay Time (RCDT) properly.

References:
[1] 5.7.4.2 SAS SPL
[2] Table 46 SAS SPL

Resource Requirements: SAS Analyzer capable of capturing SAS OOB sequences. A SAS Generator capable of generating custom OOB sequences.

Last Modification: July 25, 2011

Discussion: SAS standard defines the Rate Change Delay Time (RCDT) as 750000 OOBI or approximately 500 µsec. During speed negotiation devices are expected to transmit nothing for RCDT.

Test Setup: Connect the DUT and Testing Station to a SAS Analyzer capable of capturing at 3G.

Test Procedure:
1. Power on the DUT.
2. Wait for the DUT to transmit COMINIT, perform the OOB sequence with the DUT.
3. When OOB is complete the DUT should transition to SP8 and begin Speed Negotiation. The Testing Station should perform a normal Speed Negotiation with the DUT.

Observable Results: Verify that the DUT uses RCDT correctly. It is expected that the DUT transmit nothing for 500 µsec during Speed Negotiation.

Possible Problems: None.

Test 5.2.9 - Total Speed Negotiation Time

Purpose: To determine that the DUT negotiates to the highest supported speed in the time allotted for Speed Negotiation.

References:

[1] 5.7.4.2 SAS SPL

Resource Requirements: SAS Analyzer capable of capturing SAS OOB sequences. A SAS Generator capable of generating custom OOB sequences.

Last Modification: July 25, 2011

Discussion: SAS standard defines Speed Negotiation sequence as having 4 speed negotiation windows, each lasting approximately 6.09 µsec. It is expected that Speed Negotiation complete in approximately 2.4 msec. The Testing station is not to participate in SAS 2.0 Speed negotiation (The Testing station should not transmit it's phy capabilities bits to the DUT during SNW-3).

Test Setup: Connect the DUT and Testing Station to a SAS Analyzer capable of capturing at 3G.

Test Procedure:

1. Power on the DUT.
2. Wait for the DUT to transmit COMINIT, perform the OOB sequence with the DUT.
3. When OOB is complete the DUT should transition to SP8 and begin Speed Negotiation. The Testing Station should perform a normal Speed Negotiation with the DUT.

Observable Results: Verify that the DUT negotiates to the highest supported rate. Verify that the time from the end of the last COMSAS signal transmitted by the DUT to the first Identify Device is approximately 2.436 msec.

Possible Problems: None.

Test 5.2.10 -SAS Speed Negotiation 1.5 and 3.0 Gbps Operation Supported on both sides

Purpose: To determine that the DUT performs the proper actions when moving through the speed negotiation state machine if the device and its link partner both support 1.5 and 3.0 Gbps operation.

References:

[1] 5.7.4.2 SAS SPL

Resource Requirements: SAS Analyzer capable of capturing SAS OOB sequences. A SAS Generator capable of generating custom OOB sequences.

Last Modification: July 25, 2011

Discussion: The SP state machine defines the operation of the SAS Phy layer. After completing the OOB sequence a SAS Phy will perform speed negotiation, defined in clause 6.7.4 of the SAS Standard. The initial state of the SAS Speed Negotiation sequence is SP8:SAS_Start. In the SP8 state the SAS Phy will initialize and start the RCDT timer. The RCDT Timer is defined as 750000 OOBI. Table 58 of the SAS Standard defines an OOBI as 666,600 ps. Therefore the RCDT Timer is approximately 499 µs. After the SP has transmitted and received both ALIGN(0) and ALIGN(1) primitives the SP will wait for the SNTT timer to before determining whether to attempt a higher or lower speed, or to settle on the current speed. It is expected that Speed Negotiation Sequences converging to 1.5 Gbps will complete in1.8 ms and that sequences converging to 3.0 Gbps will complete in 2.4 ms .

Test Setup: The DUT and the testing station are physically connected.

Test Procedure:

1. Power on the DUT.
2. Wait for the DUT to transmit COMINIT, perform the OOB sequence with the DUT.
3. When OOB is complete the DUT should transition to SP8 and begin Speed Negotiation.
4. The DUT and Testing Station should transmit DC Idle while waiting for the RCDT timer to expire before transitioning to the SP10 state. The DUT will then transmit ALIGN(0) repeatedly at 1.5 Gbps.
5. The Testing Station should transmit ALIGN(0) repeatedly at 1.5 Gbps upon receiving ALIGN(0) from the DUT. The DUT should then transmit ALIGN(1) repeatedly at 1.5 Gbps.
6. The Testing Station should transmit ALIGN(1) repeatedly at 1.5 Gbps upon receiving ALIGN(1) from the DUT.
7. The DUT will transition to SP12 and start the SNTT timer. The DUT and Testing Station should continue to transmit ALIGN(1) until the SNTT timer expires. The DUT will transition to SP13, then to SP8 since the state machine has not yet fallen back.
8. The DUT and Testing Station should transmit DC Idle while waiting for the RCDT timer to expire before transitioning to the SP10 state. The DUT will then transmit ALIGN(0) repeatedly at 3.0 Gbps.
9. The Testing Station should transmit ALIGN(0) repeatedly at 3.0 Gbps upon receiving ALIGN(0) from the DUT. The DUT should then transmit ALIGN(1) repeatedly at 3.0 Gbps.
10. The Testing Station should transmit ALIGN(1) repeatedly at 3.0 Gbps upon receiving ALIGN(1) from the DUT.
11. The DUT will transition to SP12 and start the SNTT timer. The DUT and Testing Station should continue to transmit ALIGN(1) until the SNTT timer expires. The DUT will transition to SP13, then to SP8 since the state machine has not yet fallen back.
12. The next speed negotiation window is for 6.0 Gbps operation. It is expected that neither the DUT nor the Testing Station will support 6.0 Gbps operation. Each should transmit DC Idle while waiting for first the RCDT Timer then the SNTT Timer to expire. The DUT will then fall back to SP8 with the 3.0 Gbps argument.
13. The DUT (in SP8) and Testing Station should transmit DC Idle while waiting for the RCDT timer to expire before transitioning to the SP10 state. The DUT will then transmit ALIGN(0) repeatedly at 3.0 Gbps.

14. The Testing Station should transmit ALIGN(0) repeatedly at 3.0 Gbps upon receiving ALIGN(0) from the DUT. The DUT should then transmit ALIGN(1) repeatedly at 3.0 Gbps.
15. The Testing Station should transmit ALIGN(1) repeatedly at 3.0 Gbps upon receiving ALIGN(1) from the DUT.
16. The DUT will transition to SP12 and start the SNTT timer. The DUT and Testing Station should continue to transmit ALIGN(1) until the SNTT timer expires. The DUT will transition to SP13, then to SP15 since the state machine has fallen back, and has successfully converged to the highest supported speed. Link Layer activity should now begin.

Observable Results: Verify that the DUT uses the RCDT and SNTT timers correctly. The following timeline shows the expected actions of the DUT and the Testing Station. The negotiation process is expected to converge to 3.0 Gbps operation within 2.4 ms by following the steps outlined in the procedure and in the timelines below:

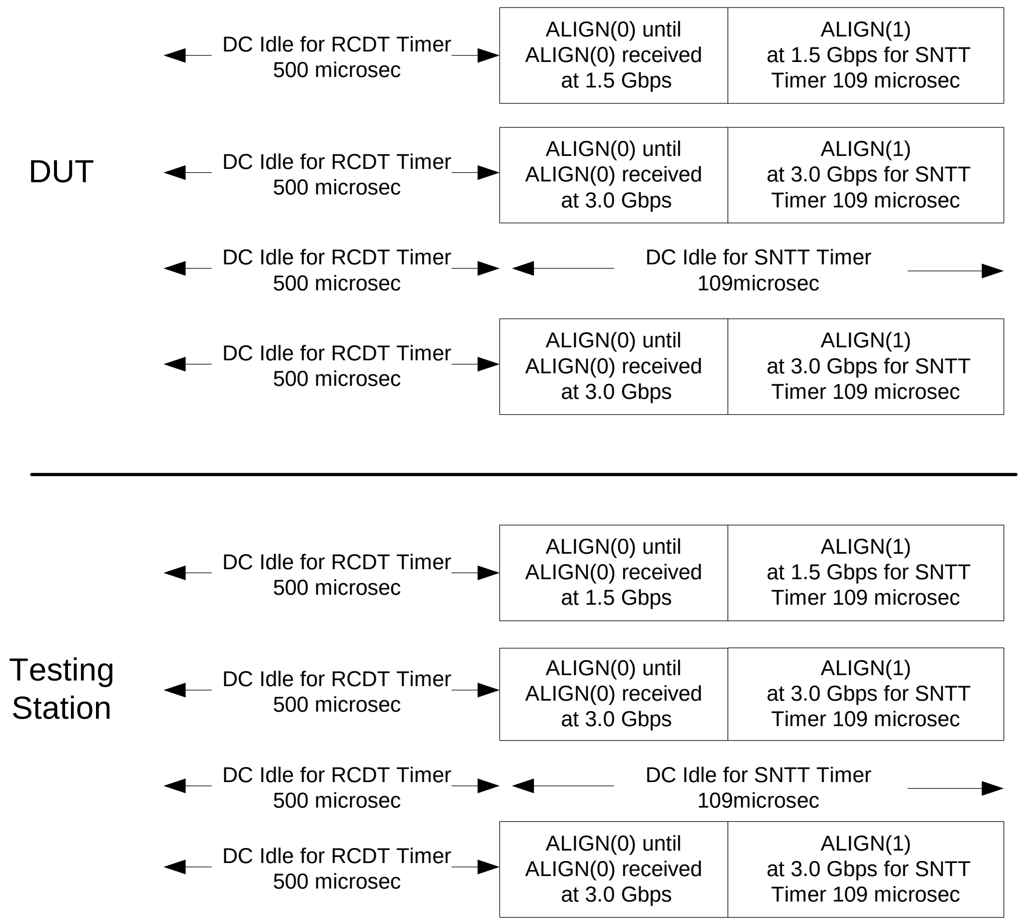

Figure 1: Timelines showing the expected behavior of the DUT and Testing Station during a speed negotiation sequence when both support 1.5 and 3.0 Gbps operation.

Possible Problems: This test is only applicable to devices that support 1.5 and 3.0 Gbps operation. If the DUT supports SAS 2.0, It should transmit it's Phy Capabilities Bits instead of D.C. Idle during SNW-3. This should not affect the observable results for this test.

Test 5.2.11 -SAS Speed Negotiation only 1.5 Gbps supported by Testing Station

Purpose: To determine that the DUT performs the proper actions when moving through the speed negotiation state machine if the device supports both 1.5 and 3.0 Gbps, but its link partner only supports 1.5 Gbps operation.

References:

[1] 5.7.4.2 SAS SPL

Resource Requirements: SAS Analyzer capable of capturing SAS OOB sequences. A SAS Generator capable of generating custom OOB sequences.

Last Modification: July 25, 2011

Discussion: The SP state machine defines the operation of the SAS Phy layer. After completing the OOB sequence a SAS Phy will perform speed negotiation, defined in clause 6.7.4 of the SAS Standard. The initial state of the SAS Speed Negotiation sequence is SP8:SAS_Start. In the SP8 state the SAS Phy will initialize and start the RCDT timer. The RCDT Timer is defined as 750000 OOBI. Table 58 of the SAS Standard defines an OOBI as 666,600 ps. Therefore the RCDT Timer is approximately 499 µs. After the SP has transmitted and received both ALIGN(0) and ALIGN(1) primitives the SP will wait for the SNTT timer to before determining whether to attempt a higher or lower speed, or to settle on the current speed. It is expected that Speed Negotiation Sequences converging to 1.5 Gbps will complete in1.8 ms and that sequences converging to 3.0 Gbps will complete in 2.4 ms .

Test Setup: The DUT and the testing station are physically connected.

Test Procedure:

1. Power on the DUT.
2. Wait for the DUT to transmit COMINIT, perform the OOB sequence with the DUT.
3. When OOB is complete the DUT should transition to SP8 and begin Speed Negotiation.
4. The DUT and Testing Station should transmit DC Idle while waiting for the RCDT timer to expire before transitioning to the SP10 state. The DUT will then transmit ALIGN(0) repeatedly at 1.5 Gbps.
5. The Testing Station should transmit ALIGN(0) repeatedly at 1.5 Gbps upon receiving ALIGN(0) from the DUT. The DUT should then transmit ALIGN(1) repeatedly at 1.5 Gbps.
6. The Testing Station should transmit ALIGN(1) repeatedly at 1.5 Gbps upon receiving ALIGN(1) from the DUT.
7. The DUT will transition to SP12 and start the SNTT timer. The DUT and Testing Station should continue to transmit ALIGN(1) until the SNTT timer expires. The DUT will transition to SP13, then to SP8 since the state machine has not yet fallen back.
8. The DUT and Testing Station should transmit DC Idle while waiting for the RCDT timer to expire before transitioning to the SP10 state. The DUT will then transmit ALIGN(0) repeatedly at 3.0 Gbps and start the SNTT Timer.
9. The Testing Station will only transmit DC Idle during this time. After the SNTT timer has expired the DUT will transition to SP14, then back to SP8 to attempt 1.5 Gbps again.
10. The DUT (in SP8) and Testing Station should transmit DC Idle while waiting for the RCDT timer to expire before transitioning to the SP10 state. The DUT will then transmit ALIGN(0) repeatedly at 1.5 Gbps.
11. The Testing Station should transmit ALIGN(0) repeatedly at 1.5 Gbps upon receiving ALIGN(0) from the DUT. The DUT should then transmit ALIGN(1) repeatedly at 1.5 Gbps.
12. The Testing Station should transmit ALIGN(1) repeatedly at 1.5 Gbps upon receiving ALIGN(1) from the DUT.
13. The DUT will transition to SP12 and start the SNTT timer. The DUT and Testing Station should continue to transmit ALIGN(1) until the SNTT timer expires. The DUT will transition to SP13, then to SP15 since the state machine has fallen back, and has successfully converged to the highest supported speed. Link Layer activity should now begin.

Observable Results: Verify that the DUT uses the RCDT and SNTT timers correctly. The following timeline shows the expected actions of the DUT and the Testing Station. The negotiation process is expected to converge to 1.5 Gbps operation within 1.8 ms by following the steps outlined in the procedure and in the timelines below:

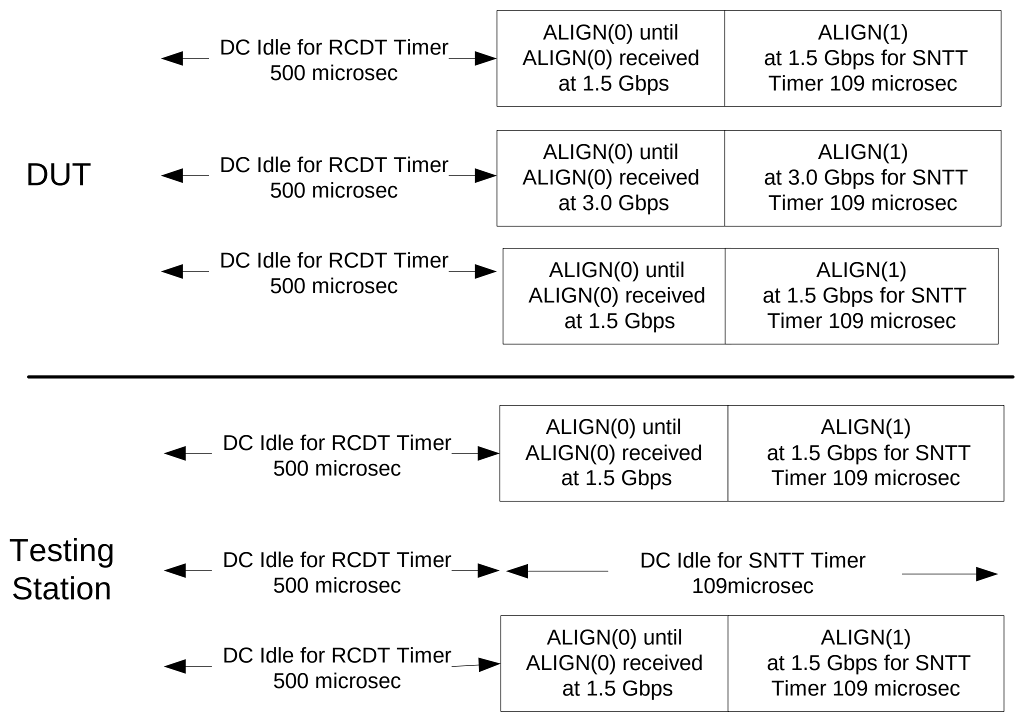

Figure 2: Timelines showing the expected behavior of the DUT and Testing Station during a speed negotiation sequence when The DUT supports 1.5 and 3.0 Gbps operation but the Testing Station only supports 1.5 Gbps. If the DUT supports SAS 2.0, It should transmit it's Phy Capabilities Bits instead of D.C. Idle during SNW-3. This should not affect the observable results for this test.

Possible Problems: None.

Test 5.2.12 -SAS Speed Negotiation only 3.0 Gbps supported by Testing Station

Purpose: To determine that the DUT performs the proper actions when moving through the speed negotiation state machine if the device supports both 1.5 and 3.0 Gbps, but its link partner only supports 3.0 Gbps operation.

References:
[1] 5.7.4.2 SAS SPL

Resource Requirements: SAS Analyzer capable of capturing SAS OOB sequences. A SAS Generator capable of generating custom OOB sequences.

Last Modification: July 25, 2011

Discussion: The SP state machine defines the operation of the SAS Phy layer. After completing the OOB sequence a SAS Phy will perform speed negotiation, defined in clause 6.7.4 of the SAS Standard. The initial state of the SAS Speed Negotiation sequence is SP8:SAS_Start. In the SP8 state the SAS Phy will initialize and start the RCDT timer. The RCDT Timer is defined as 750000 OOBI. Table 58 of the SAS Standard defines an OOBI as 666,600 ps. Therefore the RCDT Timer is approximately 499 µs. After the SP has transmitted and received both ALIGN(0) and ALIGN(1) primitives the SP will wait for the SNTT timer to before determining whether to attempt a higher or lower speed, or to settle on the current speed. It is expected that Speed Negotiation Sequences converging to 1.5 Gbps will complete in1.8 ms and that sequences converging to 3.0 Gbps will complete in 2.4 ms .

Test Setup: The DUT and the testing station are physically connected.

Test Procedure:
1. Power on the DUT.
2. Wait for the DUT to transmit COMINIT, perform the OOB sequence with the DUT.
3. When OOB is complete the DUT should transition to SP8 and begin Speed Negotiation.
4. The DUT and Testing Station should transmit DC Idle while waiting for the RCDT timer to expire before transitioning to the SP10 state. The DUT will then transmit ALIGN(0) repeatedly at 1.5 Gbps.
5. The Testing Station should transmit DC Idle only. The DUT is expected to transmit ALIGN(0) until the SNTT timer expires. The DUT should then transition to SP14, then to SP8 to attempt a different speed.
6. The DUT and Testing Station should transmit DC Idle while waiting for the RCDT timer to expire before transitioning to the SP10 state. The DUT will then transmit ALIGN(0) repeatedly at 3.0 Gbps.
7. The Testing Station should transmit ALIGN(0) repeatedly at 3.0 Gbps upon receiving ALIGN(0) from the DUT. The DUT should then transmit ALIGN(1) repeatedly at 3.0 Gbps.
8. The Testing Station should transmit ALIGN(1) repeatedly at 3.0 Gbps upon receiving ALIGN(1) from the DUT.
9. The DUT will transition to SP12 and start the SNTT timer. The DUT and Testing Station should continue to transmit ALIGN(1) until the SNTT timer expires. The DUT will transition to SP13, then to SP8 since the state machine has not yet fallen back.
10. The next speed negotiation window is for 6.0 Gbps operation. It is expected that neither the DUT or the Testing Station will support 6.0 Gbps operation. Each should transmit DC Idle while waiting for first the RCDT Timer then the SNTT Timer to expire. The DUT will then fall back to SP8 with the 3.0 Gbps argument.
11. The DUT (in SP8) and Testing Station should transmit DC Idle while waiting for the RCDT timer to expire before transitioning to the SP10 state. The DUT will then transmit ALIGN(0) repeatedly at 3.0 Gbps.
12. The Testing Station should transmit ALIGN(0) repeatedly at 3.0 Gbps upon receiving ALIGN(0) from the DUT. The DUT should then transmit ALIGN(1) repeatedly at 3.0 Gbps.
13. The Testing Station should transmit ALIGN(1) repeatedly at 3.0 Gbps upon receiving ALIGN(1) from the DUT.

14. The DUT will transition to SP12 and start the SNTT timer. The DUT and Testing Station should continue to transmit ALIGN(1) until the SNTT timer expires. The DUT will transition to SP13, then to SP15 since the state machine has fallen back, and has successfully converged to the highest supported speed. Link Layer activity should now begin.

Observable Results: Verify that the DUT uses the RCDT and SNTT timers correctly. The following timeline shows the expected actions of the DUT and the Testing Station. The negotiation process is expected to converge to 3.0 Gbps operation within 2.4 ms by following the steps outlined in the procedure and in the timelines below:

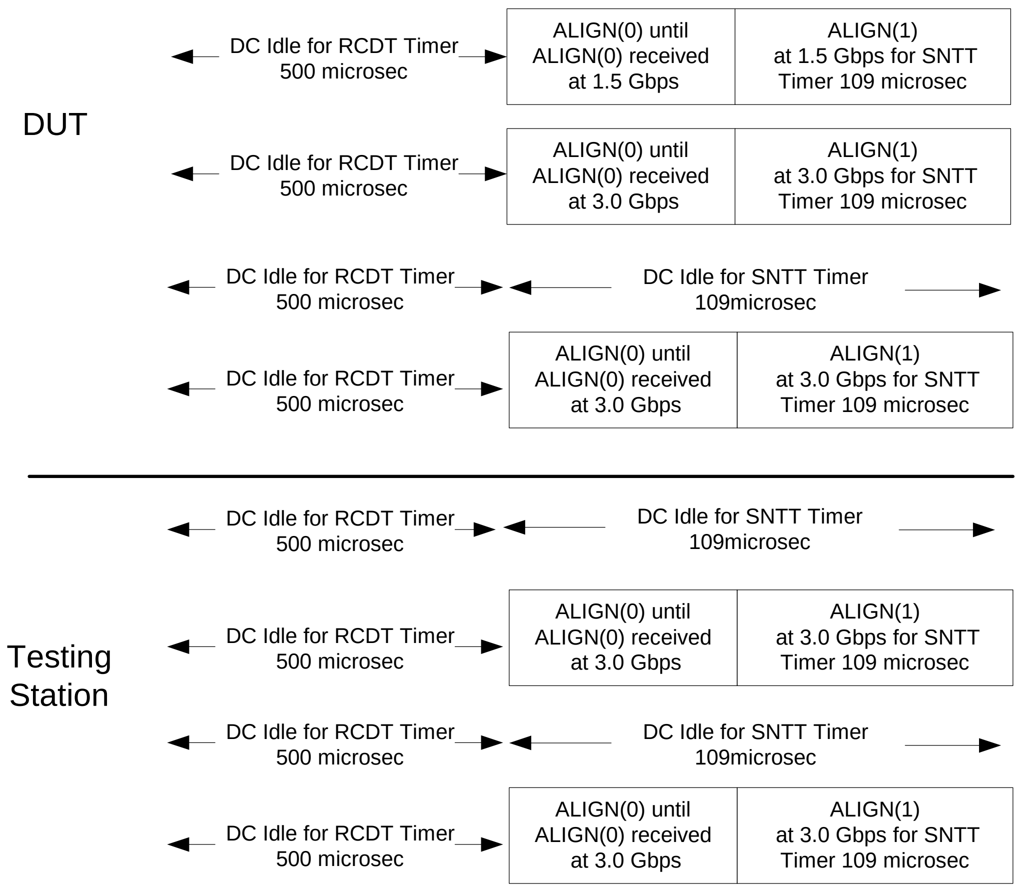

Figure 3: Timelines showing the expected behavior of the DUT and Testing Station during a speed negotiation sequence when the DUT supports 1.5 and 3.0 Gbps operation but the Testing Station supports only 3 Gbps Operation. If the DUT supports SAS 2.0, It should transmit it's Phy Capabilities Bits instead of D.C. Idle during SNW-3. This should not affect the observable results for this test.

Possible Problems: None.

Test 5.2.13 -SAS Speed Negotiation only 1.5 Gbps supported by DUT

Purpose: To determine that the DUT performs the proper actions when moving through the speed negotiation state machine if the device only supports 1.5 Gbps operation.

References:
[1] 5.7.4.2 SAS SPL

Resource Requirements: SAS Analyzer capable of capturing SAS OOB sequences. A SAS Generator capable of generating custom OOB sequences.

Last Modification: July 25, 2011

Discussion: The SP state machine defines the operation of the SAS Phy layer. After completing the OOB sequence a SAS Phy will perform speed negotiation, defined in clause 6.7.4 of the SAS Standard. The initial state of the SAS Speed Negotiation sequence is SP8:SAS_Start. In the SP8 state the SAS Phy will initialize and start the RCDT timer. The RCDT Timer is defined as 750000 OOBI. Table 58 of the SAS Standard defines an OOBI as 666,600 ps. Therefore the RCDT Timer is approximately 499 µs. After the SP has transmitted and received both ALIGN(0) and ALIGN(1) primitives the SP will wait for the SNTT timer to before determining whether to attempt a higher or lower speed, or to settle on the current speed. It is expected that Speed Negotiation Sequences converging to 1.5 Gbps will complete in1.8 ms and that sequences converging to 3.0 Gbps will complete in 2.4 ms .

Test Setup: The DUT and the testing station are physically connected.

Test Procedure:
1. Power on the DUT.
2. Wait for the DUT to transmit COMINIT, perform the OOB sequence with the DUT.
3. When OOB is complete the DUT should transition to SP8 and begin Speed Negotiation.
4. The DUT and Testing Station should transmit DC Idle while waiting for the RCDT timer to expire before transitioning to the SP10 state. The DUT will then transmit ALIGN(0) repeatedly at 1.5 Gbps.
5. The Testing Station should transmit ALIGN(0) repeatedly at 1.5 Gbps upon receiving ALIGN(0) from the DUT. The DUT should then transmit ALIGN(1) repeatedly at 1.5 Gbps.
6. The Testing Station should transmit ALIGN(1) repeatedly at 1.5 Gbps upon receiving ALIGN(1) from the DUT.
7. The DUT will transition to SP12 and start the SNTT timer. The DUT and Testing Station should continue to transmit ALIGN(1) until the SNTT timer expires. The DUT will transition to SP13, then to SP8 since the state machine has not yet fallen back.
8. The DUT and Testing Station should transmit DC Idle while waiting for the RCDT timer to expire before transitioning to the SP10 state. The DUT will then start the SNTT timer and transmit only DC Idle until the SNTT Timer expires.
9. The Testing Station will transmit ALIGN(0) at 3.0 Gbps during this time. After the SNTT timer has expired the DUT will transition back to SP8 to attempt 1.5 Gbps again.
10. The DUT (in SP8) and Testing Station should transmit DC Idle while waiting for the RCDT timer to expire before transitioning to the SP10 state. The DUT will then transmit ALIGN(0) repeatedly at 1.5 Gbps.
11. The Testing Station should transmit ALIGN(0) repeatedly at 1.5 Gbps upon receiving ALIGN(0) from the DUT. The DUT should then transmit ALIGN(1) repeatedly at 1.5 Gbps.
12. The Testing Station should transmit ALIGN(1) repeatedly at 1.5 Gbps upon receiving ALIGN(1) from the DUT.
13. The DUT will transition to SP12 and start the SNTT timer. The DUT and Testing Station should continue to transmit ALIGN(1) until the SNTT timer expires. The DUT will transition to SP13, then to SP15 since

the state machine has fallen back, and has successfully converged to the highest supported speed. Link Layer activity should now begin.

Observable Results: Verify that the DUT uses the RCDT and SNTT timers correctly. The following timeline shows the expected actions of the DUT and the Testing Station. The negotiation process is expected to converge to 1.5 Gbps operation within 1.8 ms by following the steps outlined in the procedure and in the timelines below:

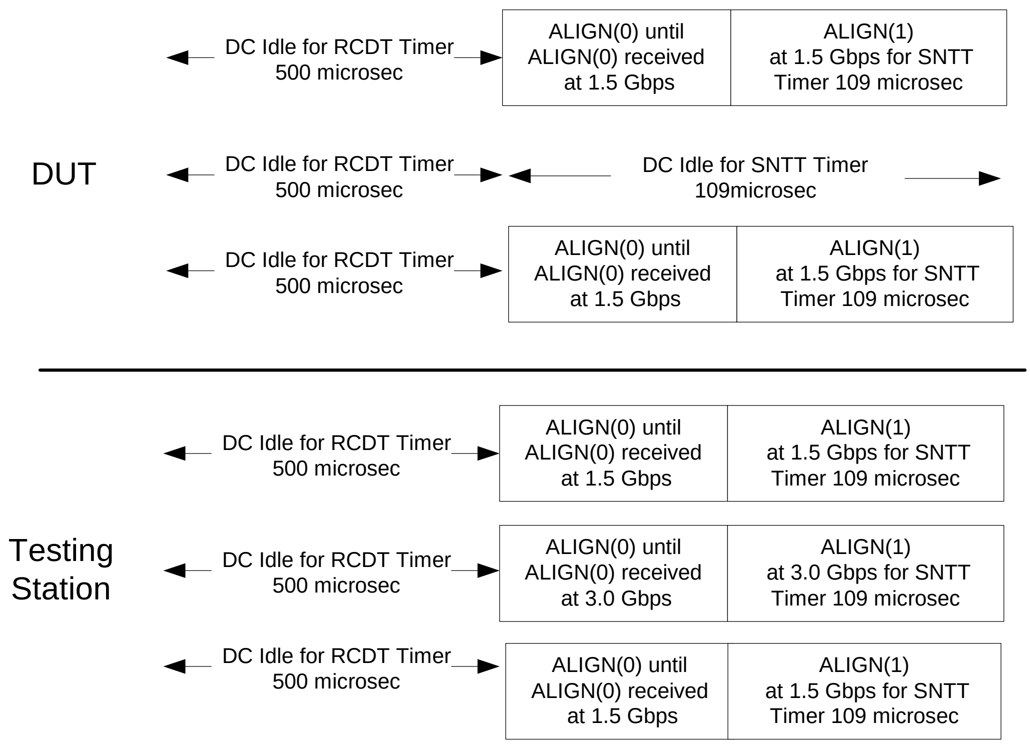

Figure 4: Timelines showing the expected behavior of the DUT and Testing Station during a speed negotiation sequence when the DUT supports 1.5 Gbps operation only, but the Testing Station supports 1.5 and 3.0 Gbps operation. If the DUT supports SAS 2.0, It should transmit it's Phy Capabilities Bits instead of D.C. Idle during SNW-3. This should not affect the observable results for this test.

Possible Problems: This test is only applicable to devices that support 1.5 Gbps operation only.

14. The DUT will transition to SP12 and start the SNTT timer. The DUT and Testing Station should continue to transmit ALIGN(1) until the SNTT timer expires. The DUT will transition to SP13, then to SP15 since the state machine has fallen back, and has successfully converged to the highest supported speed. Link Layer activity should now begin.

Observable Results: Verify that the DUT uses the RCDT and SNTT timers correctly. The following timeline shows the expected actions of the DUT and the Testing Station. The negotiation process is expected to converge to 3.0 Gbps operation within 2.4 ms by following the steps outlined in the procedure and in the timelines below:

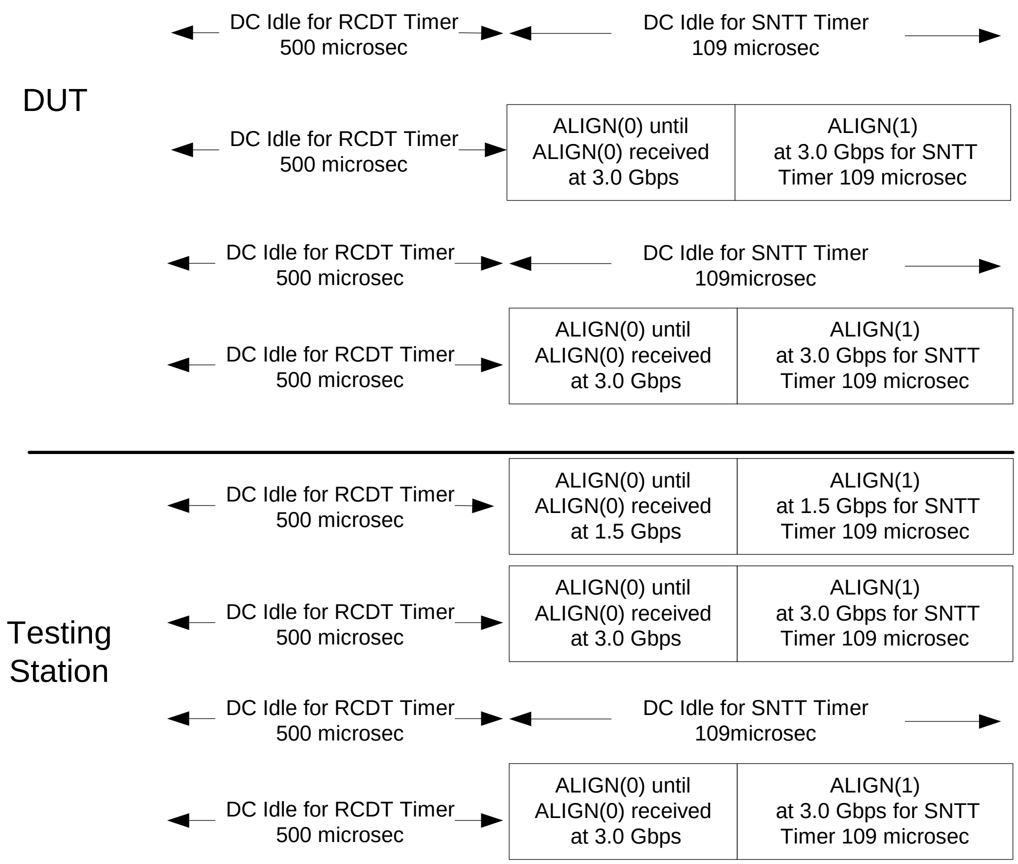

Figure 5: Timelines showing the expected behavior of the DUT and Testing Station during a speed negotiation sequence when the DUT supports 1.5 and 3.0 Gbps operation but the Testing Station supports only 3 Gbps Operation. If the DUT supports SAS 2.0, It should transmit it's Phy Capabilities Bits instead of D.C. Idle during SNW-3. This should not affect the observable results for this test.

Possible Problems: This test is only applicable to devices that support 1.5 and 3.0 Gbps operation.