Serial ATA
International Organization

Revision 1.00
18-October 2006

Serial ATA Interoperability Program
Agilent MOI for TXRX Tests, Version 1.0
Using Agilent 86100C TDR

TABLE OF CONTENTS

MODIFICATION RECORD

October 18, 2006 (Version 1.00) APPROVED RELEASE FOR V1.0 INTEROP PROGRAM

Andy Baldman: TX-01: Deleted NRZ/OOB comments under ‘Possible Problems’, and removed references to that section in all other tests’ Possible Problems sections.
All tests: Updated procedures to specify device must have completed OOB through COMWAKE.
All tests: Incremented test revision numbers by 0.1.
Updated UTD references on group header pages to reference UTD v1.0

July 18, 2006 (Version 1.00RC) RELEASE CANDIDATE DRAFT

Andy Baldman: TX-01/02: Updated procedures to include steps for enabling TDR peeling.
TX-01: Added text under ‘Possible problems’ regarding differences between OOB vs. NRZ transceiver modes.
TX-02 thru 05 and RX-01 thru 05: Added text to all ‘Possible problems’ sections referencing TX-01 text.
TX-01 thru 05: Changed all procedures to specify that the DUT should be in OOB mode, not NRZ/BIST.
RX-05: Fixed frequency ranges in table of limits. All tests now use the same frequency ranges..
Appendix A: Removed resource requirement for ability to configure DUT to BIST/vendor-specific modes.
Added legal notice to cover page.

June 21, 2006 (Version 0.98RC2) RELEASE CANDIDATE DRAFT

Andy Baldman: Updated TX-01 procedure to include picture.
Removed all Gen1/2/i./x/m references in the results tables, and replaced with 1.5G and 3.0G

June 13, 2006 (Version 0.98RC1) RELEASE CANDIDATE DRAFT

Andy Baldman: Updated TX/RX-01 procedures to new ‘2ns’ method.
Deleted Appendix D (Test requirements for 1.5/3.0G devices), as it wasn’t needed.
Fixed TX-02 Observable Results text to matcch RX-02.

March 09, 2006 (Version 0.91RC) RELEASE CANDIDATE DRAFT

Andy Baldman: Added note to all tests about putting device into active transmitting mode before performing measurements.

February 09, 2006 (Version 0.9) CLEAN-UP REVISION

Andy Baldman: Fixed incorrect TDR risetime setting (was 70ps, now 100ps)
Added procedure for deskewing cables to Appendix B setup procedure
Created Appendix C with condensed full test procedure

January 30, 2006 (Version 0.1) INITIAL DRAFT RELEASE

Andy Baldman: Initial Release

ACKNOWLEDGMENTS

The Serial ATA Logo Group would like to acknowledge the efforts of the following individuals in the development of this document:

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INTRODUCTION

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.

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 6.A”, or “Table 6.1.1-1”)

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.

GROUP 2: PHY TRANSMITTER REQUIREMENTS

Overview:

This group of tests verifies the Phy Transmitter Requirements, as defined in Section 2.11 of the SATA Interoperability Unified Test Document, v1.0 (which references the SATA Standard, v2.5).

Test TX-01 - Pair Differential Impedance

Purpose: To verify that the Pair Differential Impedance of the DUT's transmitter is within the conformance limits.

References:

[1] SATA Standard, 7.2.1, Table 21 – Transmitter Specifications
[2] Ibid, 7.2.2.2.1 – TX Pair Differential Impedance (Gen1i)
[3] Ibid, 7.4.22 – TDR Differential Impedance (Gen1i/Gen1m)
[4] SATA Interoperability Program Unified Test Document, Section 2.11.1 – Pair Differential Impedance

Resource Requirements:

See Appendix A

Last Modification: October 18, 2006 (Version 2.2)

Discussion:

Reference [1] specifies the Transmitter Specification conformance limits for SATA devices. This specification includes conformance limits for the Pair Differential Impedance. Reference [2] provides the definition of this term for the purposes of SATA testing. Reference [3] defines the measurement requirements for this test. Reference [4] provides additional requirements for performing this test for the purposes of the SATA Logo program.

Test Setup:

See Appendix A

Test Procedure:

Assuming the initial setup/cal procedures in Appendix B have been performed, the measurement for this test is as follows:

1 Ensure that the DUT is powered on, and has completed an initial OOB sequence through the device COMWAKE in order to allow device calibration to occur.
2 Connect the TDR cables to J16 (TP+) and J15 (TP-) of the Agilent SAS/SATA Drive Fixture.
3 Adjust the scope timebase and delay to display the Pair Differential Impedance on the screen.
4 Enable TDR Peeling on the Response 1 trace by selecting MEASURE->Math from the top menu bar, then under the Function 3 tab, check the 'Function 3 Display On' box, and select 'TDR Peeling' and 'Response 1' under the Operator and Source 1 pulldown menus, respectively.
5 Using the cursors on the Function 3 response, determine the time point of the last major capacitive dip.
6 Record the impedance value at the point occurring 2ns after the last major capacitive dip (See Figure 1, next page, for sample measurement.)

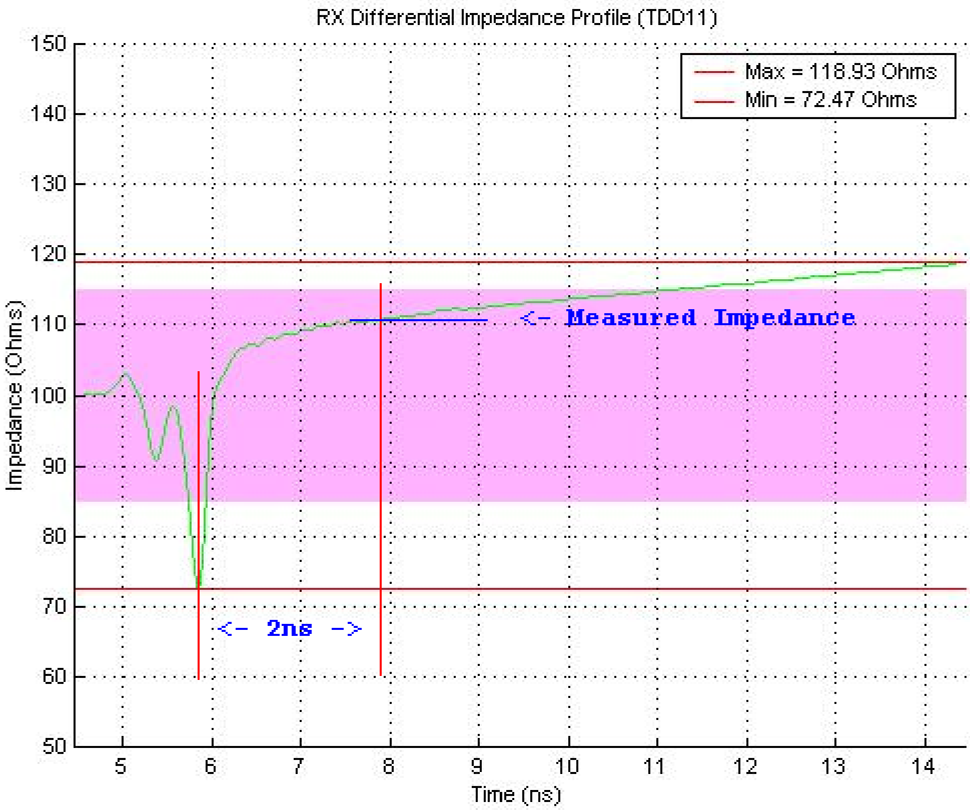

Figure 1: Sample Impedance Measurement at time point 2ns after last major dip

Observable Results:

The measured impedance value shall be between 85 and 115 ohms for 1.5G devices, as well as 3.0G devices operating in 1.5G mode.

Possible Problems:

None.

Test TX-02 - Single-Ended Impedance

Purpose: To verify that the Single-Ended Impedance of the DUT's transmitter is within the conformance limits.

References:

[1] SATA Standard, 7.2.1, Table 21 – Transmitter Specifications
[2] Ibid, 7.2.2.2.2 – TX Single-Ended Impedance (Gen1i)
[3] Ibid, 7.4.23 – TDR Single-Ended Impedance (Gen1i/Gen1m)

Resource Requirements:

See Appendix A

Last Modification: October 18, 2006 (Version 1.4)

Discussion:

Reference [1] specifies the Transmitter Specification conformance limits for SATA devices. This specification includes conformance limits for the Single-Ended Impedance. Reference [2] provides the definition of this term for the purposes of SATA testing. Reference [3] defines the measurement requirements for this test.

Test Setup:

See Appendix A

Test Procedure:

Assuming the initial setup/cal procedures in Appendix B have been performed, the measurement for this test is as follows:

1 Ensure that the DUT is powered on, and has completed an initial OOB sequence through the device COMWAKE in order to allow device calibration to occur.
2 Connect the TDR cables to J16 (TP+) and J15 (TP-) of the Agilent SAS/SATA Drive Fixture.
3 Adjust the scope timebase and delay to display the Pair Differential Impedance on the screen.
4 Go to the TDR Setup screen and choose Common Mode Stimulus. Close the Setup screen.
5 Open the Response screen and choose Response 1 to be Individual and Response 2 to be Individual.
6 Enable TDR Peeling on the Response 1 trace by selecting MEASURE->Math from the top menu bar, then under the Function 3 tab, check the 'Function 3 Display On' box, and select 'TDR Peeling' and 'Response 1' under the Operator and Source 1 pulldown menus, respectively.
7 Enable TDR Peeling on the Response 2 trace by selecting MEASURE->Math from the top menu bar, then under the Function 4 tab, check the 'Function 4 Display On' box, and select 'TDR Peeling' and 'Response 2' under the Operator and Source 1 pulldown menus, respectively.
8 Using the min/max measurement functions on the Measure tab on the left side of the screen, measure and record the maximum and minimum values of the Pair Single-Ended Impedance for the Function 3 and Function 4 responses.

Observable Results:

The measured impedance value shall be greater than 40 ohms for 1.5G devices, as well as 3.0G devices operating in 1.5G mode.

Possible Problems:

None

Test TX-03 - Differential Mode Return Loss

Purpose: To verify that the Differential Mode Return Loss of the DUT's transmitter is within the conformance limits.

References:

[1] SATA Standard, 7.2.1, Table 21 – Transmitter Specifications
[2] Ibid, 7.2.2.2.3 – TX Differential Mode Return Loss (Gen2i, Gen2m)
[3] Ibid, 7.4.10 – Return Loss and Impedance Balance

Resource Requirements:

See Appendix A

Last Modification: October 18, 2006 (Version 1.4)

Discussion:

Reference [1] specifies the Transmitter Specification conformance limits for SATA devices. This specification includes conformance limits for the Differential Mode Return Loss. Reference [2] provides the definition of this term for the purposes of SATA testing. Reference [3] defines the measurement requirements for this test.

Test Setup:

See Appendix A

Test Procedure:

Assuming the initial setup/cal procedures in Appendix B have been performed, the measurement for this test is as follows:

1 Ensure that the DUT is powered on, and has completed an initial OOB sequence through the device COMWAKE in order to allow device calibration to occur.
2 Connect the TDR cables to J16 (TP+) and J15 (TP-) of the Agilent SAS/SATA Drive Fixture.
3 Adjust the scope timebase and delay to display the Pair Differential Impedance on the screen.
4 Display the S-Parameters for the Differential response by selecting the "S-Param" pulldown in the upper right corner of the display. This is effectively the Differential Return Loss.
5 Using the cursors, verify that the Return Loss meets or exceeds the values shown in the table below.

Observable Results:

The TX Differential Mode Return Loss shall be greater than the minimum limits specified in reference [1] for 3.0G devices. For convenience, the values are reproduced below.

Frequency Range	Minimum Limit (3.0G)
150-300 MHz	14 dB
300-600 MHz	8 dB
600-1200 MHz	6 dB
1200-2400 MHz	6 dB
2400-3000 MHz	3 dB
3000-5000 MHz	1 dB

Possible Problems:

None.

Test TX-04 - Common Mode Return Loss

Purpose: To verify that the Common Mode Return Loss of the DUT's transmitter is within the conformance limits.

References:

[1] SATA Standard, 7.2.1, Table 21 – Transmitter Specifications
[2] Ibid, 7.2.2.2.4 – TX Common Mode Return Loss (Gen2i, Gen2m)
[3] Ibid, 7.4.10 – Return Loss and Impedance Balance

Resource Requirements:

See Appendix A

Last Modification: October 18, 2006 (Version 1.4)

Discussion:

Reference [1] specifies the Transmitter Specification conformance limits for SATA devices. This specification includes conformance limits for the Common Mode Return Loss. Reference [2] provides the definition of this term for the purposes of SATA testing. Reference [3] defines the measurement requirements for this test.

Test Setup:

See Appendix A

Test Procedure:

Assuming the initial setup/cal procedures in Appendix B have been performed, the measurement for this test is as follows:

1 Ensure that the DUT is powered on, and has completed an initial OOB sequence through the device COMWAKE in order to allow device calibration to occur.
2 Connect the TDR cables to J16 (TP+) and J15 (TP-) of the Agilent SAS/SATA Drive Fixture.
3 Adjust the scope timebase and delay to display the Pair Common Mode Impedance on the screen.
4 Display the S-Parameters for the response by selecting the "S-Param" pulldown in the upper right corner of the display. This is effectively the Return Loss.
5 Using the cursors, verify that the Return Loss meets or exceeds the values shown in the table below.

Observable Results:

The TX Common Mode Return Loss shall be greater than the minimum limits specified in reference [1] for 3.0G devices. For convenience, the values are reproduced below.

Frequency Range	Minimum Limit (3.0G)
150-300 MHz	8 dB
300-600 MHz	5 dB
600-1200 MHz	2 dB
1200-2400 MHz	2 dB
2400-3000 MHz	2 dB
3000-5000 MHz	1 dB

Possible Problems:

None.

Test TX-05 - Impedance Balance

Purpose: To verify that the Impedance Balance of the DUT's transmitter is within the conformance limits.

References:

[1] SATA Standard, 7.2.1, Table 21 – Transmitter Specifications
[2] Ibid, 7.2.2.2.5 – TX Impedance Balance (Gen2i, Gen2m)
[3] Ibid, 7.4.10 – Return Loss and Impedance Balance

Resource Requirements:

See Appendix A

Last Modification: October 18, 2006 (Version 1.4)

Discussion:

Reference [1] specifies the Transmitter Specification conformance limits for SATA devices. This specification includes conformance limits for the TX Impedance Balance. Reference [2] provides the definition of this term for the purposes of SATA testing. Reference [3] defines the measurement requirements for this test.

Test Setup:

See Appendix A

Test Procedure:

Assuming the initial setup/cal procedures in Appendix B have been performed, the measurement for this test is as follows:

1 Ensure that the DUT is powered on, and has completed an initial OOB sequence through the device COMWAKE in order to allow device calibration to occur.
2 Connect the TDR cables to J16 (TP+) and J15 (TP-) of the Agilent SAS/SATA Drive Fixture.
3 Adjust the scope timebase and delay to display the TDC11 response on the screen.
4 Display the S-Parameters for the response by selecting the "S-Param" pulldown in the upper right corner of the display. This is effectively the Return Loss.
5 Using the cursors, verify that the Return Loss meets or exceeds the values shown in the table below.

Observable Results:

The TX Impedance Balance, TDC11, shall be greater than the minimum limits specified in reference [1] for 3.0G devices. For convenience, the values are reproduced below.

Frequency Range	Minimum Limit (3.0G)
150-300 MHz	30 dB
300-600 MHz	20dB
600-1200 MHz	10 dB
1200-2400 MHz	10 dB
2400-3000 MHz	4 dB
3000-5000 MHz	4 dB

Possible Problems:

None.

GROUP 4: PHY RECEIVER REQUIREMENTS

Overview:

This group of tests verifies the Phy Receiver Requirements, as defined in Section 2.14 of the SATA Interoperability Unified Test Document, v1.0 (which references the SATA Standard, v2.5).

Test RX-01 - Pair Differential Impedance

Purpose: To verify that the Pair Differential Impedance of the DUT's receiver is within the conformance limits.

References:

[1] SATA Standard, 7.2.1, Table 23 – Receiver Specifications
[2] Ibid, 7.2.2.4.1
[3] Ibid, 7.4.22

Resource Requirements:

See Appendix A

Last Modification: October 18, 2006 (Version 2.2)

Discussion:

Reference [1] specifies the Transmitted Signal conformance limits for SATA devices. This specification includes conformance limits for the RX Pair Differential Impedance. Reference [2] provides the definition of this term for the purposes of SATA testing. Reference [3] defines the measurement requirements for this test.

Test Setup:

See Appendix A

Test Procedure:

(The procedure for this test is identical to that of test TX-01, with the exception that the TDR cables shall be connected to J13 (RP+) and J14 (RP-) of the Agilent SATA Drive Fixture.)

Observable Results:

The measured impedance value shall be between 85 and 115 ohms for 1.5G devices, as well as 3.0G devices operating in 1.5G mode.

Possible Problems:

None.

Test RX-02 - Single-Ended Impedance

Purpose: To verify that the Single-Ended Impedance of the DUT's receiver is within the conformance limits.

References:

[1] SATA Standard, 7.2.1, Table 23 – Receiver Specifications
[2] Ibid, 7.2.2.4.2
[3] Ibid, 7.4.23

Resource Requirements:

See Appendix A

Last Modification: October 18, 2006 (Version 1.4)

Discussion:

Reference [1] specifies the Transmitted Signal conformance limits for SATA devices. This specification includes conformance limits for the RX Single-Ended Impedance. Reference [2] provides the definition of this term for the purposes of SATA testing. Reference [3] defines the measurement requirements for this test.

Test Setup:

See Appendix A

Test Procedure:

(The procedure for this test is identical to that of test TX-02, with the exception that the TDR cables shall be connected to J13 (RP+) and J14 (RP-) of the Agilent SATA Drive Fixture.)

Observable Results:

The RX Single-Ended Impedance shall be at least 40 Ohms for 1.5Gb/s devices as well as 3.0G devices operating in 1.5G mode.

Possible Problems:

None.

Test RX-03 – Differential Mode Return Loss

Purpose: To verify that the Differential Mode Return Loss of the DUT's receiver is within the conformance limits.

References:

[1] SATA Standard, 7.2.1, Table 23 – Receiver Specifications
[2] Ibid, 7.2.2.4.3
[3] Ibid, 7.4.10

Resource Requirements:

See Appendix A

Last Modification: October 18, 2006 (Version 1.4)

Discussion:

Reference [1] specifies the Transmitted Signal conformance limits for SATA devices. This specification includes conformance limits for the RX Differential Mode Return Loss. Reference [2] provides the definition of this term for the purposes of SATA testing. Reference [3] defines the measurement requirements for this test.

Test Setup:

See Appendix A

Test Procedure:

(The procedure for this test is identical to that of test TX-03, with the exception that the TDR cables shall be connected to J13 (RP+) and J14 (RP-) of the Agilent SATA Drive Fixture.)

Observable Results:

The RX Differential Mode Return Loss shall be greater than the minimum limits specified in reference [1] for 3.0G devices. For convenience, the values are reproduced below.

Frequency Range	Minimum Limit (3.0G)
150-300 MHz	18 dB
300-600 MHz	14 dB
600-1200 MHz	10 dB
1200-2400 MHz	8 dB
2400-3000 MHz	3 dB
3000-5000 MHz	1 dB

Possible Problems:

None.

Test RX-04 – Common Mode Return Loss

Purpose: To verify that the Common Mode Return Loss of the DUT's receiver is within the conformance limits.

References:

[1] SATA Standard, 7.2.1, Table 23 – Receiver Specifications
[2] Ibid, 7.2.2.4.4
[3] Ibid, 7.4.10

Resource Requirements:

See Appendix A

Last Modification: October 18, 2006 (Version 1.4)

Discussion:

Reference [1] specifies the Transmitted Signal conformance limits for SATA devices. This specification includes conformance limits for the RX Common Mode Return Loss. Reference [2] provides the definition of this term for the purposes of SATA testing. Reference [3] defines the measurement requirements for this test.

Test Setup:

See Appendix A

Test Procedure:

(The procedure for this test is identical to that of test TX-04, with the exception that the TDR cables shall be connected to J13 (RP+) and J14 (RP-) of the Agilent SATA Drive Fixture.)

Observable Results:

The RX Common Mode Return Loss shall be greater than the minimum limits specified in reference [1] for 3.0G devices. For convenience, the values are reproduced below.

Frequency Range	Minimum Limit (3.0G)
150-300 MHz	5 dB
300-600 MHz	5 dB
600-1200 MHz	2 dB
1200-2400 MHz	2 dB
2400-3000 MHz	2 dB
3000-5000 MHz	1 dB

Possible Problems:

None.

Test RX-05 – Impedance Balance

Purpose: To verify that the Impedance Balance of the DUT's receiver is within the conformance limits.

References:

[1] SATA Standard, 7.2.1, Table 23 – Receiver Specifications
[2] Ibid, 7.2.2.4.5
[3] Ibid, 7.4.10

Resource Requirements:

See Appendix A

Last Modification: October 18, 2006 (Version 1.4)

Discussion:

Reference [1] specifies the Transmitted Signal conformance limits for SATA devices. This specification includes conformance limits for the RX Impedance Balance. Reference [2] provides the definition of this term for the purposes of SATA testing. Reference [3] defines the measurement requirements for this test.

Test Setup:

See Appendix A

Test Procedure:

(The procedure for this test is identical to that of test TX-05, with the exception that the TDR cables shall be connected to J13 (RP+) and J14 (RP-) of the Agilent SATA Drive Fixture.)

Observable Results:

The RX Impedance Balance shall be greater than the minimum limits specified in reference [1] for 3.0G devices. For convenience, the values are reproduced below.

Frequency Range	Minimum Limit (3.0G)
150-300 MHz	30 dB
300-600 MHz	30 dB
600-1200 MHz	20 dB
1200-2400 MHz	10 dB
2400-3000 MHz	4 dB
3000-5000 MHz	4 dB

Possible Problems:

None.

APPENDICES

Overview:

Test suite appendices are intended to provide additional low-level technical detail pertinent to specific tests contained in this test suite. These appendices often cover topics that are outside of the scope of the standard, and are specific to the methodologies used for performing the measurements in this test suite. Appendix topics may also include discussion regarding a specific interpretation of the standard (for the purposes of this test suite), for cases where a particular specification may appear unclear or otherwise open to multiple interpretations.

Scope:

Test suite appendices are considered informative supplements, and pertain solely to the test definitions and procedures contained in this test suite.

Appendix A – Resource Requirements and Test Setup

Purpose: To define the hardware/software requirements and basic test setup used for all tests in this test suite.

References:
None.

Last Modification: July 18, 2006 (Version 1.2)

Discussion:

A.1 - Introduction

Custom SATA test fixtures are required for performing the physical layer tests covered in this document. The purpose of this appendix is to present a reference implementation of these test fixtures, to specify the basic test equipment used for performing the tests contained in this document, and to define the basic test setup which is used for all tests.

A.2 - Equipment

The list below summarizes the measurement equipment required for performing the tests contained in this document.

- 1-Agilent 86100C DCA-J with options 001, 200 and 202
- 1-Agilent 54754A TDR module
- 2-high quality SMA cables
- 1-Agilent SAS Drive X2 Primary Test Fixture, Agilent P/N N5421-26401
- 1 – 3.5 mm Connector torque wrench
- 1 – Agilent N1024A Cal Kit

A.3- Fixture Implementations

Figure A-1: Agilent SAS/SATA Drive Test Fixture

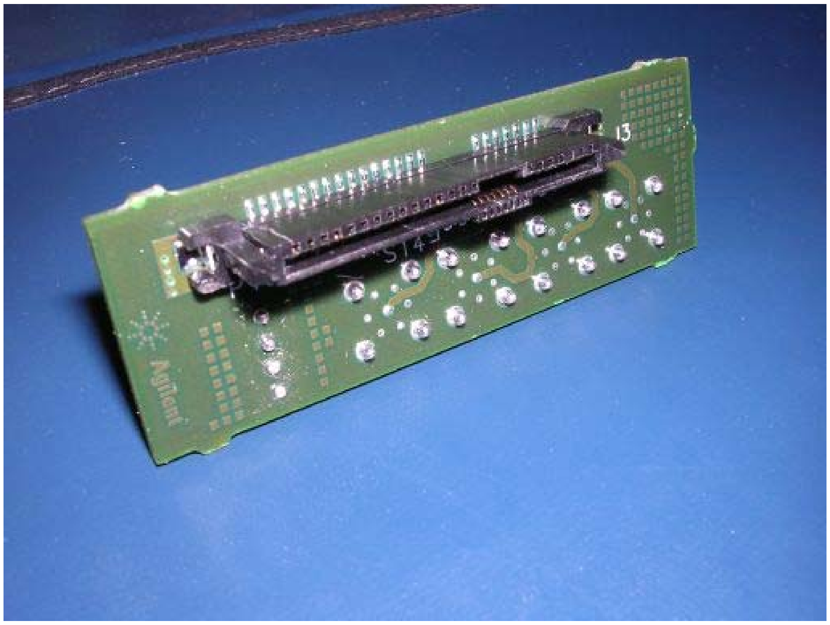

Figure A-2: Agilent SAS/SATA Drive Test Fixture (Reverse)

Above is a picture of the Agilent SAS Primary X2 Drive Fixture, which converts a SAS/SATA connector to 4 SMAs in order to make signal quality measurements.

A.4- Test Setup

Shown below is the basic setup used for all tests in this test suite. TDR Channels 1 and 2 are connected to either the TX or RX pair of the DUT (for tests TX-01/05 or RX-01/05, respectively), while the DUT is powered using a standard PC power supply connected to the Agilent test fixture.

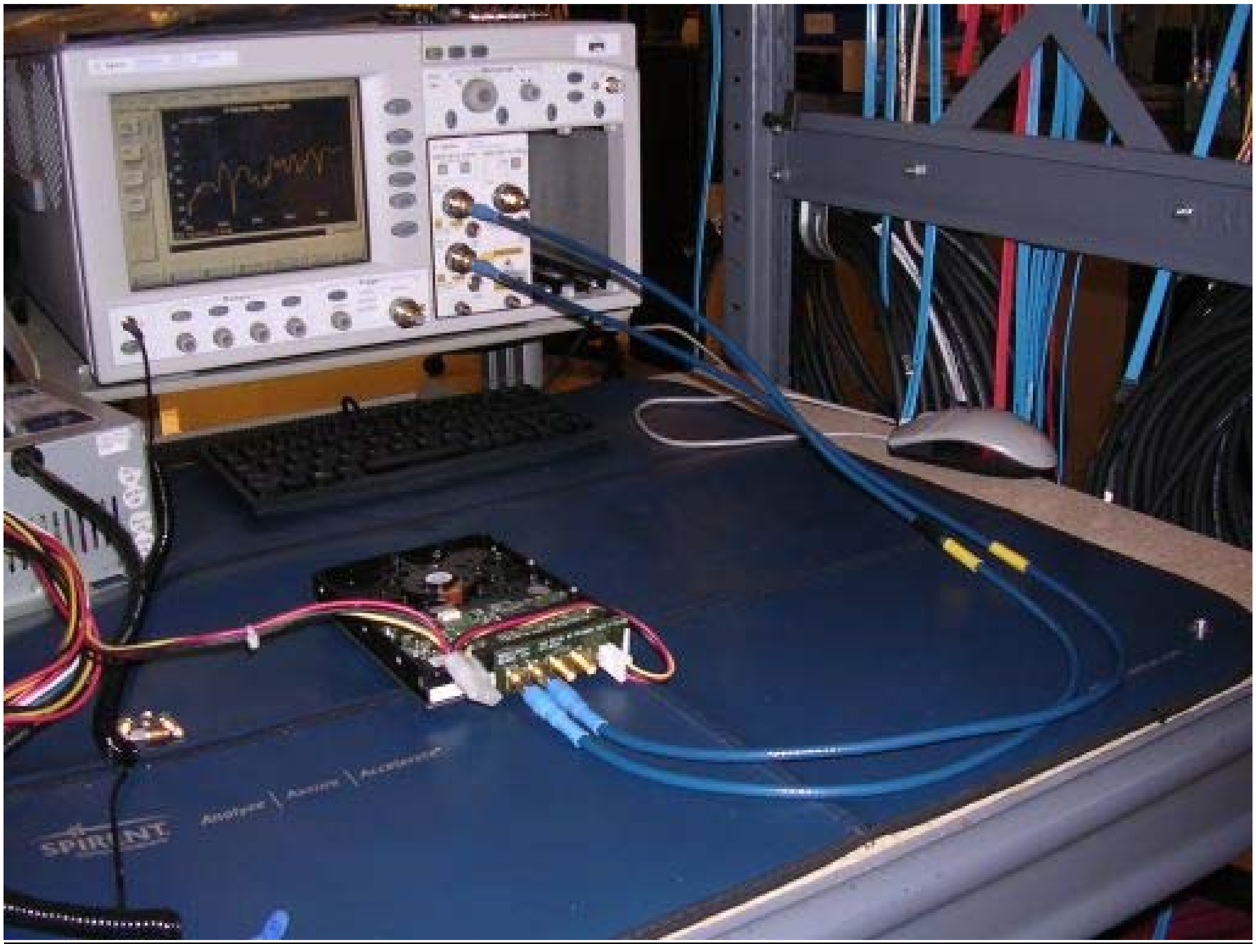

Figure A-3: General TDR Test Setup

Appendix B – Agilent 86100C TDR - Setup and Calibration Procedure

Purpose: To define the initial setup and calibration procedure which applies to all tests in this test suite.

References:
None.

Last Modification: January 25, 2006 (Version 1.0)

Discussion:

B.1 - Introduction

Before performing any of the tests in this suite, the Agilent 86100C must be initialized and calibrated specifically for the requirements of the tests that are to be performed. This appendix covers the initialization procedure, as well as the calibration steps that will prepare the instrument for performing the tests.

Note that the procedure in this appendix must only be performed once, before performing any/all of the tests defined in this document. (It will typically be performed prior to performing the TX-01 test.)

B.2 – Initialization and Calibration Procedure

Initialize 86100C:

- Ensure the DCA-J has been running for at least 1 hour for proper warm-up.
- Remove all cables from the instrument and press the **DEFAULT SETUP** button, then the **TDR/TDT MODE** button.

Perform Module Calibration:

- Using menus, select **Calibrate->All Calibrations->Calibrate Left Module**, and follow on-screen instructions.

Turn down sampling rate:

Click the **TDR Setup** button on the left side of the screen, go to **Advanced**, and select a manual rate of **50kHz**. (You can leave the TDR Setup window open here, as it's used in the next step.)

Set up hardware and deskew cables:

- Connect cables to left module. Torque properly.
- Deskew both pairs of cables using the procedure found in the 86100C on-line help: **Help->Contents->S->Skew->Differential TDR Skew**. (A modified summary of procedure is included below, as the Agilent procedure is somewhat confusing, and I believe contains minor erroneous typos.)
    - With cables connected, click the **TDR SETUP** button on the left setup bar.
    - Select **Common Mode** stimulus and **Common Mode 1-Port** DUT type.
    - Uncheck both measurement boxes, and click **DESKEW**.
    - Under normal circumstances (1m cables), the markers on screen will be shown on the first incident step. Move them to the second (reflected) step by adjusting the **Horizontal Position** knob to bring the reflected step to the middle of the display.
    - The channel with the longer cable will be the one whose step is further to the right side of the screen. If yellow is on the right, CH1 is longer. Green on right means CH2 is longer. (Note: This procedure assumes the longer cable is on CH2. If yellow is on the right, swap the cables at this point to put the longer on CH2, so green is on the right.)
    - Read the **Mean** value from the measure bar, which should be a positive value. Enter half of the absolute value of the mean into the **Horizontal Skew** box for the longer channel

- Adjust the **TDR Skew** values to initial values +10%/-10% for CH1/CH2, and then tweak them to make the mean delta time as close to zero as possible. Somewhere below 500fs should be fine. (Note, the Agilent help text says use a positive percentage value for the longer cable, but their picture shows the opposite. I believe the picture is correct, and the values shown here are consistent with the picture. Also note not it is unclear whether the values must be adjusted symmetrically. UNH uses symmetrical values, but the Agilent help shows otherwise. Thirdly, note that the default horizontal settings are somewhat coarse, and if you zoom in on the step a bit by turning the Horizontal Scale knob right 2-3 clicks and re-centering the display, you can get a much more accurate value.)
    - Close the **Differential TDR Skew** window.
- Set up Differential TDR:
    - Back on the **TDR/TDT Setup window**, select **Differential Stimulus Mode**, and check the **SDD11** response box. Close the window.

<u>Perform TDR Calibration:</u>

- Touch the **Calibration Wizard** button on the left setup bar, which will guide you through the TDR calibration process.
- The second step of the cal will ask you to "Adjust the timebase so that the entire response of the DUT is visible". Set the **Horizontal Scale** to **1.000ns/div**. Note that the excessively-long timebase setting is required in order to get adequate resolution in the frequency domain for the Return Loss measurements.
- Doublecheck that the spike in the response (corresponding to the open at the end of the cables) is located within the first graticule from the left side of the screen. (It should be this way by default, as long as the horizontal position knob wasn't touched.)
- Finish the rest of the cal procedure.

<u>Adjust TDR Risetime for Proper Test Value (100ps, 20-80%):</u>

- Connect the cables to the Agilent SAS/SATA fixture (either port will do.)
- Vertically center the differential response to appear fully on-screen by clicking the **Response** button, and under **Response 1** enter a manual offset value of **500mV**. Close the Response window.
- Touch the **Measure** tab on the left side of the screen and choose **Rise Time** to measure the rise time of the differential stimulus as it exits the fixture.
- Touch the **Setup/info** button to the right of the measurement results, choose **Configure Meas…** and choose **20%,50%,80%** for the threshold.
- Go back to the **TDR Setup** screen (button on left tab) and adjust the **Effective Rise Time** until the measured rise time is **100ps**. Note: UNH uses ~144ps in the risetime window, which yields ~99.5ps at the fixture tip.
- Save the cal under **File->Save->TDR/TDT Calibration** as **Pair A TDR 100.tdr**.

<u>Finish config and save instrument setup:</u>

- Specify Ohms for units by clicking the yellow **Channel 1 config button** on the lower left corner of the display and select **Advanced->Ohms**. Repeat for **Channel 2**.
- Set the display by clicking the Response button, and set Response 1 to Differential (should already be set), and set a manual scale of **50 Ohms/div** and **100 Ohms offset**.
- Save the setup under **File->Save->Instrument Setup** as **Pair A set.set**.

Note: To reset the instrument to the fully configured and calibrated state prior to any test, first press the DEFAULT SETUP button, then recall the **Pair A set.set** settings file, then recall the **Pair A TDR 100.tdr** TDR/TDT calibration file.

Appendix C – Condensed Test Procedure

Purpose: To define a condensed and combined procedure which covers all tests in this test suite.

References:
None.

Last Modification: February 9, 2006 (Version 1.0)

Discussion:

C.1 - Introduction

The standard procedures in this test document are defined for each individual test. Because there is a large degree of similarity and overlap between the tests, it is possible to define a single procedure that covers all of the tests with a minimum number of steps, if the separate procedures are combined and re-arranged. This appendix provides such a procedure, to allow all of the tests to be performed in an optimally short time period.

C.2 – Test Procedure

1) Perform the initial setup and calibration procedure found in Appendix B.
2) Upon finishing the setup/cal procedure, the instrument is already set up to do the RX-01 test. We will do this one first. Connect the DUT. Verify conformance using cursors. Save a screen capture to RX-01.jpg, and save a copy of the waveform to RX-01.txt in **XY verbose** format.
3) Setup for RX-03 is the same as RX-01, so we'll do that one next. All you have to do is pull down the **S-Param** window to get the SDD11 return loss. Use the cursors to verify conformance. Save a screen capture to **RX-03.jpg**, and export the SDD11 data to **RX-03.txt** using **File->Save->S-Parameter Touchstone**.
4) Next, we'll do the **Common-Mode Return Loss** test (RX-04). Click the **TDR Setup** button, pull down to **Common Mode Stimulus**, and click the **SCC11** box (uncheck SDC11). Close the window. You should see the common mode response in green. Pull down the **S-Param** tab. Verify conformance, and save screenshot+text data file as you did in the previous test **(RX-04.jpg**, and **RX-04.txt**).
5) Since we are already set up for **Common Mode Stimulus**, we can do test RX-05, which measures the SDC11. From the previous test, go back to the **TDR Setup** window and check only the **SDC11** box. Close the window and go to the **Response** window and click the **Auto** button. Verify conformance, grab a screen capture of the TDC11 waveform as **RX-05.jpg**, and pull down the S-parameter window and save that data to **RX-05.txt**.
6) Finally, we'll do the **Single-Ended Impedance** test (RX-02). With the stimulus still set to Common Mode, go to **Response**, and configure Responses 1 and 2 both to **Individual**. Turn the cursor 1 front panel button on, measure the low points of the two responses, take a screen capture, and save both waveforms (Responses 1 and 2) to verbose txt files **RX-02p.txt** and **RX-02n.txt**.

Once these steps are complete, all you need to do is repeat steps 2-6 for the TX pair, simply by moving the SMA cables to the TX ports on the fixture, and repeating all of the steps above. Save all of the same files, but use TX-xx instead of RX-xx filenames.