



Version 1.00

January 12, 2011

**Serial ATA Interoperability Program Revision 1.4**  
**Agilent MOI for SATA SI Tests**  
**Using Agilent E5071C ENA Network Analyzer Option TDR**

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## 1. Modification Record

Revision	Comments	Issue Date
1.00	- Changed version number to 1.00 - Add clarification about rise time adjustment plane in chapter 6.3.2 SI-C3 Rise Time Adjustment	Jan 12, 2011
1.00RC	- Changed version number to 1.00RC	Nov 11, 2010
0.90	- Changed page layouts - Added Acknowledgements	Sep 23, 2010
0.80	- Initial Draft Release	Sep 10, 2010

## 2. Acknowledgements

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### **3. Purpose**

This test procedure was written to explain how to use the Agilent E5071C ENA Network Analyzer Option TDR to make the measurements required per the Serial ATA specification rev 3.0 for cable assemblies.

### **4. References**

Serial ATA Revision 3.0

Serial ATA Interoperability Program Revision 1.4 Unified Test Document Version 1.01

### **5. Resource Requirements**

1. E5071C Network Analyzer with option TDR and one of the following options  
4D5/4K5
2. Electronic Calibration Module N4433A
3. Four 3.5 mm cables and adapters of 20 GHz bandwidth or equivalent
4. 50 Ohm terminators to terminate unused channels (ex. Agilent 909D-301)
5. Two SATA plug fixtures. Recommended fixtures are listed below.
  - Crescent Heart Software P/N TF-SATA-FE-ZP
  - ICT Solutions P/N TF-1P21
  - Wilder Technologies P/N SATA-TPA-P 600-1013-000

## 6. Measurement Setup

### 6.1. Recalling State File

This section describes how to setup the instrument for SATA compliance testing. Using the state file distributed on [www.agilent.com/find/ena-tdr\\_sata-si](http://www.agilent.com/find/ena-tdr_sata-si), the setup operation can be skipped. Download the file that matches the E5071C option, and extract the file. The zip file includes two state files for internal SATA and eSATA. If you use your local PC to download, save the state file to a USB mass storage device in order to move it to the E5071C. Connect the USB mass storage device into the USB port on the front panel of the E5071C. For manual measurement setup, refer to the section 8 Appendix.

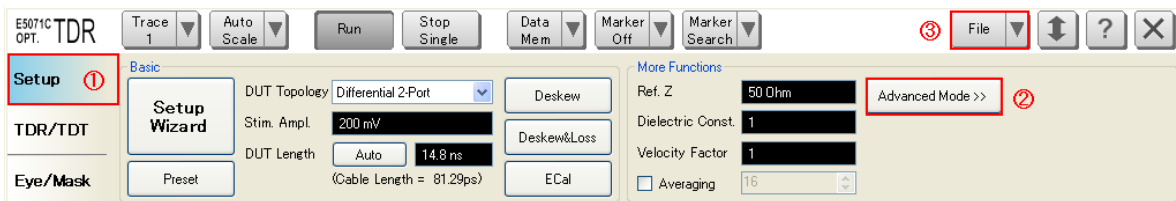
*Note: Hard Keys (Keys located on the Front panel of E5071C) are displayed in **Blue color and Bold**. (Example: **Avg, Analysis**)*

*Note: Soft keys (Keys on the screen) are displayed in **Bold**. (Example: **S11, Real, Transform**)*

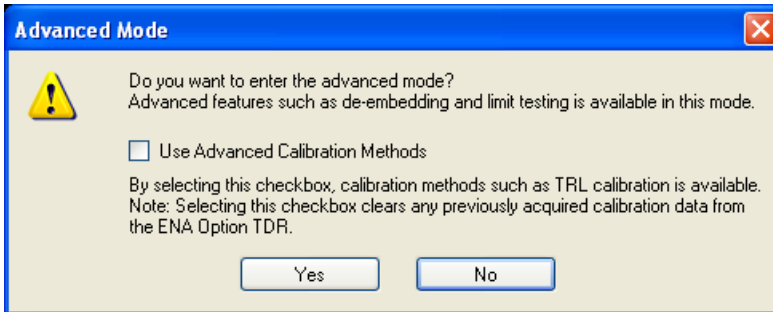
*Note: Buttons (in the TDR) are displayed in **Green color and Bold**. (Example: **Trace, Rise Time**)*

*Note: Tabs (in the TDR) are displayed in **Brown color and Bold**. (Example: **Setup, Trace Control**)*

1. If TDR setup wizard appears, click **Close** button on the wizard.
2. Open **Setup** tab (item1).
3. Click **Advanced Mode** (item2).



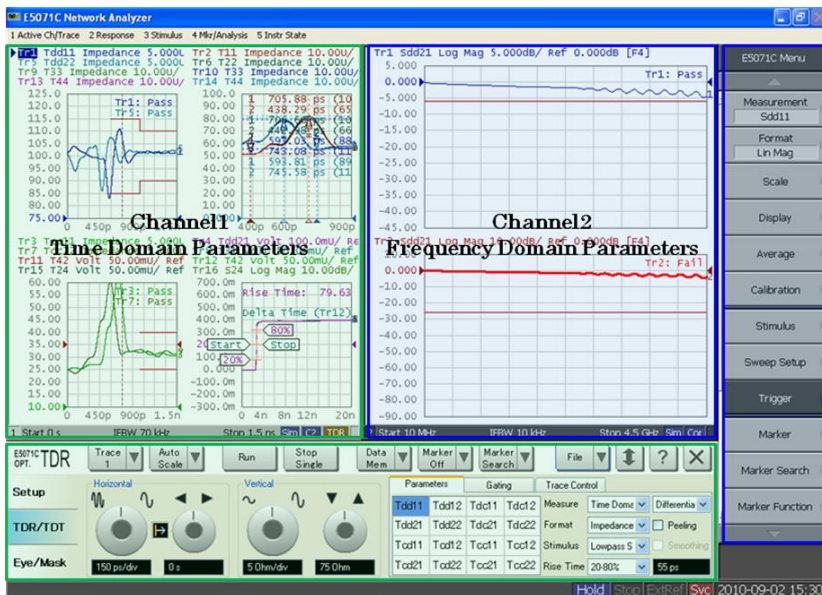
4. A dialog box appears requesting for confirmation. Then click **Yes**. (Clear the check box for “Use Advanced Calibration Methods”)



5. Click **File** (item3) and select **Recall State** to open the Recall State dialog box.
6. Specify a folder and a file name, and click **Open**.

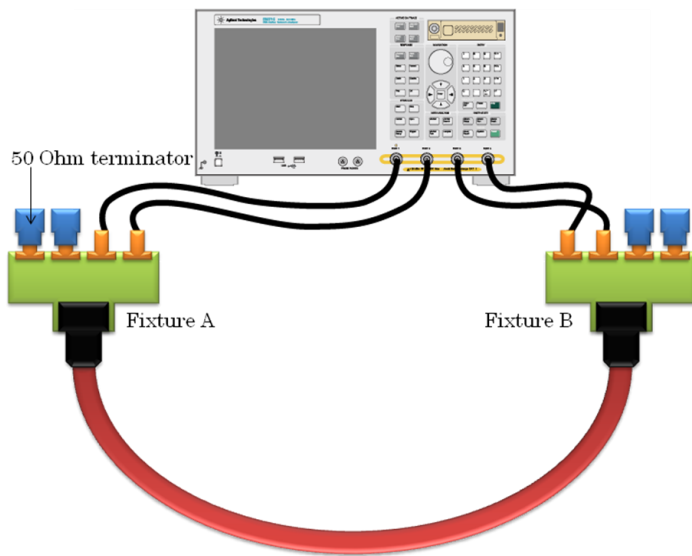
## 6.2. Measurement Configuration

This Section describes the screen configuration of the E5071C and the cable connection.



**Figure 6-1: SATA SI compliance test setup**

Channel1 for time domain measurement is controlled by the TDR user interface at the bottom of the screen and Channel2 for frequency domain measurement is controlled by the softkey on the right-side of the screen or hardkey on the instrument front panel.



**Figure 6-2: Cable and fixture connection**

The cables and fixtures should be connected to the instrument as shown in the figure above. Table 4-1 shows the cable connection for each measurement item. The measurement items of the same cable connection can be done simultaneously.

**Table 6-1: Cable and Fixture Connection**

ENA Port Number		Port1	Port2	Port3	Port4
Fixture PIN Number	Mated Connector Impedance				
	Cable Absolute Impedance				
	Cable Pair Matching				
	Common Mode Impedance	A Tx+	A Tx-	B Rx+	B Rx-
	Insertion Loss	B Tx+	B Tx-	A Rx+	A Rx-
	Differential Rise Time				
	Inter-Symbol Interference (Eye Diagram)				
	Intra-Pair Skew				
	Differential-to-Differential Crosstalk	A Tx+	A Tx-	A Rx+	A Rx-
		B Tx+	B Tx-	B Rx+	B Rx-

Note: A and B represent each one of the test fixtures.



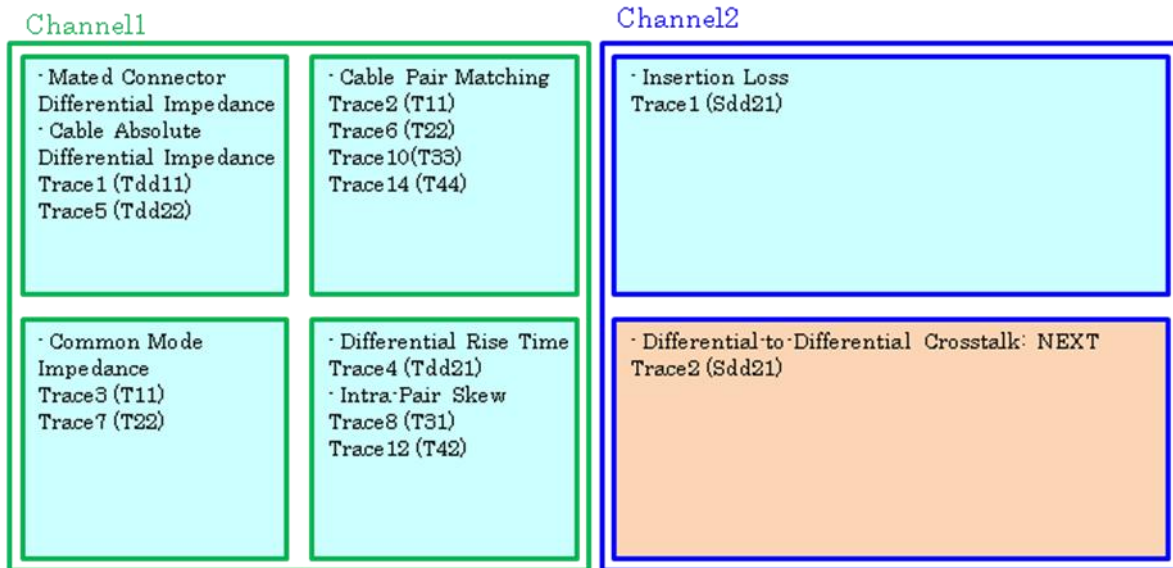


Figure 6-3: Description of measurement window

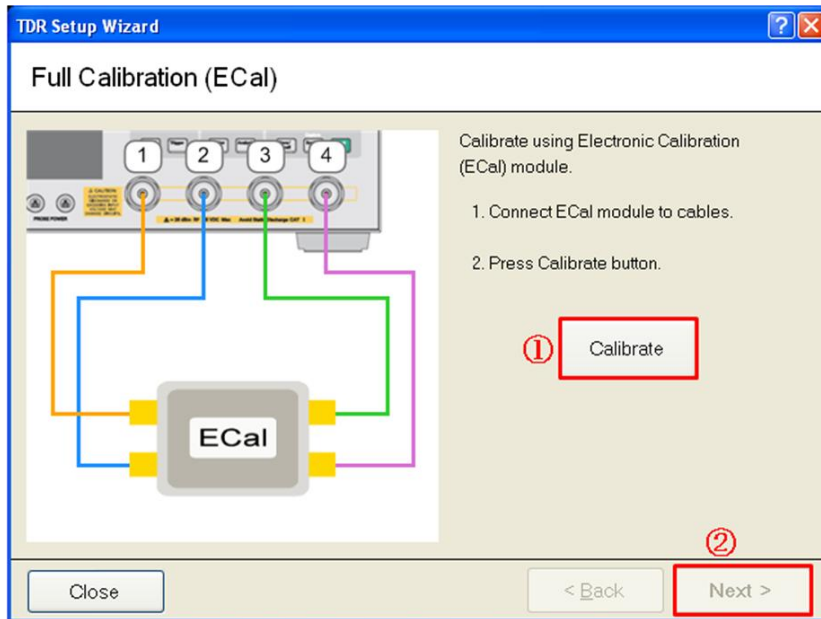
## 6.3. Calibration and Adjustment

### 6.3.1. SI-C1, SI-C2 Time Domain Calibration

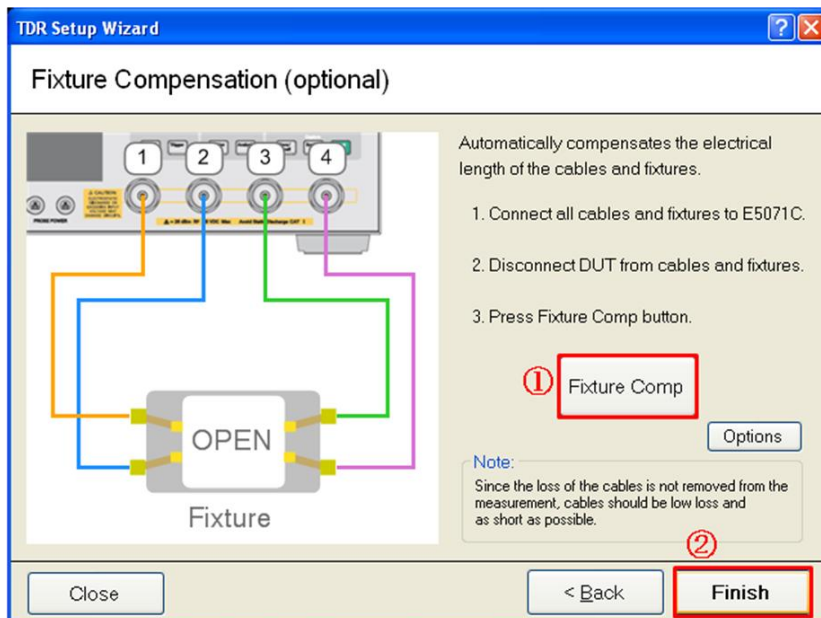
1. Press **Channel Next** key to select Channel1.
2. Open **Setup** tab (item1).
3. Click **ECal** (item2) to launch TDR Setup Wizard.



4. Connect the test cables to the ECal module.
5. Click **Calibrate** button, then click **Next >**.



6. Disconnect the ECal module then connect the test fixtures and leave them at OPEN.
7. Click **Fixture Comp** (item1).
8. Click **Finish** (item2).



### 6.3.2. SI-C3 Rise Time Adjustment

The system rise time is adjusted at the connector of the test fixture.

1. Press **Channel Next** key to select Channel1.
2. Press **Channel Max** key to enlarge Channel1.
3. Connect the SMA cables from port 1 and 2 of the E5071C to the TX+ and TX- connectors of the SATA-to-SMA Test Fixture. Leave the test fixture at OPEN.
4. Select **Trace4**.
5. Open **TDR/TDT** tab.
6. Select **Tdd11**.
7. Click **Run** button.
8. Adjust **Rise Time** so that the marker value on Trace 4 is as close as 70 psec, and note the input value (Input value #1). Repeat the same procedure on Trace 4 for rise time as close as 35 psec and note the input value (Input value #2).
9. Set measurement parameter on Trace 4 back to the original **Tdd21**.
10. Set the rise time to the input value #1 on the trace 1, 2, 3, 5, 6, 7, 9, 10, 13, 14 in Channel 1.
11. Set the rise time to the input value #2 on the trace 4, 8, 12 in Channel 1.
12. Press **Channel Max** key to get Channel1 back to the normal size.

### 6.3.3. SI-C1, SI-C2, SI-C3 Frequency Domain Calibration

1. Press **Channel Next** key to select channel 2.
2. Connect SMA cables to the ECal module.
3. Press **Cal** button on the instrument front panel.
4. Press ECal > 4-Port Cal to perform calibration.

## 7. Measurement and Data Analysis

### 7.1. 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. 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 MOI, 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 MOI document itself (e.g., “Appendix 8.1.”, or “Figure 7.1”).

#### **Last Modification**

This specifies the date of the last modification to this test.

#### **Test 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.

## 7.2. Cable Assembly Requirement

### 7.2.1. SI-01 Mated Connector Impedance

**Purpose:** To verify that the mated connector impedance of the DUT is within the conformance limits.

**References:** [1] SATA Interoperability Program Revision 1.4 Unified Test Document, Section 2.8.1.

**Last Modification:** November 11, 2010 (Version 1.00RC)

**Test Procedure:**

Assuming the initial setup/calibration procedures in chapter 6 have been performed, the measurement for this test is as follows:

1. Connect the test fixture to the test cables according to the Table 7-1. Unused test ports should be terminated.

**Table 7-1: Cable Connection**

ENA Port Number	Port1	Port2	Port3	Port4
Fixture PIN Number	A Tx+	A Tx-	B Rx+	B Rx-
	B Tx+	B Tx-	A Rx+	A Rx-

Note: A and B represent each one of the test fixtures.

2. Connect SATA cable to the test fixture.
3. Press **Channel Next** key to select Channel1.
4. Press **Channel Max** key to enlarge Channel1.
5. Click **Stop Single** for Time Domain measurement.

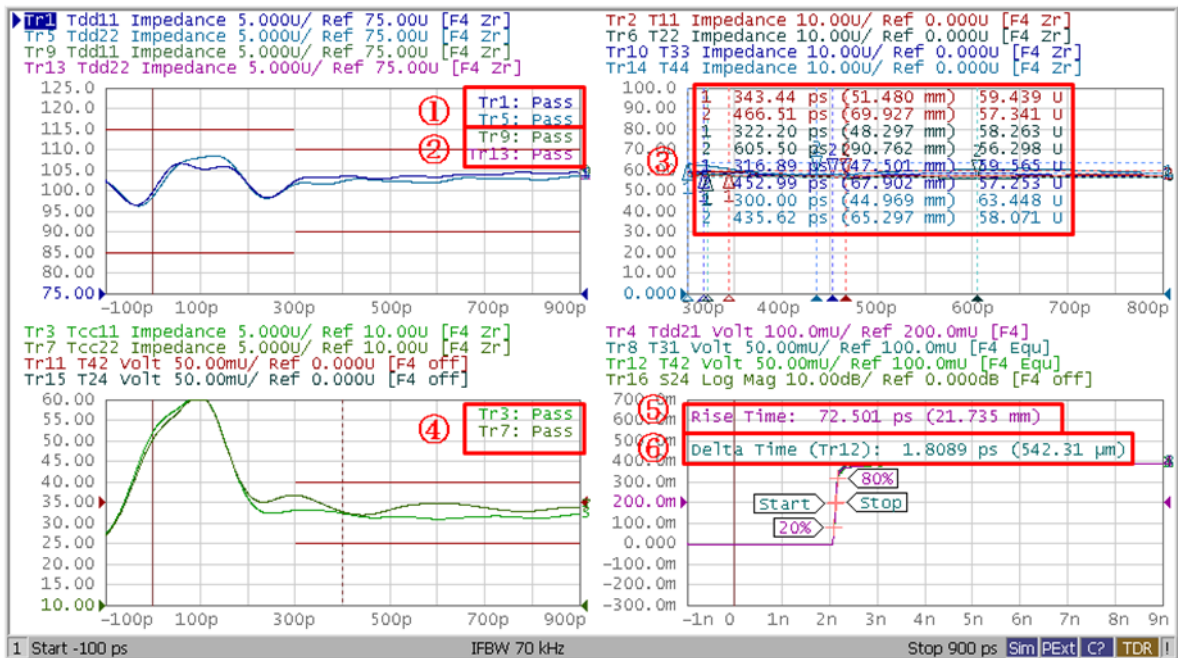


Figure 7-1: Measurement example of SI-01, SI-02, SI-03, SI-04, SI-08, and SI-10.

Observable Results: Read Pass/Fail sign on Trace1 and Trace5 (item1 in Figure 7-1).

#### Mated Connector Impedance Limit Line

Type	Begin Stimulus	End Stimulus	Begin Response	End Response
Max	-0.1 ns	0.3 ns	115 Ohm	115 Ohm
Min	-0.1 ns	0.3 ns	85 Ohm	85 Ohm

## 7.2.2. SI-02 Cable Absolute Impedance

**Purpose:** To verify that the cable absolute impedance of the DUT is within the conformance limits.

**References:** [1] SATA Interoperability Program Revision 1.4 Unified Test Document, Section 2.8.2.

**Last Modification:** November 11, 2010 (Version 1.00RC)

### Test Procedure:

Assuming the initial setup/calibration procedures in chapter 6 have been performed, the measurement for this test is as follows:

1. Connect the test fixture to the test cables according to the Table 7-2. Unused test ports should be terminated.

**Table 7-2: Cable Connection**

ENA Port Number	Port1	Port2	Port3	Port4
Fixture PIN Number	A Tx+	A Tx-	B Rx+	B Rx-
	B Tx+	B Tx-	A Rx+	A Rx-

Note: A and B represent each one of the test fixtures.

2. Connect SATA cable to the test fixture.
3. Press **Channel Next** key to select Channel1.
4. Press **Channel Max** key to enlarge Channel1.
5. Click **Stop Single** for Time Domain measurement.

**Observable Results:** Read Pass/Fail sign on Trace9 and Trace13 (item 2 in Figure 7-1).

### Cable Absolute Impedance Limit Line

Type	Begin Stimulus	End Stimulus	Begin Response	End Response
Max	0.3 ns	0.9 ns	110 Ohm	110 Ohm
Min	0.3 ns	0.9 ns	90 Ohm	90 Ohm

### 7.2.3. SI-03 Cable Pair Matching

**Purpose:** To verify that the maximum and minimum cable impedance value of each single ended channel is matched within the conformance limits.

**References:** [1] SATA Interoperability Program Revision 1.4 Unified Test Document, Section 2.8.3.

**Last Modification:** November 11, 2010 (Version 1.00RC)

**Test Procedure:**

Assuming the initial setup/calibration procedures in chapter 6 have been performed, the measurement for this test is as follows:

1. Connect the test fixture to the test cables according to the Table 7-3. Unused test ports should be terminated.

**Table 7-3: Cable Connection**

ENA Port Number	Port1	Port2	Port3	Port4
Fixture PIN Number	A Tx+	A Tx-	B Rx+	B Rx-
	B Tx+	B Tx-	A Rx+	A Rx-

Note: A and B represent each one of the test fixtures.

2. Connect SATA cable to the test fixture.
3. Press **Channel Next** key to select Channel1.
4. Press **Channel Max** key to enlarge Channel1.
5. Click **Stop Single** for Time Domain measurement.

**Observable Results:**

Read the marker values on Trace2, Trace6, Trace10, and Trace14. (item3 in Figure 7-1)

If all conditions shown below are satisfied, then pass. Otherwise fail.

(Marker1 on Trace2) – (Marker1 on Trace6) < +-5 Ohm,

(Marker2 on Trace2) – (Marker2 on Trace6) < +-5 Ohm,

(Marker1 on Trace10) – (Marker1 on Trace14) < +-5 Ohm,

(Marker2 on Trace10) – (Marker2 on Trace14) < +-5 Ohm.



## 7.2.4. SI-04 Common Mode Impedance

**Purpose:** To verify that the common mode impedance of the DUT is within the conformance limits.

**References:** [1] SATA Interoperability Program Revision 1.4 Unified Test Document, Section 2.8.4.

**Last Modification:** November 11, 2010 (Version 1.00RC)

### Test Procedure:

Assuming the initial setup/calibration procedures in chapter 6 have been performed, the measurement for this test is as follows:

1. Connect the test fixture to the test cables according to the Table 7-4. Unused test ports should be terminated.

**Table 7-4: Cable Connection**

ENA Port Number	Port1	Port2	Port3	Port4
Fixture PIN Number	A Tx+	A Tx-	B Rx+	B Rx-
	B Tx+	B Tx-	A Rx+	A Rx-

Note: A and B represent each one of the test fixtures.

2. Connect SATA cable to the test fixture.
3. Press **Channel Next** key to select Channel1.
4. Press **Channel Max** key to enlarge Channel1.
5. Click **Stop Single** for Time Domain measurement.

### Observable Results:

Read Pass/Fail sign on the Trace3 and Trace7. (item4 in Figure 7-1)

### Common Mode Impedance Limit Line

Type	Begin Stimulus	End Stimulus	Begin Response	End Response
Max	0.3 ns	0.9 ns	40 Ohm	40 Ohm
Min	0.3 ns	0.9 ns	25 Ohm	25 Ohm

### 7.2.5. SI-05 Differential Rise Time

**Purpose:** To verify that the differential rise time of the DUT is within the conformance limits.

**References:** [1] SATA Interoperability Program Revision 1.4 Unified Test Document, Section 2.8.5.

**Last Modification:** November 11, 2010 (Version 1.00RC)

**Test Procedure:**

Assuming the initial setup/calibration procedures in chapter 6 have been performed, the measurement for this test is as follows:

1. Connect the test fixture to the test cables according to the Table 7-5. Unused test ports should be terminated.

**Table 7-5: Cable Connection**

ENA Port Number	Port1	Port2	Port3	Port4
Fixture PIN Number	A Tx+	A Tx-	B Rx+	B Rx-
	B Tx+	B Tx-	A Rx+	A Rx-

Note: A and B represent each one of the test fixtures.

2. Connect SATA cable to the test fixture.
3. Press **Channel Next** key to select Channel1.
4. Press **Channel Max** key to enlarge Channel1.
5. Click **Stop Single** for Time Domain measurement.

**Observable Results:** Read the rise time on the Trace4. (item5 in Figure 7-1)

<b>Internal SATA cable</b>	If the rise time < 85 ps, then pass. Otherwise fail.
<b>eSATA cable</b>	If the rise time < 150 ps, then pass. Otherwise fail.

### 7.2.6. SI-06 Intra-Pair Skew

**Purpose:** To verify that the differential rise time of the DUT is within the conformance limits.

**References:** [1] SATA Interoperability Program Revision 1.4 Unified Test Document, Section 2.8.6.

**Last Modification:** November 11, 2010 (Version 1.00RC)

**Test Procedure:**

Assuming the initial setup/calibration procedures in chapter 6 have been performed, the measurement for this test is as follows:

1. Connect the test fixture to the test cables according to the Table 7-6. Unused test ports should be terminated.

**Table 7-6: Cable Connection**

ENA Port Number	Port1	Port2	Port3	Port4
Fixture PIN Number	A Tx+	A Tx-	B Rx+	B Rx-
	B Tx+	B Tx-	A Rx+	A Rx-

Note: A and B represent each one of the test fixtures.

2. Connect SATA cable to the test fixture.
3. Press **Channel Next** key to select Channel1.
4. Press **Channel Max** key to enlarge Channel1.
5. Click **Stop Single** for Time Domain measurement.

**Observable Results:** Read the delta time between Trace8 and Trace12. (item6 in Figure 7-1)

<b>Internal SATA cable</b>	If the delta time < 10 ps, then pass. Otherwise fail.
<b>eSATA cable</b>	If the delta time < 20 ps, then pass. Otherwise fail.

### 7.2.7. SI-07 Insertion Loss

**Purpose:** To verify that the insertion loss of the DUT is within the conformance limits.

**References:** [1] SATA Interoperability Program Revision 1.4 Unified Test Document, Section 2.8.7.

**Last Modification:** November 11, 2010 (Version 1.00RC)

**Test Procedure:**

Assuming the initial setup/calibration procedures in chapter 6 have been performed, the measurement for this test is as follows:

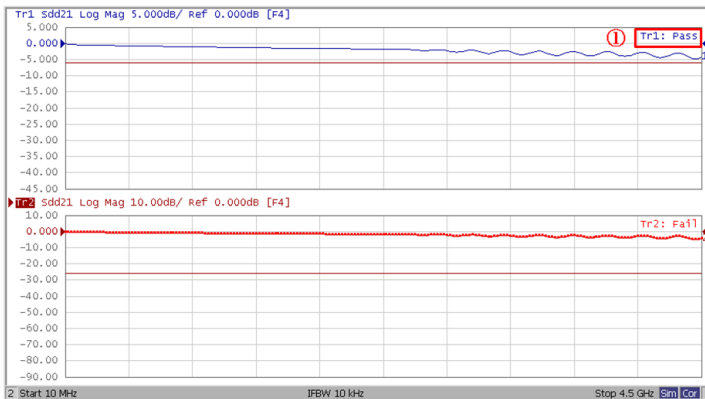
1. Connect the test fixture to the test cables according to the Table 7-7. Unused test ports should be terminated.

**Table 7-7: Cable Connection**

ENA Port Number	Port1	Port2	Port3	Port4
Fixture PIN Number	A Tx+	A Tx-	B Rx+	B Rx-
	B Tx+	B Tx-	A Rx+	A Rx-

Note: A and B represent each one of the test fixtures.

2. Connect SATA cable to the test fixture.
3. Press **Channel Next** key to activate Channel2.
4. Press **Trigger** > **Single** for Frequency Domain measurement.



**Figure 7-2: Measurement example of SI-07**

**Observable Results:** Read Pass/Fail sign on Trace1 (item1 in Figure 7-2).

**Insertion Loss Limit Line (Internal SATA)**

Type	Begin Stimulus	End Stimulus	Begin Response	End Response
Min	10 MHz	4.5 GHz	-6 dB	-6 dB

**Insertion Loss Limit Line (eSATA)**

Type	Begin Stimulus	End Stimulus	Begin Response	End Response
Min	10 MHz	4.5 GHz	-8 dB	-8 dB

## 7.2.8. SI-08 Differential to Differential Crosstalk: NEXT

**Purpose:** To verify that the differential to differential crosstalk the DUT is within the conformance limits.

**References:** [1] SATA Interoperability Program Revision 1.4 Unified Test Document, Section 2.8.8.

**Last Modification:** November 11, 2010 (Version 1.00RC)

### Test Procedure:

Assuming the initial setup/calibration procedures in chapter 6 have been performed, the measurement for this test is as follows:

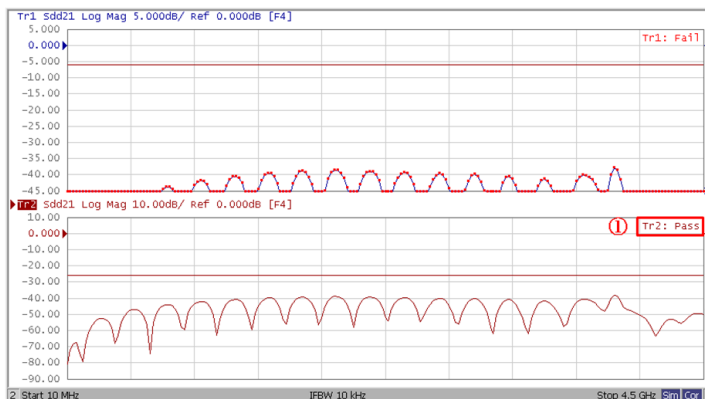
1. Connect the test fixture to the test port cables according to the Table 7-8: Cable Connection. Unused test ports should be terminated.

**Table 7-8: Cable Connection**

ENA Port Number	Port1	Port2	Port3	Port4
Fixture PIN Number	A Tx+	A Tx-	A Rx+	A Rx-
	B Tx+	B Tx-	B Rx+	B Rx-

Note: A and B are the fixture identifiers.

2. Connect SATA cable to the test fixture.
3. Press **Trigger > Single** for Frequency Domain measurement.



**Figure 7-3: Measurement Example of SI-08**

**Observable Results:** Read the pass/fail sign on Trace2 (item1 in Figure 7-3).

**Differential to Differential Crosstalk: NEXT Limit Line**

<b>Type</b>	<b>Begin Stimulus</b>	<b>End Stimulus</b>	<b>Begin Response</b>	<b>End Response</b>
Max	10 MHz	4.5 GHz	-26 dB	-26 dB

## 7.2.9. SI-09 Inter-Symbol Interference

**Purpose:** To verify that the mated connector impedance of the DUT is within the conformance limits.

**References:** [1] SATA Interoperability Program Revision 1.4 Unified Test Document, Section 2.8.1.

**Last Modification:** November 11, 2010 (Version 1.00RC)

### Test Procedure:

Eye diagram test is performed with the lone-bit pattern (LBP)<sup>1</sup>. The LBP bit pattern file can be downloaded from [www.agilent.com/find/ena-tdr\\_sata-si](http://www.agilent.com/find/ena-tdr_sata-si). Assuming the initial setup/calibration procedures in chapter 6 have been performed, the measurement for this test is as follows:

1. Connect the test fixture to the test cables according to the Table 7-9. Unused test ports should be terminated.

**Table 7-9: Cable Connection**

ENA Port Number	Port1	Port2	Port3	Port4
Fixture PIN Number	A Tx+	A Tx-	B Rx+	B Rx-
	B Tx+	B Tx-	A Rx+	A Rx-

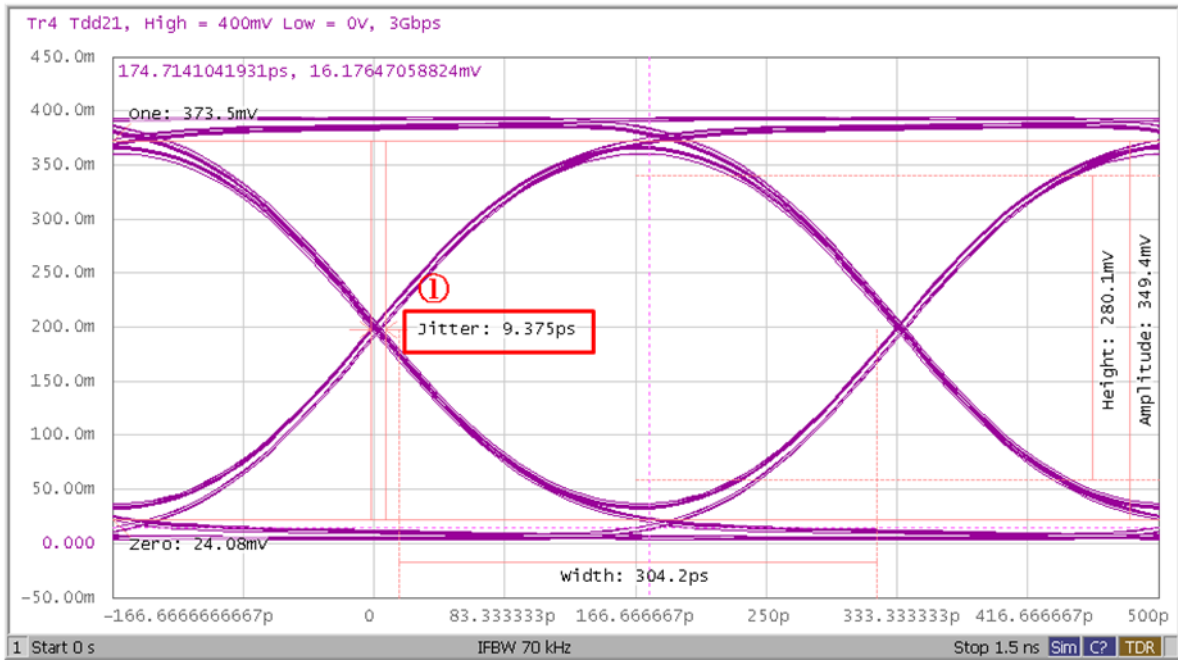
Note: A and B represent each one of the test fixtures.

2. Connect SATA cable to the test fixture.
3. Press **Channel Next** key to select Channel1.
4. Press **Channel Max** key to enlarge Channel1.
5. Click **Stop Single** for Time Domain measurement.
6. Select **Trace4**.
7. Open **Eye/Mask** tab.
8. Click **User Pattern** button, then Bit Pattern Editor appears.
9. Click **Load** button and specify the LBP bit pattern file with the dialog box.
10. Click **Close** button.
11. Click **Draw Eye** button.

---

<sup>1</sup> The LBP is comprised of the repetition of the following bit pattern, resulting in a bit length of 2048. 0011 0110 1111 0100 0010 0011 0110 1111 0100 0011 0011 0101 0011 0100 1101 0011 0101 0011 0100 1100





**Figure 7-4: Measurement Example of SI-09**

**Observable Results:**

Read Jitter p-p on the eye diagram (item1 in Figure 7-4). If Jitter p-p < 50 ps, then pass. Otherwise fail.

## 8. Appendix

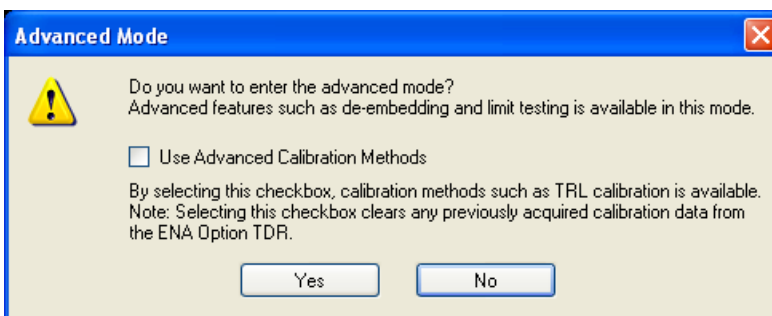
### 8.1. Manual Setup for Time Domain Measurement

#### 7.5.1. Starting Setup

1. If TDR setup wizard was appeared, click **Close** button in the TDR setup wizard.
2. Open **Setup** tab (item1).
3. Click **Preset** (item2) under Basic to preset the E5071C.
4. A dialog box appears requesting for confirmation. Then click **OK**.
5. Set **DUT Topology** (item3) to “Single-Ended 4-Port”.
6. Click **Advanced Mode** (item4).



7. A dialog box appears requesting for confirmation. Then click **Yes**. (Clear the check box for “Use Advanced Calibration Methods”)



#### 7.5.2. Mated Connector Impedance

1. Click **Stop Single**.
2. Open **TDR/TDT** tab.
3. Open **Trace Control** tab.
4. Clear **Time** and **Marker** check box under Coupling.
5. Select **Trace1**.
6. Open **Parameters** tab.

7. Set **Measure** to “Differential”.
8. Set **Rise Time** to 70 psec (20-80%).
9. Click the box below the left knob under Horizontal.
10. Input 100 psec/div with the Entry dialog box.
11. Click the box below the right knob under Horizontal.
12. Input -100 psec with the Entry dialog box.
13. Click the box below the left knob under Vertical.
14. Input 5 Ohm/div with the Entry dialog box
15. Click the box below the right knob under Vertical.
16. Input 75 Ohm with the Entry dialog box
17. Open **Trace Control** tab.
18. Click **Trace Settings Copy** button. Then Trace Settings Copy dialog box appears.
19. Select **Trace1** in the From list.
20. Select **Trace5** in the To list.
21. Click **Copy**.
22. Click **Close**.
23. Select **Trace5**.
24. Open **Parameters** tab.
25. Click **Tdd22** in the table.

### 7.5.3. Cable Absolute Impedance

1. Open **Trace Control** tab.
2. Click **Trace Settings Copy** button. Then Trace Settings Copy dialog box appears.
3. Select **Trace1** in the From list.
4. Select **Trace9** in the To list.
5. Click **Copy**.
6. Select **Trace5** in the From list.
7. Clear **Trace9** and select **Trace13** in the To list.

8. Click **Close**.

#### 7.5.4. Cable Pair Matching

1. Select **Trace2**.
2. Open **Parameters** tab.
3. Set **Measure** to “Time Domain”.
4. Set **Rise Time** to 70 psec (20-80%).
5. Click the box below the left knob under Horizontal.
6. Input 50 psec/div with the Entry dialog box.
7. Click the box below the right knob under Horizontal.
8. Input 300 psec with the Entry dialog box.
9. Click the box below the left knob under Vertical.
10. Input 10 Ohm/div with the Entry dialog box
11. Click the box below the right knob under Vertical.
12. Input 0 Ohm with the Entry dialog box.
13. Click **Maker** menu and select **1**.
14. Click **Maker Search** menu and Select **Max**.
15. Click **Maker** menu and select **2**.
16. Click **Maker Search** menu and Select **Min**.
17. Open **Trace Control** tab.
18. Click **Trace Settings Copy** button. Then Trace Settings Copy dialog box appears.
19. Select **Trace2** in the From list.
20. Select **Trace6**, **Trace10**, and **Trace14** in the To list.
21. Click **Copy**.
22. Click **Close**.
23. Open **Parameters** tab.
24. Select **Trace6**.
25. Click **T22** in the table.

26. Select **Trace10**.
27. Click **T33** in the table.
28. Select **Trace14**.
29. Click **T44** in the table.

### 7.5.5. Common Mode Impedance

1. Select **Trace3**.
2. Set **Measure** to “Differential”.
3. Set **Format** to “Impedance”.
4. Select **Tcc11** in the table.
5. Set **Rise Time** to 70 psec (20-80%).
6. Press **Display > Equation Editor... >** Enter an equation “**CMI1= S11+S12**”.
7. Check **Equation Enabled** check box.
8. Click **Apply**.
9. Click **Close**.
10. Click the box below the left knob under Horizontal.
11. Input 100 psec/div with the Entry dialog box.
12. Click the box below the right knob under Horizontal.
13. Input -100 psec with the Entry dialog box.
14. Click the box below the left knob under Vertical.
15. Input 5 Ohm/div with the Entry dialog box
16. Click the box below the right knob under Vertical.
17. Input 10 Ohm with the Entry dialog box
18. Open **Trace Control** tab.
19. Click **Trace Settings Copy**. Then Trace Settings Copy dialog box appears.
20. Select **Trace3** in the From list.
21. Select **Trace7, Trace11, Trace15** in the To list.
22. Click **Copy**.

23. Click **Close**.
24. Select **Trace7**.
25. Press **Display** > **Equation Editor...** > Enter an equation “**CMI2= S22+S21**”.
26. Repeat step7 to step9.
27. Select **Trace11**.
28. Press **Display** > **Equation Editor...** > Enter an equation “**CMI3= S33+S34**”.
29. Repeat step7 to step9.
30. Select **Trace15**.
31. Press **Display** > **Equation Editor...** > Enter an equation “**CMI4= S44+S43**”.
32. Repeat step7 to step9.

### 7.5.6. Differential Rise Time

1. Select **Trace4**.
2. Set **Measure** to “Time Domain” and “Differential”.
3. Set **Format** to “Volt”.
4. Select **Tdd21** in the table.
5. Set **Rise Time** to 35 psec (20-80%).
6. Click the box below the left knob under Horizontal. Then Entry dialog box appears.
7. Input horizontal scale to 2 ns/div.
8. Click the box below the right knob under Horizontal. Then Entry dialog box appears.
9. Input horizontal position to -1 ns.
10. Click the box below the left knob under Vertical. Then Entry dialog box appears.
11. Input vertical scale to 100 mV/div.
12. Click the box below the right knob under Vertical. Then Entry dialog box appears.
13. Input vertical position to 200 mV.
14. Click **Marker Search** menu and select **Rise Time (20-80%)**.

### 7.5.7. Intra-Pair Skew

1. Select **Trace8**.
2. Set **Measure** to “Time Domain”.
3. Set **Format** to “Volt”.
4. Select **T31** in the table.
5. Set **Rise Time** to 35 psec (20-80%).
6. Click the box below the left knob under Horizontal. Then Entry dialog box appears.
7. Input horizontal scale to 2 ns/div.
8. Click the box below the right knob under Horizontal. Then Entry dialog box appears.
9. Input horizontal position to -1 ns.
10. Click the box below the left knob under Vertical. Then Entry dialog box appears.
11. Input vertical scale to 50 mV/div.
12. Click the box below the right knob under Vertical. Then Entry dialog box appears.
13. Input vertical position to 100 mV.
14. Open **Trace Control** tab.
15. Click **Trace Settings Copy**. Then Trace Settings Copy dialog box appears.
16. Select the **Trace8** in the From list.
17. Select the **Trace12** in the To list.
18. Click **Copy**.
19. Click **Close**.
20. Select **Trace12**.
21. Open **Parameters** tab.
22. Select **T42** in the table.
23. Select **Trace8**.
24. Click **Marker Search** menu and select **Δ Time**. Then Delta Time dialog box appears.
25. Check **Δ Time** check box.
26. Set **Target (Stop)** to “Trace12 (T42)”.
27. Click **OK**.

28. Press **Display** > **Equation Editor...** > Enter an equation “**Intra+= S31-S32**”.
29. Check **Equation Enabled** check box.
30. Click **Apply**.
31. Click **Close**.
32. Select **Trace12**.
33. Press **Display** > **Equation Editor...** > Enter an equation “**Intra-= S42-S41**”.
34. Check **Equation Enabled** check box.
35. Click **Apply**.
36. Click **Close**.
37. Select **Trace16**.
38. Click **Data Mem** and select **Off**.

## 7.6. Manual Setup for Eye Diagram Measurement

1. Open **Eye/Mask** tab.
2. Set Bit Pattern **Data Rate** to 3 Gbps.
3. Set Bit Pattern **Rise Time** to 133 ps (20-80%).
4. Set Bit Pattern **Type** to “USER”.

## 7.7. Manual Setup for Frequency Domain Measurement

### 7.7.1. Channel and Trace Settings

1. Press **Display**.
2. Click **Allocate Channels** >  .
3. Press **Channel Next**.
4. Click **Num of Traces** > **2**.
5. Click **Allocate Traces** >  .



### 7.7.2. Common Settings

1. Press **Sweep Setup** > **Sweep Type** > **Lin Freq.**
2. Set **Points** to 201.
3. Press **Start** > Set start value to 10 MHz.
4. Press **Stop** > Set stop value to 4.5 GHz.
5. Press **Avg** > Set **IF Bandwidth** to 10 kHz.
6. Press **Analysis** > **Fixture Simulator** > **Fixture Simulator** and turn it **ON**.

### 7.7.3. Insertion Loss Measurements

1. Press **Trace Next** to select Trace1.
2. Click **Topology** > **Device** > **Bal-Bal**.
3. Click **Port1 (bal)** > **1-2**.
4. Click **Port2 (bal)** > **3-4**.
5. Click **Return**.
6. Click **BalUn** and turn it **ON**.
7. Click **Measurement** > **Sdd21**.
8. Press **Scale**.
9. Set **Scale/Div** to 5 dB/div.
10. Set **Reference position** to 9 Div.

### 7.7.4. Differential to Differential Crosstalk: NEXT

1. Press **Trace Next**.
2. Press **Analysis** > **Fixture Simulator** > **BalUn** and turn it **ON**.
5. Click **Measurement** > **Sdd21**.
6. Press **Scale**.
7. Set **Scale/Div** to 10 dB/div.
8. Set **Reference position** to 9 Div.

## 7.8. Limit Test Settings

### 7.8.1. Displaying Judgment Result of Test

If a channel has a judgment result of fail, the fail message appears on the screen. It will be judged as failed if one or more unsatisfactory trace exists within the channel.

Follow the procedure below.

1. Press **Analysis** > **Limit Test** > **Fail Sign** to switch the fail sign ON/OFF.

### 7.8.2. Setting the Warning Beeper

Beep sound that occurs when the judgment result is fail. Follow the procedure below.

1. Press **System** > **Misc Setup** > **Beeper** > **Beep Warning** to switch the warning beeper ON/OFF.

### 7.8.3. Defining the Limit Line

Set limit lines to perform pass/fail tests on the following measurement items.

- Mated Connector Impedance (Trace1, 5 in Channel1)
- Cable Absolute Impedance (Trace1, 5 in Channel1)
- Common Mode Impedance (Trace3, 7 in Channel1)
- Insertion Loss (Trace1 in Channel2)
- Differential to Differential Crosstalk: NEXT (Trace2 in Channel2).

1. Press **Channel Next** key and **Trace Next** key to activate the trace on which limit lines should be set.
2. Press **Analysis** > **Limit Test** > **Edit Limit Line** to display the limit table shown below (Initially, no segments are entered in the limit table). Using the limit table, create/edit a segment.

	Type	Begin Stimulus	End Stimulus	Begin Response	End Response
1	MAX	0 s	600 ps	105 u	105 u
2	MIN	0 s	600 ps	75 u	75 u
3					

3. Enter the limit line data following the tables below.
4. Click **Return**.
5. Click **Limit Line** and turn it **ON**.
6. Click **Limit Test** and turn it **ON**.
7. Repeat 1 to 6 for each Measurement items.

**Mated Connector Impedance Limit Line**

Type	Begin Stimulus	End Stimulus	Begin Response	End Response
Max	-0.1 ns	0.3 ns	115 Ohm	115 Ohm
Min	-0.1 ns	0.3 ns	85 Ohm	85 Ohm

**Cable Absolute Impedance Limit Line**

Type	Begin Stimulus	End Stimulus	Begin Response	End Response
Max	0.3 ns	0.9 ns	110 Ohm	110 Ohm
Min	0.3 ns	0.9 ns	90 Ohm	90 Ohm

**Common Mode Impedance Limit Line**

Type	Begin Stimulus	End Stimulus	Begin Response	End Response
Max	0.3 ns	0.9 ns	40 Ohm	40 Ohm
Min	0.3 ns	0.9 ns	25 Ohm	25 Ohm

**Insertion Loss Limit Line (Internal SATA)**

Type	Begin Stimulus	End Stimulus	Begin Response	End Response
Min	10 MHz	4.5 GHz	-6 dB	-6 dB

**Insertion Loss Limit Line (eSATA)**

Type	Begin Stimulus	End Stimulus	Begin Response	End Response
Min	10 MHz	4.5 GHz	-8 dB	-8 dB

**Differential to Differential Crosstalk: NEXT Limit Line**

Type	Begin Stimulus	End Stimulus	Begin Response	End Response
Max	10 MHz	4.5 GHz	-26 dB	-26 dB